UNIVERSITY of DELAWARE

Research

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A hub for 21st-century SCIENCE

INSIDE

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COVER

Come explore our bright, shiny hub for 21st-century science—the Interdisciplinary Science and Engineering Laboratory (ISE Lab).

UNIVERSITY of DELAWARE

Research

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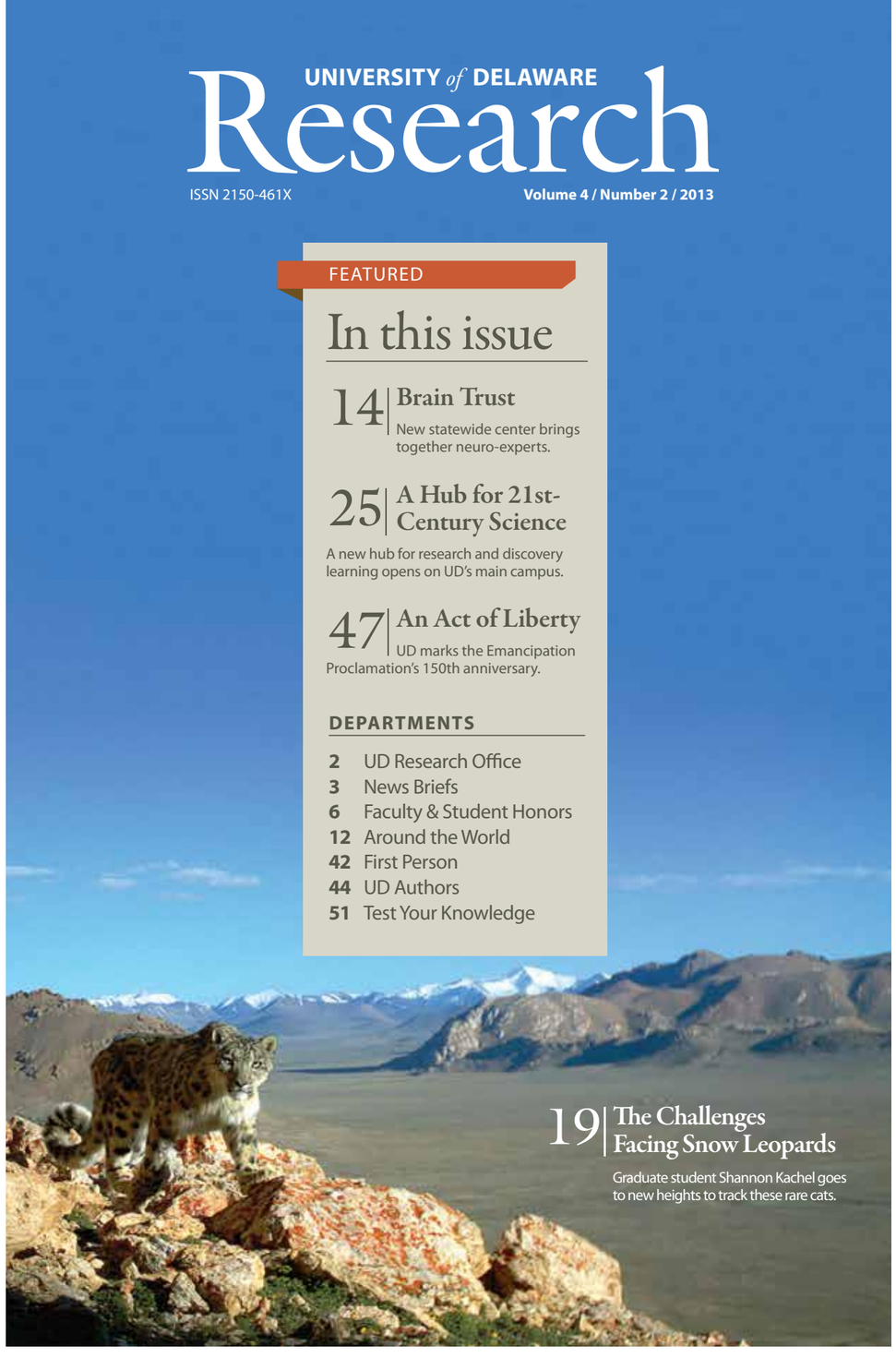
FEATURED

In this issue



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FROM THE PRESIDENT

Louis Pasteur would well understand the electric anticipation accompanying the opening of UD's Interdisciplinary Science and Engineering Lab this fall. ISE Lab is, indeed, our temple of the future, where the University's pioneering research will find a home built on the foundation of openness and collaboration; where new discoveries will redraw the boundaries of human knowledge, and new innovations will help us harness it; where young talent will be developed and deployed to solve the problems that challenge us locally and globally; where students will see every day the enormous power of putting science to work.

Take interest, I implore you, in those sacred dwellings which one designates by the expressive term: Laboratories. Demand that they be multiplied, that they be adorned; these are the temples of the future—temples of well-being and of happiness. There it is that humanity grows greater, stronger, better.

— Louis Pasteur, 1822–1895

Certainly, UD's research isn't confined to a building. Look through these pages and you'll see that the world is our laboratory, bringing our people into schools and neighborhoods and families, taking us into the eye of a Mid-Atlantic hurricane and across the desolate mountain ranges of Central Asia.

But still we build laboratories, and thank goodness we do. Laboratories are our incubators for inquiry and invention. They're an endorsement of our best ideas. They're an investment in the extraordinary people who've signed onto our mission of transforming the world and shrinking human limitations. Laboratories are many students' first experience with education in action. It's where they coax meaning from curricula, and first fall in love with learning.

"Live in the serene peace of laboratories and libraries," Pasteur said. While I have heavy doubts about how serene ISE Lab will be come fall, I have no doubt whatsoever that the buildings we build today—these temples to discovery and knowledge and progress—will help create the future we all long for, the future that's within our grasp.

Patrick T. Harker
President, University of Delaware

ISE ISE Baby

by Charles Riordan

That hip-hop anthem I'm channeling in the title starts off talking about collaboration and invention, which also rings true for our "Ice"—the Interdisciplinary Science and Engineering Laboratory, or ISE Lab, set to open this fall semester. As the largest academic building project in UD's history, it will fundamentally transform how our research university prepares students as collaborators and innovators, ready to address the challenges of the future.

ISE Lab's classrooms and instructional laboratories are designed to leverage UD's leadership in problem-based learning, providing flexible spaces and movable furniture, augmented with the latest technologies to optimize collaborative learning. Faculty groups have been meeting for several years to revamp the curriculum to be delivered in these new spaces. Over time, students from all disciplines will have the opportunity to take classes in ISE Lab.

Charles Riordan,
Vice Provost for Research

Higher education is aflutter with terms such as collaborative learning, massive open online courses (MOOCs), flipped classrooms and the like. The learning spaces in ISE Lab also are designed to afford faculty opportunities to "experiment" in the delivery of curricula to best suit the changing learning approaches of college students and to most effectively prepare our students with the skills necessary to succeed in the workforce.

The research wing of ISE Lab will be home to UD's Energy (UDEI) and Environmental (DENIN) Institutes, the Catalysis Center for Energy Innovation, faculty research laboratories, and core research facilities for nanofabrication, microscopy and materials characterization. Faculty, staff and students from four colleges and nine departments will be co-located in the building around these research thrusts.

The laboratories are designed to figuratively and literally "remove the walls" between and among research efforts. Providing unprecedented opportunities for collaboration will ensure that discoveries made in the laboratory are quickly and effectively translated into classroom curricula and to the marketplace, where appropriate. Additionally, UD's strength in policy will seek to ensure that public policy is advanced to align with the latest research developments.

The core facilities will provide research capabilities necessary to recruit and retain the best faculty and students and will serve to augment efforts to draw in collaborators from other academic institutions and the private sector.

Built to meet the U.S. Green Building Council's LEED Silver Certification standards, UD's commitment to sustainability and energy efficiency are on display in ISE Lab from the courtyard featuring native plants and the water retention basins (the latter to eliminate stormwater runoff), to the three green roofs. Classes across campus will be able to access ISE Lab's energy generation and consumption profile as real-time data.

At a time when the federal government is cutting back on its investments in research and infrastructure via the "blunt instrument" that is sequestration, it is inspiring to note that the University of Delaware, its alumni, friends and other benefactors are stepping up in tangible ways to enhance the research and learning infrastructure necessary to prepare our faculty and students to compete in a global marketplace.

We invite you to visit ISE Lab this fall to see the University's interdisciplinary research and education leadership in action. It's certain to become a new hub of student activity on campus.

Electric cars at UD's STAR Campus don't just take power from the grid. Now they can give power back to the grid and get paid for it.

Ka-ching! Your car as a cash machine

It's no longer a one-way street for the plug-in.

With a test fleet of 15 Mini-Coopers, University of Delaware researchers have proven that all-electric vehicles don't just plug in to take power from the grid, now they can *give power back* and get paid for it.

UD celebrated this world first at the Science, Technology and Advanced Research (STAR) Campus on April 26. Each car currently averages $5 a day, or about $1,800 per year.

Since February, UD's Mini-Cooper fleet has been connected with PJM, a regional transmission organization that coordinates the movement of wholesale electricity over 13 states and the District of Columbia, an area of 60 million people.

UD invented and holds four patents on the technology that enables an electric car to plug in and sell battery storage back to the grid, as an official participant in PJM's frequency regulation market. As demands for electricity fluctuate, large generators ramp up and down quickly to balance electricity supply and demand.

"Our cars provide that same balancing service," says Willett Kempton, professor in the College of Earth, Ocean, and Environment (CEOE), research director for the Center for Carbon-free Power Integration and inventor of the grid-integrating technology.

"Our system responds faster, is less expensive to operate and it does not burn fuel or create pollution. The batteries are storage devices, so we can take off excess electricity, and we can push electricity back when there is not enough," he explains.

Kempton's vision for grid-integrated vehicles began in 1997 when he and a graduate student published a paper about the technology. After doing much of the initial development himself, Kempton realized that his plan bridging three industries—automotive, energy and electronics—needed more than academic publications to become a reality. It required a campaign that included gaining support from the state legislature, changing public policies and building partnerships—lots of them.

UD's Office of Economic Innovation and Partnerships (OEIP) worked closely with the Office of General Counsel to help form a partnership with NRG, one of the nation's largest retail electricity businesses.

"Working with a university was new for NRG," said Scott Fisher, the company's director of alternative energy sources. "Our partnership with UD has been a very positive experience. We have been given access to cutting-edge technology; highly capable, motivated students and faculty; and an administration committed to forming successful relationships with companies like ours."

BMW AG provided the vehicles and sent a senior technician from Munich, Germany, to live in Delaware and support the project.

PJM adapted its rules to allow energy storage technologies to participate in the market; automobile retrofitter AutoPort Inc. fitted the standard production vehicles with the grid-integrating technology; and Milbank Manufacturing Company built the charging stations to required specifications.

CEOE's School of Marine Science and Policy helped advance public policy changes, and the electrical engineering department developed the electronics that perform the vehicle-to-grid technology functions.

How far down the road before the technology is available to you? Kempton is now working with three global automakers who are developing vehicles compatible with the technology. A 2011 study by Pike Research estimates that 100,000 cars will be able to return power to the grid by 2017.

CARS EARNING

$1,800

A YEAR

Electric cars with UD's patented grid-integrated technology earn about **$5 a day**, which adds up to about $1,800 a year.

Equipping an electric car with the technology **costs about $400**.

100,000 cars will be able to return power to the grid by 2017. (Source: Pike Research, 2011)

For a recap of the celebration of this technology milestone, watch UD's video on YouTube.

Students take on sweet challenge

If Willy Wonka had gotten his hands on a modern coffee machine, his invention probably would have involved something magically sweet. In fact, it might have looked something like the "Marshmallo Peep Maker," a nifty, Keurig-like machine that, in one simple step, pops out any style of the soft, sugary snack desired.

"Tired of having to go to the store to get your Peeps? Have a Peep any time you want with our Peep maker that will make as many Peeps as you want whenever you want without having to wait for them to be produced at a factory and shipped to the store," students from Jones Elementary School in Newark told a group of judges as they presented their winning product idea in Delaware's 27th annual Meaningful Economics and Entrepreneurship (ME) Competition this past May.

UD's Center for Economic Education and Entrepreneurship, the Delaware Council on Economic Education and the Delaware Financial Literacy Institute sponsor the ME Competition in partnership with Bank of America and Discover. The event challenges third- through sixth-grade students to demonstrate their knowledge of economics, entrepreneurship and personal finance.

This year's competition called for student teams to help Just Born Inc., the family-owned business that produces the marshmallow candy, Peeps, by creating a new design or new use for its treats to help increase demand for the product.

Students needed to give the product or service a catchy name, determine a market, outshine their competition, price the product and plan on modes of distribution and selling. They then needed to prepare a strategy and a commercial to present to a panel of professional judges.

While the Peep maker took home top honors (it also had a sugar-free option for diabetic consumers) runners-up from 138 teams from 25 schools brainstormed tasty ideas that would have made Wonka proud.

"Flower Power Peeps" not only look like daisies, roses or tulips but smell like them; camouflage "CamoPeeps" remind people of military overseas; and "Skeep" lets consumers sculpt their very own Peep.

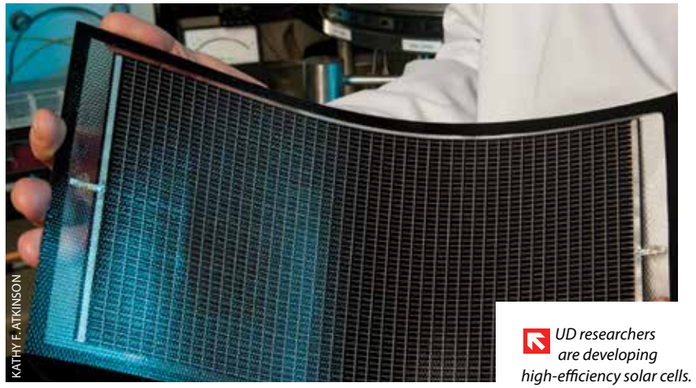
For the consumer not interested in eating Peeps, students from West Park Elementary School in Newark thought outside the box, with their "Peep Roof and Pipe Solvent."

Have a drip in your roof? A leak in your pipe? Stick a Peep in it, said the students, who designed their product "for people who have leaks in their homes." They won third prize.

EVAN KRAPE

Teams in the Meaningful Economics (ME) competition developed ways to boost the demand for Peeps.

Powering up solar partnerships



KATHY F. ATKINSON

UD researchers are developing high-efficiency solar cells.

The University of Delaware, a pioneer in solar energy research, recently announced collaborations with two international solar programs.

Robert Opila, professor in the Department of Materials Science and Engineering, is leading UD's involvement in the United States–Australia Solar Energy Collaboration (USASEC) and the Quantum Energy and Sustainable Solar Technologies (QESST) Engineering Research Center.

Opila and his team are partnering with two former UD colleagues—Allen Barnett, currently a professor in the School of Photovoltaics and Renewable Energy Engineering at the University of New South Wales, and Christiana Honsberg, a professor in the School of Electrical, Computer and Energy Engineering at Arizona State University.

Formed to support collaborative research between the United States and Australia, the USASEC aims to fast-track cost reductions in capturing solar energy beyond what is achievable by either country on its own.

Other U.S. partners on the project with UD include two companies—AmberWave Inc. and Veeco Inc.—as well as Arizona State University, Yale University and the National Renewable Energy Laboratory.

The project team aims to cut solar energy costs by developing a high-voltage solar cell that will be 40 percent more efficient than conventional solar cells. Researchers and industry partners will combine three cutting-edge technologies to produce a new low-cost, high-efficiency solar cell.

The technology base combines a solar cell developed by University of New South Wales researchers with a novel high-performance, low-cost silicon-germanium (SiGe) solar cell grown on silicon and a new high-voltage gallium-arsenide-phosphide (GaAsP) solar cell grown as the top cell using an innovative set of processes developed by the U.S. partners.

As part of the collaboration, Ken Schmieder, a UD doctoral student in electrical engineering, recently participated in a one-semester exchange at the University of New South Wales, and Opila spent the spring 2013 semester there.

Funded jointly by the National Science Foundation and the Department of Energy, the QESST Engineering Research Center focuses on developing technologies, educational programs, and analysis of policy and sustainability issues that promote the rapid use and advancement of photovoltaics.

UD researchers in collaboration with ASU's Solar Power Laboratory—directed by former UD faculty member Christiana Honsberg—will combine the rapid processing and low processing cost of organic solar cells with the high efficiency of silicon solar cells. The approach allows improved surface properties on silicon solar cells, in turn allowing thin, high-efficiency, low-cost devices. UD also brings to the project expertise in the design of energy policies on photovoltaic technology diffusion, market development and growth.

As part of the project, Nicole Kotulak, a doctoral student in electrical engineering at UD, participated in a one-semester exchange at Arizona State University, as well as a solar cell fabrication workshop this past January.

Other partners include the California Institute of Technology, the Massachusetts Institute of Technology and the University of New Mexico.

Artificial bait helps horseshoe crabs, birds, fishermen

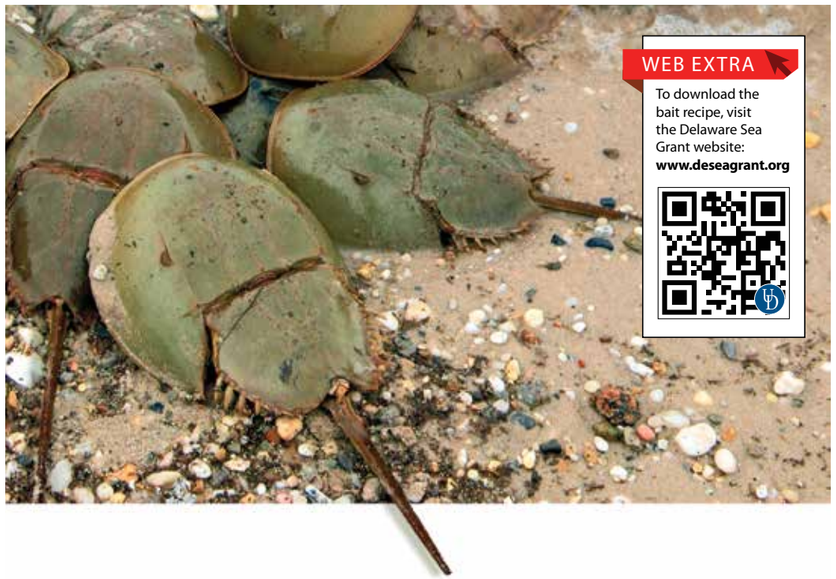
Eel and whelk don't typically feed on adult horseshoe crabs in their natural environment, yet find them hard to resist in baited pots.

That disconnect intrigued Nancy Targett, director of Delaware Sea Grant, dean of UD's College of Earth, Ocean, and Environment and an ecologist who studies the chemical cues that influence animal behavior in the sea. She and her research team set out to identify the mysterious "scent" that lures in eels—and after years of research, came up with a bait alternative to horseshoe crabs.

Delaware Bay is the epicenter of the world's horseshoe crab population, but the animal's numbers have declined in recent decades. That downturn has been linked to the decline of the red knot, a shorebird that relies on horseshoe crab eggs to fuel its spring migration north.

To reach the goal of finding an alternative bait, Targett partnered with DuPont scientists to analyze the horseshoe crab's chemical makeup. They identified 100 compounds in tissue samples and were able to rule out some as key components in the scent that appeals so strongly to eel and whelk.

Concurrent with the chemical approach, Targett's lab developed artificial bait made from alginates (compounds found in brown seaweeds and kelp), a small amount of coarsely ground horseshoe crab and food-grade chemicals including baking soda and citric acid. When mixed together, these ingredients form a quick-set gelatin.



WEB EXTRA

To download the bait recipe, visit the Delaware Sea Grant website: **www.deseagrant.org**

Compared with using half of a female horseshoe crab, which is the Delaware limit, the mixture was just as productive in catching eel using only one-eighth of a female. By substituting an invasive species, the Asian shore crab, the researchers cut that amount down to as little as one-sixteenth of a horseshoe crab. They tested catching whelk with the bait and found similarly successful results.

In addition, despite speculation that female horseshoe crabs were better baits than males, the scientists found that artificial baits composed of males or females were equally effective. The Delaware limit is one whole male per trap or pot.

LaMonica Fine Foods in Millville, N.J., has started producing the bait commercially. Field tests in Delaware Bay with local whelk fishermen have been successful so far.

"The hallmark of this bait is that everyone wins," says Jim Roussos of LaMonica Fine Foods LLC. "This is a major step in conserving the natural resource of horseshoe crabs. The conch and eel fishermen are relieved of the pressures of buying, storing and processing horseshoe crabs. The University of Delaware has proven once again that it is a vital, important and valuable institution not only to its students but to the public at large. And commercial fisheries win when we can be conservators of public resources while maintaining our historical way of life."

The research was funded by Delaware Sea Grant, the Delaware Department of Natural Resources and Environmental Control, and DuPont Chemicals and Fluoroproducts.

For the latest UD news, visit **www.udel.edu/udaily/**

FACULTY & STUDENT
HONORS

Award-winning Kloxin has great reasons to smile

What's the story behind April Kloxin's beaming smile? There are great reasons both professionally and personally, as you'll find out in the following Q&A.

This past spring, the assistant professor of chemical and biomolecular engineering won two of the most prestigious awards available to researchers in the early stages of their careers: a four-year, $500,000 National Science Foundation Faculty Early Career Development Award, which supports integrated research and education projects by outstanding teacher-scholars; and a Pew Scholar in the Biomedical Sciences award, for which she will receive $240,000 in research funding from the Pew Charitable Trusts.

Q. Where's your hometown?

A. I grew up in a small farming community in North Carolina called Germanton (population ca. 827 in 2010), outside of the city of Winston-Salem.

Q. Who got you hooked on science?

A. My mom and dad—we went to the public library a lot to attend science and nature demonstrations and to pick out books, some on designing science experiments to do at home as well as solving puzzles. Perhaps most importantly, my parents taught me to believe that I could become anything that I wanted career-wise as long as I was willing to work hard and apply myself.

Q. What big scientific questions are you working to answer?

A. My group is focused on understanding how changes in the physical and chemical 'inputs' to human cells influence how our bodies heal or how disease progresses. In particular, some of the big questions we are excited about and on which currently we are working include—what are the key 'inputs' at different times for (1) regenerating tissue interfaces, such as those between bone and ligament for enhanced ACL [anterior cruciate ligament] repair, (2) controlling cancer dormancy to prevent recurrence, and (3) regulating an inappropriate wound healing response in the lungs toward preventing tissue stiffening and loss of function?

April Kloxin is an assistant professor of chemical and biomolecular engineering at UD.

Q. What's in your lab that you could not live without?

A. First and foremost, I could not live without the students working with me, as well as our collaborators. The students are fantastic and drive me to be a better scientist, mentor and teacher, and I am very fortunate to have been the recipient of outstanding mentoring throughout my career. The instrument I could not live without is a microscope. It is critical for understanding how cells respond to our materials and, more generally, seeing is believing (when paired with other quantitative data).

Q. What's your best advice to students considering science careers?

A. Work hard, dream big, and do not give up. There is a lot to learn initially in science and engineering, which can be intimidating, but with this knowledge base, you truly can solve important problems and help others.

Q. What's something most people don't know about you?

A. I enjoy the simple daily pleasures in life: cooking a meal with my family, going for a walk and having a nice glass of Scotch or red wine while watching *Top Chef*. Joyfully, I cannot do that last one these days though, as my husband and I currently are expecting our first child.

McNair Scholar selected for prestigious summer program

For N'Kosi Oates, who begins his senior year at UD this fall, everything has come full circle.

Last summer, Oates—who is in the McNair Scholars Program—began researching potential schools where he could eventually pursue a doctoral degree. The double major in communication and political science came across a professor at Columbia University with whom he thought he'd like to work.

That instructor was Dorian T. Warren, associate professor in the Department of Political Science and the School of International and Public Affairs at Columbia.


N'Kosi Oates

In January, as Oates prepared to apply to the Leadership Alliance Summer Research Early Identification Program, he contacted Warren. The program provides undergrads interested in applying to doctoral programs with the opportunity to conduct research for 8–10 weeks with a mentor at one of 22 participating institutions.

"I wanted to see if he could serve as my research mentor as well as give me a glimpse of life in the profession," says Oates, who received an email back from Warren in less than five minutes.

How did Oates' summer of research go? Read on.

Q. Where's your hometown?

A. I live in Neptune, N.J.

Q. What was the research experience like, day-to-day?

A. Columbia's research program is distinctive. In addition to having a faculty mentor, we were assigned graduate student mentors (GSMs). I met with my GSM three or four times a week, and she helped me with my research project. I went to the library at 10 or 11 a.m. and left when it closed at 8 p.m. The schedule would be slightly altered when we had mandatory workshops to attend.

Q. What were the coolest things you learned about?

A. New York is unlike anything I have ever experienced. Life unfolds in the city. I walk down one street, and there is one culture. I turn the corner, and I am immersed in another culture. I was intrigued and inspired by what I witnessed in New York.

Q. What did you present at the Leadership Alliance National Symposium?

A. My research concentrated on the relationship between neighborhood poverty and African American political participation in the context of the 2008 presidential election. I used political scientists Michael Dawson and Cathy Cohen's article in 1993 as my main resource for my theoretical framework. Using recent information and data, I challenged their theory.

Q. Has the experience influenced your career outlook?

A. Absolutely! Everyone that was integral to the program has influenced my trajectory. The graduate student mentors helped me conceptualize grad school life. My research mentor, Dr. Warren, was very helpful in sculpting my future. I met with him regularly, and in every encounter he elevated my intellectual consciousness as a scholar.

Q. What will be the focus of your senior year at UD?

A. Every year, I raise the bar and try to maximize my experiences. There is no doubt that I will continue to have that mindset this year. However, my primary focus is on applying to Ph.D. programs and successfully defending my senior thesis. I'm not sure what the future holds, but I remain optimistic because I know I didn't come this far to fail.

AFTER THE STORM

Hurricane Sandy: UD response helps region

BY TERESA MESSMORE

Hurricane Sandy *was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season. It ranks as the second-costliest hurricane to hit the U.S. since 1900, the year when such reporting began.*

COURTESY OF NOAA

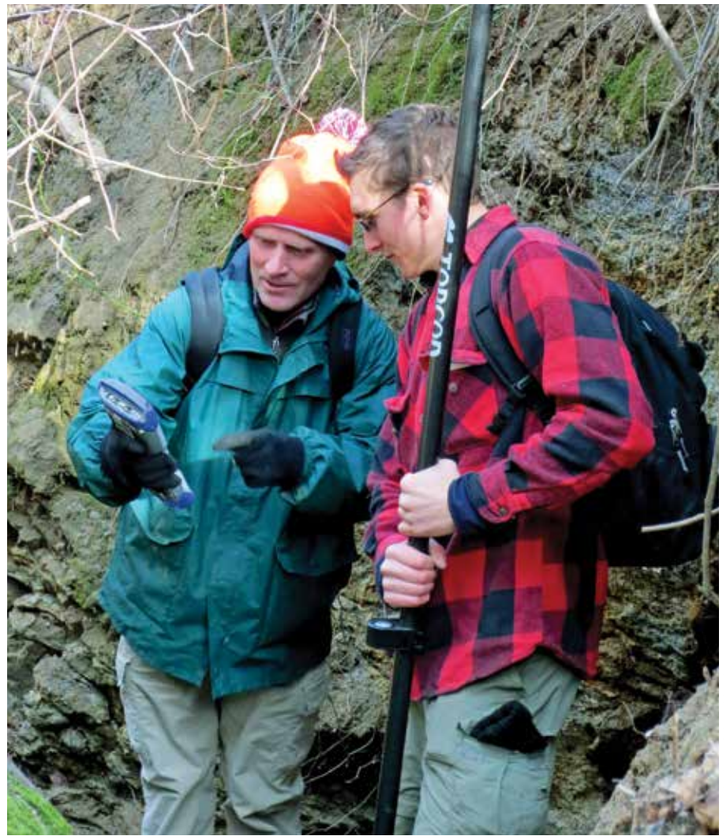
When Hurricane Sandy targeted Delaware last fall, scientists in UD's College of Earth, Ocean, and Environment (CEOE) tracked the storm's path, scrutinized its environmental impacts and considered implications for the future. Their quick responses and ongoing analyses help keep the region prepared for natural hazards.

As the massive storm approached, the Office of the Delaware State Climatologist and the Delaware Geological Survey provided emergency responders with up-to-date weather information. They pulled data from satellite receiving stations on campus, as well as a statewide monitoring system that aggregates measurements like rainfall and wind speed online.

Once the storm passed, they used hundreds of satellite images to make a computer animation that showed Hurricane Sandy's dramatic development. They also looked for trends among the nearly 200 such tropical cyclones that have touched Delaware since 1851, finding that the storms most often hit in September and arrive from the Caribbean—although the most powerful ones tend to originate in the open ocean.

Fellow CEOE scientists Xiao-Hai Yan and Matthew Oliver used UD's satellite data to follow raw sewage entering coastal waters off New Jersey. Malfunctioning wastewater treatment plants generated the sludge, and the researchers looked at temperature and color variations on satellite maps to trace where the wastewater was headed and to keep municipalities informed.

Other scientists ventured out into the field to collect valuable data relevant to their work. Luc Claessens, a geography faculty member who studies human impacts on watersheds, dashed out in the rain just before and after the storm to see how runoff was pouring into White Clay Creek. Areas near UD's Laird Campus are known to have runoff issues, where stormwater from parking lots carves deep gullies into the ground and flushes sediment and nutrients into the creek. Hurricane Sandy's heavy rainfall created mocha-colored plumes of mud, and Claessens' water samples showed high levels of nutrients and sediment that can pose problems for aquatic life. Claessens is working to address these issues through green stormwater infrastructure and plans to expand his study throughout the Delaware Bay watershed.



COURTESY OF LUC CLAESSENS

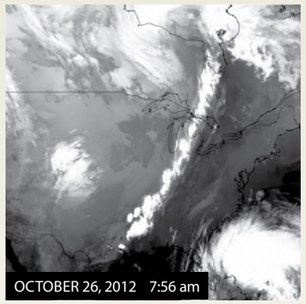
Designing green infrastructure to improve storm drainage.
Geographer Luc Claessens (left) and his students are mapping stormwater hotspots in northern Delaware and designing green solutions to runoff problems. Constructing wetlands and rain gardens can help absorb water, and adding filter strips in parking lots can prevent water from entering storm drains.

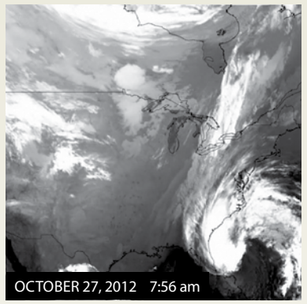
Oceanographers Arthur Trembanis and Douglas Miller also looked at sediment changes caused by Sandy, but instead examined the sandy bottom of the ocean off Delaware's coast. They used sonar and an underwater robot to map the seafloor at a site 16 miles offshore before and after the storm hit to study the fingerprint left by 20-foot waves and strong winds. As they aim to better understand these environmental processes, their research also has potential military applications: Shifting underwater sands and sediment can bury and uncover explosives, so knowing how weather conditions affect such objects could assist the Navy.

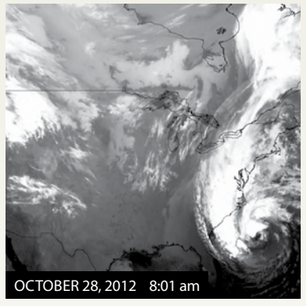
Hurricane Sandy altered water properties in Delaware Bay, from sediment churned up by waves to dips in water temperature. William Ullman, professor

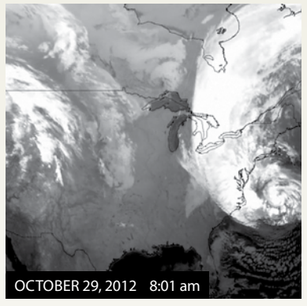
AFTER THE STORM
Sandy's path of destruction

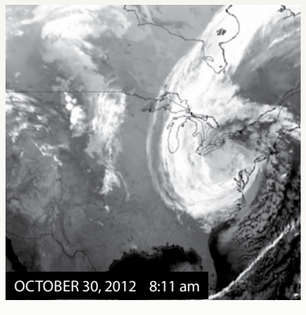
UD computer research specialist Matt Shatley digitally stitched together 800 images taken by GOES, the Geostationary Operational Environmental Satellite, from Oct. 20–31, 2012, to produce a computer animation showing the explosive development of Hurricane Sandy and the superstorm's unusual track. The animation was broadcast by media around the globe. To view it in motion, visit *UD Research* online at **www.udel.edu/researchmagazine**.

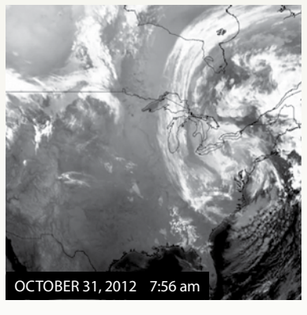












See Hurricane Sandy in action at
www.udel.edu/researchmagazine

of oceanography and geological sciences, and postdoctoral research associate Yoana Voynova studied those kinds of impacts on the bay and its tributaries. They collected data from Kent County's Land Ocean Biogeochemical Observatory, which they maintain, and monitoring stations managed by the U.S. Geological Survey and the National Oceanic and Atmospheric Administration. They found that water temperature and chlorophyll levels decreased as salt content and turbidity, or water murkiness, increased. The surge associated with the storm also significantly affected water circulation patterns in tributary branches of the bay. The researchers are trying to better understand what to monitor during future storms and how to interpret these data.

At Delaware Sea Grant, which supports research, education and outreach serving the state's coast, staff took a big-picture approach and documented Sandy's impact in southern Delaware through photos and video. Sea Grant's Wendy Carey and Chris Petrone used a time-lapse camera to capture inundation at a flood-prone road in Lewes, showing how a full moon and Hurricane Sandy combined to make for intense flooding. Carey also took photos in the field to record damage to Delaware beaches and bays. The material is now available for use in workshops and educational programs to demonstrate the results of storms and coastal flooding—both today and for the future.

WENDY CAREY

Surf Avenue, Rehoboth Beach, lived up to its name during Hurricane Sandy.

TERESA MESSMORE

Arthur Trembanis (left) and graduate student Justin Walker launch an autonomous underwater vehicle (AUV) at Redbird Reef off Indian River Inlet, Delaware, to get a fingerprint of Sandy's impact on the seafloor.

Writing helps students get past the trauma of disaster

by Ann Manser

COURTESY OF DEBORAH ALVAREZ

Deborah Alvarez *helped teachers and students cope in the aftermath of Hurricane Katrina. Now, she will work with those affected by Hurricane Sandy.*

Deborah Alvarez is spending time this summer in some of the New Jersey beach communities devastated by last fall's Hurricane Sandy, and when she arrives, she will be armed with her most important tools—pencils and paper.

"Children and adults have been through trauma because of this storm and how it disrupted their lives," says the associate professor of English at UD. "And when people have experienced this kind of critical incident stress, they need to tell."

For Alvarez, who specializes in adolescent composing and literacy processes, writing is a natural way for people to begin to deal with their trauma and move on after a disaster. Her focus is on teenagers and their teachers, exploring the kinds of writing activities that students do—either assigned in class or on their own—to tell their stories of coping with violence, abuse or natural disaster.

Also an adjunct faculty member in UD's Disaster Research Center, Alvarez was conducting her own doctoral research on writing literacy among teens when she learned that many of the students participating in the research had been victims of violence or other trauma.

"It really opened my eyes to what some of these kids have been through and the way they respond afterward," she says. "There are going to be serious impediments to learning after a traumatic event, and these children have to be helped to get past them."

After Hurricane Katrina struck New Orleans and the city and its schools began starting the recovery process, Alvarez expanded her work to victims of natural disasters. She spent two years in several New Orleans schools, investigating the way storytelling was used in the aftermath of the hurricane and flood.

"The need to communicate is critical," she says. "Some teachers ignored [the trauma of Katrina] because they couldn't deal with it, but the children are almost incapable of learning until they get help. Other teachers did some very creative things to help their students tell their Katrina stories."

Teachers know their own students, Alvarez says, and often are the best judges of what will help them deal with trauma.

As a result of her research in New Orleans, she wrote numerous articles and *Writing to Survive: Teachers and Teens Negotiate the Effects of Violence, Abuse and Disaster*. The book analyzes the effects of such traumatic events on adolescents' writing processes and the writing lessons that teachers use in their classrooms.

Now, Alvarez hopes to conduct similar research in New Jersey. She plans to survey language-arts teachers in affected communities and then conduct follow-up interviews about the kinds of changes they noticed in their students after the storm, as well as the types of assignments they gave and the writing their students did related to the experience.

If requested, she says, she will also offer workshops for teachers, as she did in New Orleans.

"I'm not a psychologist, I'm not a doctor, but as a teacher I can suggest ways that other teachers can structure learning to help the students by letting them tell their stories," Alvarez says. "And if the teachers have experienced trauma, too, I encourage them to seek help. I tell them: You can help the children cope by coping yourself; help them handle stress by learning how to handle your own."

AROUND THE WORLD

EVAN KRAPF

Adrienne Lucas *brings her experiences from Africa into her classroom at UD to encourage students to think critically about development policies.*

Is free primary education making a difference in Kenya?

by Kathryn Meier

Imagine if a country could harness the power of education to positively impact its economic development. That's the idea behind universal primary education, one of the United Nations' 2015 Millennium Development Goals, and resultant programs like the Kenyan Free Primary Education (FPE) initiative.

KENYA: Named after Mt. Kenya, Africa's second highest peak, it covers an area twice the size of Nevada. The country's population of 44 million comprises more than 40 indigenous communities, each with its own mother tongue. The majority of the people speak three languages. English and Swahili are the official languages.

Before the FPE policy was enacted in 2003, many children in Kenya could not attend school due to the cost. Additionally, an estimated 1.1 million Kenyan children have lost one or both parents to AIDS.

Yet while FPE and similar programs are becoming increasingly common in developing countries, little research has examined the impact of these programs on student achievement or educational attainment and whether investment efforts have been successful.

Enter Adrienne Lucas, assistant professor of economics in the Alfred Lerner College of Business and Economics at the University of Delaware.

A development economist, Lucas specializes in the economics of education and disease. Currently, her research focuses on the effects of Kenya's FPE program, as well as secondary school quality, on student achievement in that country. She also is examining the achievement return to a primary school literacy intervention in both Kenya and Uganda, and the intergenerational effects of adult antiretroviral therapy in Zambia.

"Free Primary Education was heralded as the solution to bring universal primary education to all students, but almost immediately after its implementation worries emerged about its true ability to bring students into school and the effect on student achievement," says Lucas. "So the question is, are students learning more, and are more students completing school?"

To that end, Lucas examined test score and primary school completion data from the six years around the implementation of the program and made site visits to Kenyan primary schools to talk with principals to gather information. Based on these data, she has been able to estimate the effect of FPE on primary school completion and student achievement.

Her findings, which were published last year in the *American Economic Journal: Applied Economics*, suggest that FPE increased the number of students who completed primary school, including students from disadvantaged backgrounds, and led to, at most, only a small score decline for students who would have been in school anyway.

Lucas makes the effort to bring her experiences in Africa, as well as journal articles and popular press excerpts, into her classroom at UD to encourage students to think critically about the evaluation of contemporary development policies.

"Students in my econometrics course are pretty skeptical at the start about the relevance of the topic, but I like to show them that these are the tools economists use every day to evaluate policy," says Lucas. "It's the basic idea of using data and econometrics to estimate causal inferences about real-world issues and economic and social policies."

The effect of Lucas' approach is evident. In January 2013, she received recognition from UD's Office of Residence Life and Housing as a faculty member who makes a substantial positive impact on students.

And her students speak highly of her class. Says one, "She opened my eyes to the world around me and allowed me to see many things, especially in the field of economics, in a new light. It is because of her that I am considering a career in Sub-Saharan African development."

Lucas is passionate about helping students think critically about issues of causation and says she hopes her own research not only helps them explore cutting-edge research in economics but paves the way for social and economic improvement in Kenya, Uganda and beyond.

"My goal is to give policymakers empirical evidence to guide a coherent policy that leverages the strengths of different types of schools and pedagogical materials, I guess from the naïve belief that it will make a difference," says Lucas.

But with a clear and positive impact on students, a recent grant to conduct further research, and a growing number of publications reporting findings that show increases in educational access, Lucas' belief is anything but naïve.

UD-led team informing future education policy in Kenya

by Danielle C. DeVita

UD's Adrienne Lucas recently won a $50,000 grant to conduct research on the cost-effectiveness of raising student achievement in schools in Africa and India. The funding is part of a $300,000 grant from the William and Flora Hewlett Foundation through its Quality of Education in Developing Countries (QEDC) initiative, which provides an opportunity to compare the impacts and cost-effectiveness of six school interventions.

During the past year, Lucas has worked closely with Patrick McEwan of Wellesley College and Maria Perez of the University of Washington to evaluate the overall effectiveness and cost-effectiveness of a classroom intervention in Kenya and Uganda. The project examines whether the Reading to Learn Program, which mentored and trained teachers and provided limited classroom resources, can increase the quality of education in both countries.

Schools in the two countries were randomly selected to be either in the "treatment" or "control" groups. All schools received the standard government materials. Additionally, treatment schools were given the intervention. All students in the treatment and control schools were given both a pre- and post-test. Lucas is comparing the test score gains of the treatment students to the control students to assess the effectiveness of the intervention.

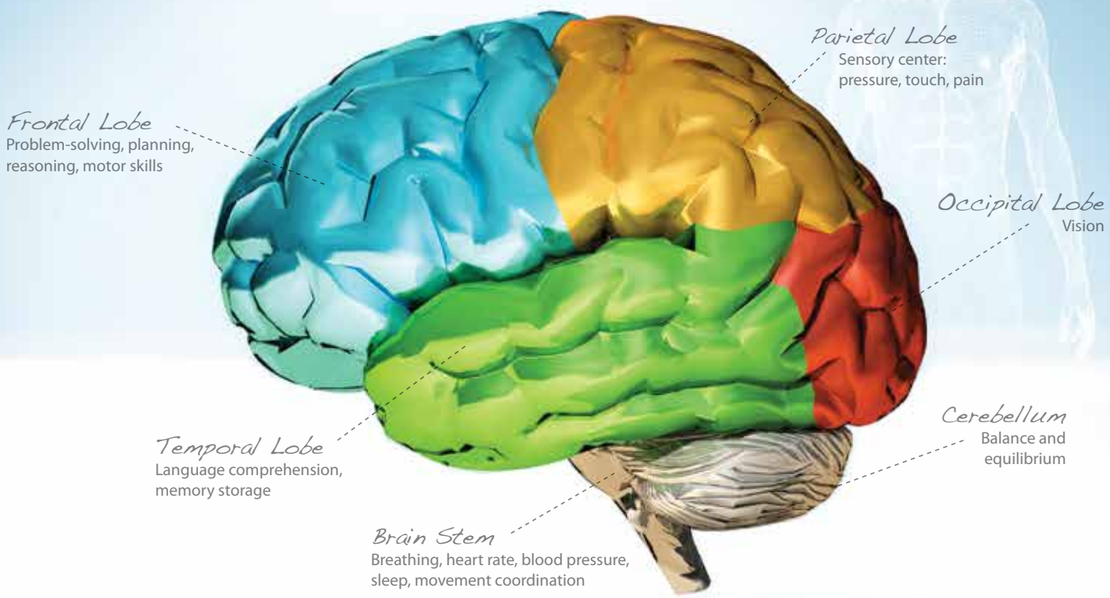
Last year, practitioners from Sub-Saharan Africa and India met at a conference organized by Lucas and her team to present preliminary findings from all of the QEDC studies.

The team is now conducting a meta-analysis of all developing country, school-based, primary school interventions that measured an achievement outcome and plan to draw together the disparate studies into a cohesive narrative that will inform future education policy.

New statewide center brings together neuroscience experts

BRAIN TRUST

by Ann Manser



Internationally, neuroscience is an expanding field of study, and that trend is reflected in Delaware—not only at UD, but also throughout the state's scientific community.

Now, a five-year, $10.5 million grant from the National Institutes of Health is funding a new Delaware Center for Neuroscience Research that will facilitate collaborations between researchers at UD and their counterparts at Delaware State University (DSU). The center, a partnership between the two universities that is located at DSU, the lead institution, has been established to conduct cutting-edge scientific research on brain development and the neurobiology of learning.

Delaware State University

University of Delaware

KATHY F. ATKINSON

Jeffrey B. Rosen, *professor of psychology at UD, is co-administrator of the new Delaware Center for Neuroscience Research.*

While UD's neuroscience program has a behavioral focus and is housed in the Department of Psychology, and DSU's has a biological focus, the field itself is highly interdisciplinary, says Jeffrey B. Rosen, professor of psychology at UD. As co-administrator of the center, he works closely with Melissa Harrington, the center's director at DSU.

"Neuroscience is a growing field, and it encompasses so many different fields—from engineering to kinesiology and physical therapy—in addition to psychology and biology," Rosen says. "In our psychology department, we've hired several neuroscience faculty members in the last couple of years, and our undergraduate program is very successful and popular."

The grant for the new center is geared to funding early career scientists. It will provide support for the research programs of five such scientists, three at UD and two at DSU.

Four other faculty members will receive smaller, pilot grants to begin new research projects or take their current work in new directions. Recipients of those pilot grants are involved in such areas as infant verb learning and the role of microRNA in new neuron development.

Researchers at the two universities say they've been collaborating informally for some time but that the new center and funding will greatly enhance those partnerships. Of the total grant, DSU will receive $7.3 million and UD $3.2 million.

"This will have an impact on my lab because it will mean more funding for my research and, as a junior faculty member, I'll be able to receive mentoring support," says Amy Griffin, assistant professor of psychology. She and fellow psychology professors Anna Klintsova and Tania Roth all received funding for their research through the new center.

"Beyond that, we have a community now that we're building with Delaware State and the neuroscientists there. It's very exciting for faculty and for our students," Griffin says.

Plans call for students from both institutions to have the opportunity to do some work at the other university. Rosen says he expects the center to be useful in recruiting graduate students as well.

Funding came from the National Institutes of Health Centers of Biomedical Research Excellence (COBRE) program, which supports interdisciplinary centers that strengthen institutions' research.

Neuroscientist of the Year

Jeffrey Rosen, who directs the Delaware Center for Neuroscience Research programs at UD and serves as a mentor for the UD faculty members affiliated with the center, was named the 2012 Neuroscientist of the Year by the Delaware Chapter of the Society for Neuroscience this past November.

The award recognized his success at winning funding for his research in the field, as well as his work as the new center's co-administrator.

Rosen's research on the neurobiology of emotion focuses on understanding the physiological, neuroanatomical and molecular bases of fear and anxiety.

Last year, he was awarded a $250,000 grant from the National Institutes of Health for his examination of the role of the hormone oxytocin in anxiety.

Unveiling the maze of mechanisms at work in 'working memory'

Not so long ago, scientists studying how learning occurs were looking to identify the region of the brain responsible for that process, says Amy Griffin, assistant professor of psychology at UD. Today, the research has a different focus.

"It's not any one single region of the brain that's known to be responsible for complex learning, Griffin says. "The regions all do their different things, but the key is that they have to communicate and interact for learning to occur."

Her own research, which is among the projects being supported by the new Delaware Center for Neuroscience Research, focuses on the mechanisms in the brain that are responsible for what's called working memory. Problems with working memory, Griffin says, are common features of a variety of psychiatric disorders including schizophrenia and general anxiety disorder.

On a more everyday level, it's also "the kind of memory that fails when you walk into a room and forget why you came there," Griffin says.

She is specifically investigating the structure that runs from the hippocampus, the portion of the brain responsible for memory, to the prefrontal cortex, responsible for executive function, which includes such cognitive abilities as problem-solving, planning and abstract thinking.

"These two key structures, the hippocampus and the prefrontal cortex, need to work together for working memory to occur," she says. The prefrontal cortex is thought to receive direct projections from the hippocampus and then to use retrieved memories to construct a plan of action that enables a task to be performed.

Griffin uses a rat model to study the interaction between the two brain regions and its effect on working memory. Rats are trained to navigate a maze in which they must remember which way to turn and then use executive function to plan the route they will take. Once the animals are trained to do the task well, the relay between the hippocampus and prefrontal cortex is inactivated, and their success rate drops to 50–60 percent, or about what could be explained by chance.

In addition to giving the rats the test of their working memory, Griffin simultaneously studies the mechanisms of how the brain works in the process. She says her research interests for some time have been in multi-regional brain interactions, an area of study that is increasingly the subject of neuroscience work.

Eventually, she says, "Understanding the nature of complex cognitive processes such as learning and memory will have important implications, including the possible treatment of neurological disorders such as Alzheimer's disease, attention deficit hyperactivity disorder and schizophrenia."

AMBRE ALEXANDER

Amy Griffin *is studying the mechanisms in the brain that are responsible for working memory. Problems with working memory are common in schizophrenia and anxiety disorders.*

FACT OR FICTION?

You only use 10% of your brain.

FICTION: You use all of your brain—neuroimaging technology has conclusively confirmed it.

Source: www.brainfacts.org

Researcher seeks to understand links between early-life stress and disease

Tania Roth, assistant professor of psychology at UD and a researcher whose work is supported by the new Delaware Center for Neuroscience Research, knows that the genes we're born with don't determine our future.

Her investigations focus on behavioral epigenetics, seeking to define the molecular mechanisms that are responsible for environmental influences on gene activity, the development of behavior and psychiatric disorders. Epigenetics refers to the tiny chemical "tags" in living things that interact with genes and affect the way they function, sometimes, for example, "turning off" the normal operation of a particular gene.

The epigenome has been compared to the software that tells a computer—the genome itself—when to operate and what to do.

"In our lab, we're interested in understanding how the environment interacts with genes," Roth says. "We look at molecular, or epigenetic, changes that occur and then how that affects the brain and behavior."

She uses a rodent model to investigate the relationship between environmental experiences and lifelong patterns of gene expression and behavior. Roth's work focuses on DNA methylation, which is a chemical change in the brain that is important for cell development and gene expression.

She is specifically researching the effects of negative experiences early in life—particularly, adverse care giving, such as neglect or mistreatment—on epigenetic programming and patterns of gene expression. Such an adverse early experience, she says, can lead to epigenetic changes in the brain that might last a lifetime and even affect later generations.

Roth, who has been interested since graduate school in early life experiences and their effects on the brain, says her work with genes and chemical tags is the specific focus of the grant she's received through the new neuroscience center. But her research also has expanded recently to include post-traumatic stress disorder (PTSD), and she has been collaborating with a national consortium of scientists studying that condition.

"Your early life experiences can chemically tag your DNA, and that in turn can cause changes in the activity of your genes and behavior," she says. "One question we are interested in addressing is: Do chemical tags on DNA produced by adverse early life experiences make you more susceptible to developing PTSD if you experience trauma as an adult?"

PTSD has gained attention in recent years because of its rates of occurrence among soldiers who served in wars in Iraq and Afghanistan, but many cases also occur outside the military, including in victims of violent crimes and survivors of serious car accidents.

However, these chemical tags are not only relevant to understanding PTSD, but a host of other health outcomes associated with early-life adversity, including depression and anxiety.

Roth adds, "Studies in the field of behavioral epigenetics are giving us a new molecular framework to understand how our experiences can become part of our biology. An epigenetics perspective in research with animal models and in clinical trials stands to yield substantial information regarding biological determinants of brain function and health outcomes, and new approaches to diagnose and possibly treat psychiatric disorders."

EVAN KRAPE

Tania Roth *is researching how negative experiences early in life affect the brain.*

Fetuses and alcohol don't mix

Can baby's brain overcome the effects of mom's drinking?

Even women who are aware of the damage they might cause their baby by drinking alcohol while pregnant often think that the danger has passed after the first several months.

And that's what concerns neuroscientist Anna Klintsova, whose research focuses on fetal alcohol syndrome (FAS) and the broader condition known as fetal alcohol spectrum disorder (FASD). While FAS, characterized by a baby's facial and cranial abnormalities, does develop after heavy drinking in the early months of pregnancy, FASD is characterized by other difficulties—including effects on learning and self-control—and can occur later in the fetus's development.

Klintsova, an associate professor of psychology at UD whose work is being supported by the new Delaware Center for Neuroscience Research, uses an animal model to investigate the effects of what in a human subject would be binge drinking during the final trimester of pregnancy.

"By that time, the mother has often had some ultrasounds and maybe some genetic testing, and she's been told that the fetus is healthy," she says. "So she might relax and think it's OK to drink a little. But there are many factors that affect how a particular person processes alcohol, and you never know if those two glasses of wine will be harmful."

Klintsova uses a rat model to study the damaging effects of alcohol on the developing brain and on altered behavior. She is seeking to understand the extent of damage alcohol can cause and whether interventions—in particular, providing a stimulating environment to those affected by FASD—can help improve the damage that occurred before birth.

She investigates these questions at a behavioral level, testing the motor abilities and memory of alcohol-exposed rats, and at cellular and sub-cellular levels, to see how the stimulating environment improves the neuron connections in the brain.

"Neurons not only have to be generated, they also have to survive," Klintsova says. "In an alcohol-damaged brain, they don't survive as well. But new neurons do survive better after this kind of super-stimulating experience." The rats with which she works get that experience by sharing large, multi-level housing with other rats and with a generous supply of toys and activities.

Her latest studies, she says, "show a clear connection between structure and function" within the brain.

Klintsova has been researching the effects of alcohol on a fetus since 1995, when she began collaborating with William T. Greenough. Now professor emeritus at the University of Illinois, Greenough is a pioneer in the study of brain plasticity and the concept that the brain is subject to change not only in early childhood but also throughout the lifespan. When he decided to expand his research beyond that of the normal brain and also investigate the damage that occurs from alcohol, he asked Klintsova to contribute her expertise on the formation of new synapses in the brain. The two have worked together since then, and Klintsova now leads the project.

She notes that FAS and FASD are relatively new diagnoses, with FAS only recognized as a condition in the 1970s, and that many babies—especially in countries with a culture of drinking alcohol—are still born with alcohol-related damage.

"I think it's still a big problem," Klintsova says. "And I think it needs to be addressed."

TRUE OR FALSE?

Brain damage is always permanent.

FALSE: In some instances, the brain can repair itself—it depends on the location and severity of the damage. Even after a stroke, with the aid of therapy, the brain may develop new connections and "re-route" function through healthy areas.

Source: www.brainfacts.org

KATHY F. ATKINSON

Anna Klintsova *is working to understand the extent of damage alcohol can cause on the developing brain and whether interventions can help improve the damage that occurred before birth.*

THE CHALLENGES FACING

snow leopards

And the scientists who study them

by Adam Thomas /
Photos courtesy of Panthera and Shannon Kachel

Shannon Kachel *at work preparing a camera site in mountainous Tajikistan.*

As he lay in a bathtub, seeking shelter from the barrage of mortar attacks just outside his building, Shannon Kachel realized that his summer of studying snow leopards, ibex and Marco Polo sheep in the desolate mountains ranges of Asia was over.

Kachel, a University of Delaware graduate student working with Kyle McCarthy in the Department of Entomology and Wildlife Ecology, was spending the season in the Pamir Mountains of Tajikistan to study snow leopards and wild ungulates, or hooved mammals, to determine all the variables surrounding these species and possibly get an idea about their population sizes. Venturing into the city of Khorog to resupply for the final month of research, Kachel suddenly found himself caught in the middle of a fight between the Tajikistan central government forces and what the government deemed was an illegally armed group.

Kachel wanted to stay and continue his research, but he knew he had to leave.

"I would have stayed because my read of the situation was that it was going to get better," said Kachel. "But I don't know that I would have gotten anything done."

Luckily for Kachel, he had already set up enough cameras in the region—cameras designed to record the movement of the various animals—that he was confident he had enough material for his study.

Researching two distinct areas of the Pamirs, Kachel had placed one set of cameras in a location where the government allows trophy hunting of wild ungulates while informally managing the population for sustainability.

Tajikistan *is about the size of Wisconsin. It is a landlocked country bordered by China, Kyrgyzstan, Uzbekistan and Afghanistan. Mountains cover over 90 percent of the country.*

He also set up cameras in a section where it is illegal to hunt the animals and where there is no regulation of the species, but where poaching and overgrazing still threaten the wildlife.

"What I'm doing is comparing those two sites, one for the availability of the ungulate prey, but then the snow leopard populations, as well," Kachel said.

While hunting and poaching is a concern, with the snow leopard population number dropping precipitously over recent decades, Kachel stressed that his research is looking more at the impact pastoral communities have on the species.

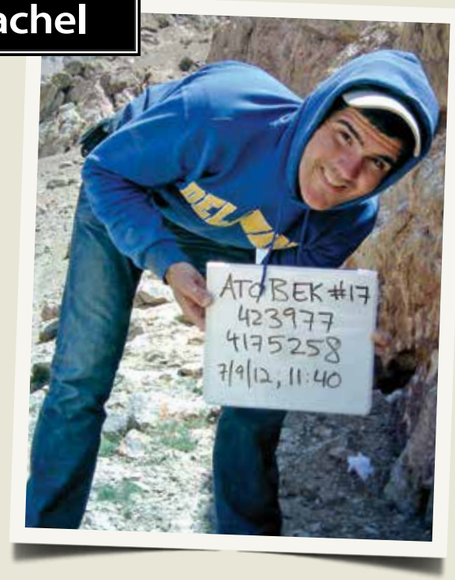
"A lot of that population loss results from the typical poaching pressures that we think of from people going out and killing big cats, but a bigger component is competition with pastoral people," Kachel noted.

He explained that as external government food subsidies dried up with the fall of the Soviet Union, it left an artificially high human population in the area based on what the environment could support. In this high and desolate region of the world, the people turned to livestock production and the killing of wild ungulates to sustain themselves.

"The component that I'm addressing is more from the ecological perspective," said Kachel. "The other side of having all

A nomadic society. *The majority of the people are ethnic Kyrgyz, who make their living breeding cattle and buffalo. Many still live in traditional felt tents called yurts, which have been a distinctive feature of life in Central Asia for at least 3,000 years.*

Q&A *with* Shannon Kachel



Shannon Kachel *tests the camera he just set to ensure proper functioning, and includes the set time, date and coordinates as a backup to his field notes. "Atobek" was the working name he and his colleagues used for the hunting concession study site.*

Where's your hometown?
Seattle, Washington

What degree are you pursuing at UD?
I'm working on an M.S. in Wildlife Ecology.

What's your dream job?
It involves large carnivores, epic landscapes, exotic cultures, maybe a bit of mountaineering from time to time, and finding workable solutions to seemingly intractable conservation problems—something not unlike my position here at UD.

What's your favorite ungulate?
It's a little bit of a stretch from anything I've ever seen firsthand, but the Saiga antelope of the Central Asian steppes has always captured my imagination. Closer to home, the pronghorn holds a special place in my heart.

How did you prepare for research in Tajikistan?
Apart from months of agonizing over research methods, triple-checking my packing list, and learning to use the cameras by placing them around White Clay Creek State Park near campus, I spent a lot of time doing cardio intervals and endurance training to prepare for the strains of working at three miles above sea level.

What elevation did you work at?
My research took me as high as 17,000 feet above sea level, but I typically slept around 13,000–14,000 feet. As a point of reference, the highest point in the Lower 48 is 14,505 feet.

What were your living conditions like?
By day, I spent hours on end hiking ridges and cliff-lines, looking for snow leopard sign. At night, the team and I were fortunate enough to find warm hospitality nearly everywhere we worked. Even when we would arrive in the small hours of the night, local herders were always willing to share a space around the fire in their yurts. Whenever we would visit larger towns to resupply, folks would rent out rooms in their homes and provide a warm meal. When the going got rough in Khorog, I stayed with my local partner's family in a Soviet-era apartment block. We could see army snipers on the surrounding mountainsides keeping watch over the streets. The tension in the air was palpable.

What were your observations about the native culture?
In the Ismaili Muslim tradition, the stranger is revered as a gift from god. Tajikistan is one of the poorest countries in the world, yet the hospitality of the people there is unlike anything I've ever encountered. Despite my shortcomings with the languages—locals in my study area spoke a mixture of Tajik, Kyrgyz, Russian, Shugni and Wakhi—I was always made to feel welcomed. I've never felt more open-heartedly embraced in my life.

What was your favorite food there?
Shir choi, hands down. A bowl of tea made with yak milk, butter and salt, with chunks of stale flatbread to dip in it—it's the typical Pamiri and Kyrgyz breakfast in Tajikistan. Incidentally, this is the name I've given to one of the big male snow leopards that showed up frequently at my camera sites.

What is your fondest memory of Tajikistan?
The first time I found snow leopard tracks. I had hiked for miles up an impossibly narrow, steep, ice-filled gorge and stumbled on a beautifully preserved set of pug marks in a rock alcove. The tracks made it real for me, in a way that defies easy description. Suddenly the landscape was full of new potential—suddenly, I saw the snow leopard not as a myth or phantom, but as a living, breathing wild animal.

Are there any other countries or places where you have studied snow leopards?
For this project, my research was limited to Tajikistan, but in reality, the snow leopards that I was studying are part of a regional population that spills over into Kyrgystan, Afghanistan, China and Pakistan, which goes to show that successful conservation in our age of globalization is reliant upon international cooperation.

Snow leopards *have numerous adaptations for living in the cold mountains, from thick fur, to wide paws for walking on snow, and small, rounded ears to minimize heat loss. Long, flexible tails help them maintain their balance on rocky terrain and are used like a blanket to protect their faces while they sleep.*

these livestock on the landscape is that it reduces the amount of natural prey that's available for snow leopards, and it gets rid of all the forage available for, specifically in my study area, the ibex and the Marco Polo sheep."

Thanks to funding from Panthera, a global wild cat conservation group, and help from the Tajik Academy of Sciences, Kachel spent June and July 2012 traversing the rugged terrain, eventually getting close to 80 cameras set up in an area about half the size of Delaware. "We were hiking around a lot," said Kachel. "Huffing and puffing in that high mountain air."

He explained that the cameras "work based on heat and motion. So an animal that's a different temperature from the background walks by, and the camera starts shooting pictures." Kachel said that since they used two different types of cameras for the study, they put out lures with the cameras to draw in the animals.

"Because the cameras function differently, we needed to make sure that any animal passing by was present long enough to get clear images," said Kachel. "So we used the lure to draw them in and hold their attention. We need clear images so we can identify the individual cats."

Kachel explained that "snow leopards are individually identifiable based on their spots, so we can use our observations of when, where and how frequently individuals are caught by the cameras to build better population estimates that tell us more than a simple minimum count."

The cameras, which were retrieved by a Tajik man once the violence ended, caught pictures and video of two snow leopard cubs, which were highlighted by Reuters and *Business Insider*.

This past July, after months of analysis, the team reported identifying a minimum of 25 individual snow leopards (vs. 37 identified from fecal DNA). Three-quarters of these cats were found in the hunting concession, where three different family groups (mothers with dependent young) also were photographed.

"This suggests that the local population there is robust and reproductively healthy," Kachel said. "Our back-of-the napkin calculations follow our predictions well—density is three to five times greater where trophy hunting is allowed, following a similar pattern in prey abundance. These results provide compelling initial evidence that trophy hunting can be a 'win-win' game for conservation and local people."

These findings encourage Kachel about the snow leopard's future.

"I'm actually really optimistic in terms of snow leopard outlook and the prognosis for the species," he said. "The global population estimate ranges from 3,500 to 7,000 animals, and that's a huge range. It could be anywhere in there, so for at least the trophy hunting site, to get the number of images we've gotten back is encouraging to me."

If these preliminary results are borne out, conservationists would gain another tool to protect snow leopards and their prey throughout their range, Kachel said. He recently received a prestigious National Science Foundation Graduate Research Fellowship to continue his studies.

Tajiks *assisted the UD team with the research project. Shannon Kachel (second from left) is shown here wearing a traditional Kyrgyz felt hat.*

A hub for 21st-century SCIENCE

It's been two decades since the University of Delaware constructed a new laboratory building—20 years that witnessed rapid technological evolution.

This fall on the main campus in Newark, UD opens the Interdisciplinary Science and Engineering Laboratory, called ISE Lab (pronounced "Ice" Lab) for short, a building designed to foster research that will impact the 21st-century world while preparing the problems solvers of the future in a whole new way.

COME ON IN FOR A CLOSER LOOK....

INNOVATION CENTRAL

America's public research universities are the backbone of advanced education and research in the U.S. today. They conduct most of the nation's academic research (62 percent), while producing the majority of its scientists, engineers, doctors, teachers and other learned professionals (70 percent).

— National Research Council

PHOTOS BY KATHY F. ATKINSON, EVAN KRAPE, AMBRE ALEXANDER

GOING GREEN

ISE Lab was constructed following the standards of the U.S. Green Building Council's LEED Silver designation. Three green roofs absorb rainwater, reducing runoff, as well as help insulate the building.

COOL CLASSROOM TECHNOLOGY

Classrooms include the latest in educational technology, tools that enhance students' capabilities and experience, including 3-D projectors.

100

That's the maximum allowable number of particles (dust, soot, pollen, etc.) per square foot in the clean labs in the Nanofabrication Facility. Compare that to the typical office space, with a half-million to a million particles per square foot!

GATHERING SPACE/CAFE

Students and faculty will have the opportunity to grab a bite and relax in ISE Lab's lobby, which will feature comfortable seating and a café occupied by Einstein Bros. Bagels.

COLLABORATORIES

Faculty members from different disciplines will work side by side in an open space without partitions.

THE ISE LAB COMETH

Renewable energy. Spintronics (the revolutionary faster, more energy-efficient next generation of electronics). Sea-level rise. Pollution. Challenges and opportunities have faced every human generation. But now the issues are so complex, the scales often so great, that experts in multiple areas are needed to address them.

UD's ISE Lab marks a new direction for academic facilities. From its classes and offices designed to foster collaboration, to its living "green" rooftop, the 194,000-square-foot facility is a novel hub for the science of the future.

It's a place where new problem solvers will be trained. It's a place where new teaching approaches will be employed. And it's a place where innovation will be cultivated. It also offers specialized facilities for nanoscale manufacturing and the development of advanced materials, benefiting researchers in academia, industry and government across the Mid-Atlantic region and beyond.

The brand-new facility brings together students and faculty from various disciplines to teach, learn and conduct research in a collaborative environment. Research will provide content for the curriculum, and students will learn through exploration of real-world problems.

Inside you will not find large lecture halls. No classroom holds more than 48 students. ISE Lab's four problem-based instructional laboratories feature lab spaces adjoining classrooms, so students can discuss a problem and immediately test a solution.

Eight general instruction classrooms include the latest in educational technology and mobile furniture, allowing for flexibility of seating arrangements to suit group or individual work, preparing students for the future workplace.

INNOVATION BY DESIGN

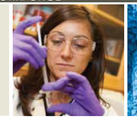
ISE Lab features top facilities for analyzing and imaging soils to solar cells, and for fabricating nanosized inventions visible only under high-powered microscopes. It also includes—on all four floors—classrooms and instructional labs side-by-side, dedicated to teaching students through hands-on problem-solving.

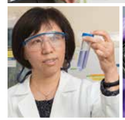
COURTYARD

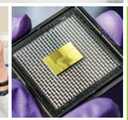
Native plants and an on-site drainage system eliminate stormwater runoff.

BUILDING TOMORROW'S WORKFORCE

Students will learn the art and science of collaboration.







Students will help launch a learning revolution.

STEM jobs

Workers in **science, technology, engineering and math** (STEM) occupations in the U.S. earned $77,880/year on average in 2009—almost $35,000 more than the national average of $43,460/year.

The U.S. Bureau of Labor Statistics estimates that over 8.6 million STEM jobs will exist in 2018, not including those self-employed.

PRODUCING PROBLEM SOLVERS

UD is internationally known for *problem-based learning*. ISE Lab will enable students to discuss a problem in a lecture format and immediately test a solution in the lab.

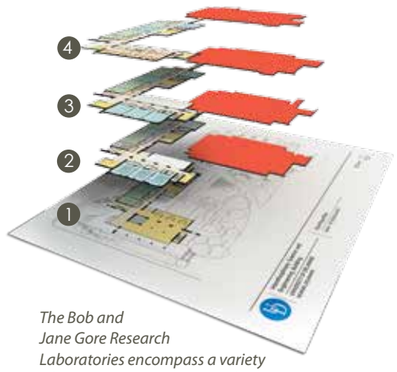
CONTACT US

University of Delaware
iselab-info@udel.edu

Visit us at www.udel.edu/iselab/

RESEARCH WING

THE BOB AND JANE GORE RESEARCH LABORATORIES



The Bob and Jane Gore Research Laboratories encompass a variety of research spaces and "core facilities" available to campus and external users for nanofabrication, microscopy and materials characterization.

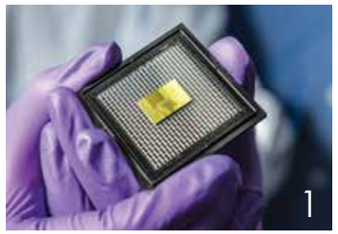
FABULOUS FACILITIES

The Bob and Jane Gore Research Laboratories—featuring the most advanced scientific equipment possible—will make kids in a candy store out of many researchers. This gleaming research wing houses three shared laboratory suites with some of the most sought-after microscopes and machinery, which will now be accessible to a larger segment of the UD community, as well as by industry and government partners. Expert staff will be on hand to assist users.

21st-CENTURY SCIENCE

Open for business

ISE Lab's core facilities will be available to university, industry and government researchers. To discuss lab capabilities and upcoming projects, contact **iselab-info@udel.edu**.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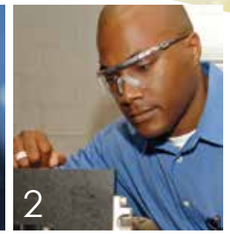
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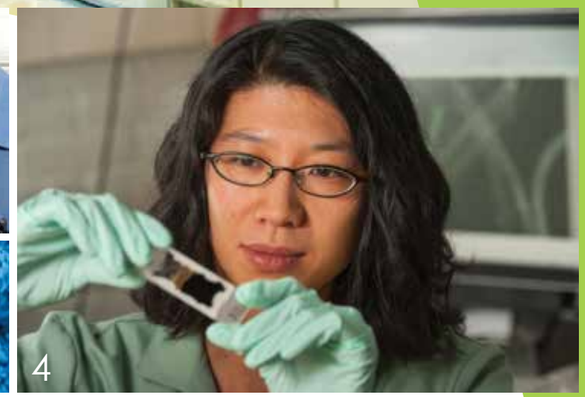
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NANOFABRICATION FACILITY

Nanofabrication labs are sometimes called "the machine shops of the 21st century," but they operate in ultra-clean rooms that filter out dust and other particles that could contaminate the research. Each piece of machinery performs a different step in the fabrication of nanoscale materials, including lithography, deposition and etching, a process likened to creating a silk screen similar to those used in printing t-shirts, but on an extremely tiny scale. The pattern is created, materials are placed on top through the holes in the "silk screen" and the unnecessary material is etched away. Using this method, countless devices can be manufactured, with uses ranging from health testing to environmental monitoring.

W.M. KECK MICROSCOPY FACILITY

This facility assists in the structural and chemical characterization of materials at scales ranging from micron to angstrom. The suite's transmission electron microscope allows researchers to create high-resolution images. The equipment is particularly sensitive to vibration, so this lab was constructed atop its own foundation, separated from the rest of ISE Lab to minimize interference.

MATERIALS CHARACTERIZATION

The advanced instruments in this laboratory, from X-ray diffraction to infrared spectroscopy, will be used to reveal the internal structures and physical, chemical and mineralogical properties of materials ranging from soils and air particulates, to quantum dots for advanced computation. The capabilities offered will not be available anywhere else in the world.

NAMING OPPORTUNITIES www.udel.edu/iselab/naming/

Naming opportunities for the laboratory spaces within ISE Lab are still available to major donors. If you're interested in learning more, contact the UD Development Office at (302) 831-0763 or visit the website above.

SUPER SENSOR

Juejun Hu and Chaoying Ni of UD's Department of Materials Science and Engineering envision an array of their sensors near a stream or in a city square, capable of detecting water, soil and air pollutants in real time and relaying that information wirelessly to a computer.

To make their "sensor-on a chip," the team uses specialized tools that will be available in ISE Lab's Nanofabrication Facility, such as a focused ion beam (FIB), to punch holes into a thin strip of chalcogenide glass only a few micrometers thick, or about one-tenth the width of a hair.

When light passes through the strip, molecules in the environment selectively absorb one or a few colors of the light. The unique optical absorption signals can then be used to identify the molecules present and their concentration. The researchers plan to group several of the tiny, chip-sized devices together to create a sensor the size of a hockey puck that can detect multiple types of molecules and do so inexpensively and in an environmentally friendly manner.

"It's a new type of sensor," says Ni. "It is very small and, more importantly, it is very sensitive and very specific."

Although the project, which was seeded by the National Science Foundation's EPSCoR program, is in its early stages, Hu is already looking ahead to the practical benefits.

"We'll be able to continuously monitor environmental pollutants, so we'll know if water in a stream is getting polluted or if a chemical plant is leaking," he says. "We can also use it to detect toxic leaks in industrial plants."

Hu adds that once the technology is sensitive enough, chip-scale sensors could be useful in other fields, including biomedicine.

"We could use the devices to check for certain diseases by analyzing a patient's breath," he says. "The sensor would be able to detect trace molecules in the air a patient exhales."— *Juan Guerrero*

SENSOR-ON-A-CHIP DEVELOPERS

From left, UD engineers Juejun Hu and Chaoying Ni will rely on ISE Lab's high-tech facilities to make their sensors for detecting environmental contaminants, and potentially, human diseases.

1 *This palm-sized sensor-on-a-chip is being developed by UD researchers to detect low levels of contaminants in water, soil and air in a cheap and eco-friendly way.*

2 *Thomas H. Epps, III, UD's Thomas and Kipp Gutshall Chair of Chemical and Biomolecular Engineering, will use ISE Lab's facilities to explore nanoscale assembly of "organic electronics," polymers that conduct electricity.*

3 *Products from sunscreen to solar cells contain nanoparticles of zinc oxide, shown here. The Zeiss Auriga 60 focused ion beam and scanning electron microscope (FIB/SEM) in the W. M. Keck Microscopy Facility was used to magnify these tiny structures.*

4 *Based in ISE Lab, geomicrobiologist Clara Chan will pursue her quest to answer two key questions: How did Earth's surface chemistry co-evolve with life, and how did life evolve with the environment around it?"*

A NEW ENERGY FOR THE FUTURE

University of Delaware researchers aren't tilting at windmills when it comes to solving energy challenges. Earlier this year, they proved that electric cars, equipped with technology invented at UD, can send battery power back to the grid, earning cash for the owner while helping to balance grid flow. ISE Lab is destined to foster plenty more innovation.

THE DRIVE TOWARD RENEWABLE ENERGY

Biomass, wind, solar, fuel cells—all have a part to play in future energy solutions, according to Michael Klein, director of the University of Delaware Energy Institute (UDEI).

UDEI's role is to bridge the various academic disciplines that support these energy areas and get people working together.

Klein sees ISE Lab, UDEI's new home, as a powerful connecting force for bringing together the 250 people across campus engaged in energy research.

"There is no single science base to energy," Klein says, "but to develop energy solutions we need coherent, functional teams that can compete for multi-year, high-dollar grants that really will make a difference."

Case in point: in 2009, the U.S. Department of Energy awarded UD a five-year, $17.5 million grant to establish the Catalysis Center for Energy Innovation (CCEI) as an Energy Frontier Research Center—one of 46 research accelerators nationwide working to establish the scientific foundation for a fundamentally new U.S. energy economy.

The CCEI attracts significant federal and industry investment in simple catalytic technologies to transform plant biomass into fuels, chemicals and electricity.

Dion Vlachos, the center's director and Elizabeth Inez Kelley Professor of Chemical and Biomolecular Engineering, is coordinating 12 teams—at UD and 11 other institutions and national laboratories—aimed at making scientific contributions that will lead to energy independence for the United States.

It is challenging work.

"Using a synergistic team approach, we leverage complementary expertise of CCEI faculty across the nation to solve complex problems and realize significant advances much faster than those working alone," Vlachos says.

With a central focus on biomass conversion, the center's major breakthroughs include discovering potential ways to produce plastics from plants, promoting the use of direct carbon fuel cells for converting biomass to electricity, and replacing biological processes with thermochemical processes to transform trees into corn syrup that can be used in food or be transformed into fuels and chemicals.

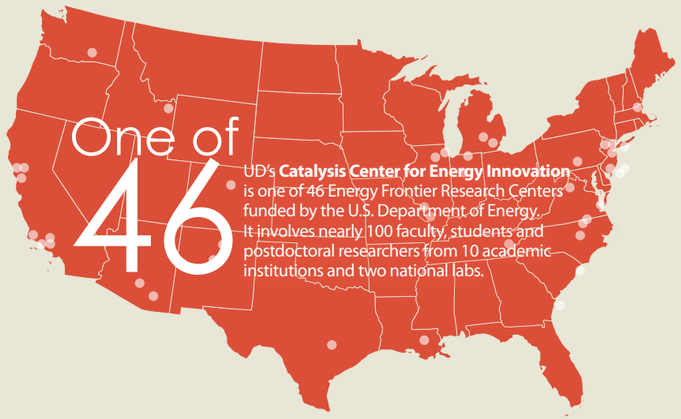
In parallel, CCEI has a concerted effort toward spin-off technologies and the development of computational and experimental tools that can be applied in other disciplines. The center provides a pathway to transfer these technologies and tools to industry, while training students and postdoctoral researchers—the next generation of engineers—for cutting-edge research.

Vlachos says ISE Lab's first-rate facilities will enable CCEI to develop new materials, test materials created by researchers at collaborating institutions and attract new industrial partners. It will also provide a showcase for renewable fuels and chemicals developed by the center, as well as an integrated demonstration system that can be used as an educational tool to illustrate the center's work to industry, granting agencies, other collaborators and students.

"I see ISE Lab as an incubator that will enhance our research, nurture new synergies on campus and foster opportunities to increase collaborations with industry here and across the nation," he says.—*Karen Roberts*

SPARKING ENERGY SOLUTIONS

Dion Vlachos leads the Catalysis Center for Energy Innovation. His team aims to find new catalysts—compounds that spark faster, more efficient chemical reactions—for transforming plant matter, or biomass, into biofuel, useful chemicals and electricity.



PARTNERING INSTITUTIONS

Brookhaven National Laboratory
California Institute of Technology
Columbia University
Georgia Institute of Technology
Lehigh University
Massachusetts Institute of Technology
Pacific Northwest National Laboratory
Rutgers University
University of Delaware
University of Massachusetts, Amherst
University of Minnesota
University of Pennsylvania


Cristina Archer

Pulling power out of thin air

As a boat propeller spins, the motion leaves a churning wake of water behind. A similar effect occurs with wind turbines, but instead with forceful swirls of air.

Cristina Archer in UD's College of Earth, Ocean, and Environment is studying airflow patterns in relation to offshore wind farms.

"The research I'm conducting right now is using very sophisticated computer models to study what happens downwind of turbines," says Archer, who is an associate professor of geography and physical ocean science and engineering.

The arrangement of wind turbines within a farm could potentially save millions of dollars when the turbines are set up to minimize interactions with each other. Turbines generate electricity by extracting kinetic energy from wind, and wakes disrupt that flow. Reducing the losses that wakes cause from 15 percent down to 10 percent may seem small, but when multiplied by hundreds of turbines can easily add up to substantial savings.

Archer and her Atmosphere and Energy Research group are crunching numbers to figure out optimal ways to place turbines offshore. As a starting point they are simulating an existing offshore wind farm in Sweden that has 48 turbines, modeling the turbine wakes and seeing what happens with shifts in the configuration.

The calculations require millions of data points on wind speed, atmospheric pressure, temperature and other atmospheric variables, requiring huge amounts of computer power and weeks—or even months—to run.

"It's really computer intense," Archer says.

Archer is moving to ISE Lab with others associated with the Center for Carbon-free Power Integration because of the interdisciplinary nature of the work and opportunities for her students to interact with those in other fields, especially engineering students doing the similarly rigorous math needed to conduct simulations.

Archer also studies how much wind there is on a global scale and is exploring the potential for kite-like airborne wind turbines, which are suspended hundreds of feet off the ground by tethers. She summarized issues related to the technology at a conference in Berlin this summer. While her work is applicable to renewable energy applications, it is grounded in her expertise in meteorology.

"Basically I'm a meteorologist and an engineer, and so wind power is a natural merge of the two," Archer says. "I look at technologies of energy from a meteorological point-of-view."—*Teresa Messmore*

FOLLOW THE LEEDER

ISE Lab was constructed to achieve, at minimum, the standards of the U.S. Green Building Council's LEED Silver designation. The lighting control system maximizes use of daylight, a function known as "daylight harvesting." Each air handler is equipped with a heat recovery system. The building has three green roofs, and the courtyard landscape uses native plants and an on-site drainage system, eliminating stormwater runoff.

AN ENVIRONMENT FOR TEAMWORK

Great teams can solve great problems. As researchers on interdisciplinary teams well know, such collaborations can push you out of your comfort zone and wind up launching entire new academic fields like bioengineering. A major ISE Lab focus is the environment, bringing together scientists, engineers and policy experts to look at both problems *and* opportunities.

MAGNET HUNTER

Your car uses at least 30 of them.

Anything with a generator that turns, from a refrigerator to a wind turbine to an airplane to a high-tech security system, has them: magnets.

The problem is that most permanent magnets are made from the same recipe of metals, and some of the ingredients are getting scarce. China has the largest deposits of neodymium, a key metal for magnet-making, but the supply is dwindling.

George Hadjipanayis, the Richard B. Murray Professor of Physics and Astronomy at UD, pioneered the development of the permanent magnets that dominate industry today, used in electric motors to computer hard drives. Thirty years ago, he published the first research on these magnets, which are made of soft, silvery neodymium, its metallic "green twin" called praseodymium (which slowly turns green when exposed to air), iron and boron.

Now, he's leading a team racing to develop the next generation of magnets. The goals: make them less reliant on rare metals and twice as strong.

"Stronger magnets allow for lighter, smaller, more energy-efficient devices," he explains.

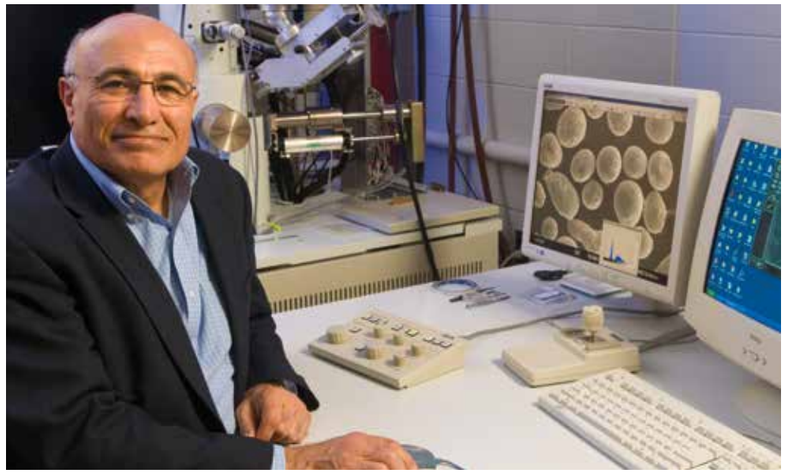
Hadjipanayis won a $4.4 million grant from the U.S. Department of Energy's Advanced Research Projects Agency (ARPA-E) in 2009 to lead one of six teams nationwide exploring a variety of angles and methodologies for advanced magnet development. The research involves multiple collaborators: chemists, engineers, physicists and materials scientists.

They work with nanoscale quantities of metals such as iron, platinum, samarian and cobalt—particles that are smaller than one-ten thousandth the thickness of a human hair.

They meticulously assemble new composite magnets from the bottom up, viewing details as fine as a single column of atoms with a transmission electron microscope (TEM). They also test the magnets' strength and coercivity, a measure of how resistant the assembled nanocomposites are to becoming demagnetized.

This summer, Hadjipanayis won two contracts from the U.S. Department of Energy to continue the research. ISE Lab will be a major asset to both studies. One project is with Argonne National Laboratory and GE; the other is with Pacific Northwest National Laboratory (PNNL).

"Thirty years ago, the U.S. led the world in magnet technology," Hadjipanayis says. "We're working to help bring that back."—*Tracey Bryant*



ADVANCED MAGNET DEVELOPMENT: AN INTERNATIONAL QUEST

George Hadjipanayis, the Richard B. Murray Professor of Physics and Astronomy at UD, is world renown for his knowledge of magnets. In 2012, he was named a distinguished lecturer by the Magnetics Society of IEEE, the largest professional association for the advancement of technology. One of only three scholars selected internationally for the honor, Hadjipanayis traveled to universities in 13 countries during the year, sharing his expertise and forging new collaborations.

BLACK IS THE NEW GREEN

Imagine a technology that simultaneously enriches the soil, neutralizes pollutants and removes carbon dioxide from the atmosphere. What would such a technology look like?

According to an enthusiastic group of researchers at the University of Delaware and Delaware State University (DSU), the answer may well be "a black powder"—charcoal.

The substance is garnering new attention from soil scientists, biologists and environmental engineers worldwide. Dubbed "biochar," especially when used as a soil amendment, charcoal is increasingly being investigated as a "carbon sink"—a means of sequestering carbon and returning it to long-term storage in the ground, both enriching the soil and mitigating global warming.

UD's ISE Lab will likely become a hub for biochar research in the coming years as interested faculty and students from a number of departments including biological sciences, civil and environmental engineering, and plant and soil sciences take up residence, use the core facilities and make the building a meeting place.

When organic matter—which could range from chicken litter to corn stalks to wood chips—is subjected to very high temperatures, combustion results as long as oxygen is present, and the carbon in the organic material is released to the atmosphere. Without oxygen, however, organic matter undergoes the process of pyrolysis, forming biochar. The word pyrolysis comes from the Greek "pyro," meaning fire, and "lysis," meaning separating, and it results in a permanent chemical change in which the carbon stays put.

EXPLORING BIOCHAR

Pei Chiu and Julie Marseca are investigating uses for charcoal or "biochar," ranging from enriching soil to filtering pollutants from stormwater.

Holly Michael and **Paul Imhoff** aim to find out how carbon gets trapped, or sequestered, in soil instead of transitioning into more carbon dioxide that we don't need.

When added to soil, biochar can persist for hundreds of years, with particles playing host to a wide range of beneficial microbes and turning the soil a rich, black color. Soils that are high in biochar often produce dramatically higher crop yields.

Among the UD faculty seeking new ways to put biochar to good use are several environmental engineers, including ISE Lab residents Pei Chiu and Paul Imhoff, along with Dan Cha and Julie Maresca. The group has also been collaborating with Mingxin Guo of DSU, who has been studying biochar as a soil amendment for years.

The group is looking into a combination of biochar and particles of iron to form filtration devices that can be placed in drainage ditches and retention ponds in order to treat contaminated agricultural or highway runoff.

According to Chiu, the combination of biochar and iron are more effective together than alone.

"They complement each other well," he says. "Biochar treats pollutants that iron does not and vice versa. For example, pollutants such as ammonia, metal ions and pesticides can be taken up by biochar, whereas nitrate, phosphate and *E. coli* can be treated with iron."

The group has been experimenting with biochar particles prepared from different types of waste biomass at different pyrolysis temperatures.

"Not all biochar is created equal," Chiu says, pointing out that the properties of biochar vary depending on the source material. Poultry litter biochar, for example, is rich in nutrients compared to wood chip char. They may also harbor different soil microbial communities.

"If the right bacteria are associated with the biochar particles, then they can help process nitrogen into nitrogen gas, which is inert and can be released harmlessly to the atmosphere," Chiu says.

Work on the stormwater filters is in its third year of funding from the Delaware Department of Transportation, with the group planning to test their device at a field site this year.

The team would eventually like to obtain a pyrolysis unit here at UD. Having such equipment would allow them to produce biochar at higher yields under a broad range of conditions, making experimental results easier to replicate and more conclusive.

To Chiu and the group, the best thing about this line of research is the potential for solving so many problems at once.

"Both the iron particles and the sources of the biochar we use in our filters are essentially waste byproducts that could otherwise become problems themselves," Chiu says. "It's good to be able to use them in a sustainable way to benefit the environment instead."

—Beth Chajes

THE TRICKLE-DOWN EFFECTS OF LAND USE

When a forest is converted into a farm or a housing development, there are bound to be trickle-down effects on the environment—and in some cases, quite literally.

UD researchers are examining how water flows differently, drop by drop, through the ground with changes in land use and what the impacts are on biological, geological and chemical processes at play.

The work could improve understanding of how carbon gets trapped, or sequestered, in soil instead of transitioning into carbon dioxide, of which the atmosphere already has too much thanks to pollution.

"The interdisciplinary nature helps us get at these feedbacks that you wouldn't normally characterize if you were just studying biogeochemistry without tying it to the hydrology, for example," said Holly Michael, assistant professor of geological sciences.

Michael, an expert in the interactions between surface water and groundwater, is teaming up with Paul Imhoff, professor of civil and environmental engineering, to conduct experiments in ISE Lab. Together with soil scientist Kyungsoo Yoo of the University of Minnesota, they are studying how minerals in dirt break down and chemically change when exposed to air, water and organic material, a process called weathering.

Soil in a forest is held together by tree roots in a different structure than soil in an agricultural field, which is loosened by plowing. Rainfall moves through the contrasting soil structures in each setting in different ways, and the increased surface area on soil particles in a field allows for more weathering and changes in the chemistry of water as it flows downward.

Weathered mineral surfaces are more reactive with plants and other organic matter also found in soil. The researchers will be looking at the resulting organic carbon dissolved in water and how it is getting into watersheds in greater or lesser quantities depending on the land use.

"We expect that agriculture accelerates weathering," Michael said. "This would probably increase mineral surface area, which means sequestering more carbon."

"In which case, you're kind of removing carbon from the cycle," Imhoff added. "So it's not then available to be converted into carbon dioxide and go into the atmosphere."

At ISE Lab, the researchers will put soil and sediment into tubes and add water that mimics conditions in forests and fields. They will measure changes in moisture content, how the water itself is flowing through and the weathering that happens as the water moves through the columns. They will compare the results to field tests and use the data to create models that can predict the kinds of changes that will happen because of changing land uses.

The new approach brings together various perspectives to sort out how soil, water and air interact underground.

"A lot of people study mineral weathering, a lot of people study land use, and a few people have studied the two combined—but not so much thinking also about the hydrologic feedbacks and the effect on carbon cycling," Michael said.

—Teresa Messmore

GROWING RESEARCH CAPABILITY STATEWIDE

DELAWARE EPSCoR PARTNERS

- Delaware State University
- Delaware Technical & Community College
- University of Delaware
- Wesley College

Four Delaware institutions are partners in a new $20 million grant awarded by the National Science Foundation's Experimental Program to Stimulate Competitive Research. EPSCoR helps states develop their research infrastructure and capabilities. The Delaware Environmental Institute, based in ISE Lab, administers Delaware EPSCoR.

The new grant will focus on "Meeting Delaware's 21st-Century Water and Energy Challenges through Research, Education, and Innovation" during the next five years. Major themes include the effect of sea level rise on contaminant mobility; land use and climate change impacts on water and ecosystems; multiscale environmental sensing; and innovations in renewable energy.

Peter Attia *(left) published in a major ethics journal with guidance from* **Tom Powers,** *director of the Center for Science, Ethics and Public Policy.*

Through an ethics lens

It's not every day that an undergraduate publishes a solo paper in a major applied ethics journal. It's even more rare when that student is an engineering major.

But that is exactly what Peter Attia, a junior chemical engineering major from Hockessin, Del., accomplished in the peer-reviewed journal *Science and Engineering Ethics* on Dec. 6, 2012.

In "Mega-Sized Concerns from the Nano-Sized World: The Intersection of Nano- and Environmental Ethics," he sets forth an argument for adopting a "weak anthropocentric ethic" (one that considers human interests, but not exclusively) as a practical guide for deciding when to allow the use of nanotechnologies that may have environmental consequences.

The paper arose out of an assignment in the environmental ethics course Attia took last spring: write a term paper examining an issue through an environmental ethics lens, using the framework of the various philosophies presented in class.

"When I write a paper, I usually ask the professor for feedback," Attia says, "and this time the professor said it had the potential for publication."

He then worked with that professor, Tom Powers of the Department of Philosophy who also directs UD's Center for Science, Ethics and Public Policy, to polish the article over the summer and submitted it to the journal in September.

"It went a lot smoother than I expected," Attia says.

Over Thanksgiving break, he received notice that the article would be published with only minor changes.

Attia, who also received a prestigious Goldwater Scholarship this year, has been supported at UD by the National Science Foundation's Nanotechnology Undergraduate Education in Engineering (NUE) program, under the mentorship of materials science and engineering professor Ismat Shah.

Powers and Shah are co-PIs on an NSF grant supporting nanoscience and ethics education in Pakistan. Attia accompanied them there for spring break and presented his work in a joint talk with Powers, whose work is cited—but disputed slightly—in Attia's paper.

Attia is working at the DuPont Company as an intern this summer. Although unsure of his future plans, the experience has turned on a new light.

"I can see myself becoming more involved in the policy aspects of science," he says. "Maybe it will only be a sideline, but it's definitely something I'm interested in."—*Elizabeth Chajes*

CRITICAL THINKING FOR THE REAL WORLD

Deborah Allen taps her fingers on a massive biology textbook. It sits atop two others covering the same topic on a table in her office. She refers to these 1,000-plus-page tomes as student guidebooks.

"They should make excursions into this, pull what they need and go from there," she says. The students in introductory biology courses already learned many of the fundamentals of the subject in high school. Allen says they need not repeat the basics in college; what they should be learning is how to think critically.

In her classes, Allen builds critical thinking skills through the problem-based learning (PBL) method. Traditional lectures featuring a professor behind a podium are replaced by problems to be solved and group work. PBL promotes inquiry, leading students to formulate their own scientific questions.

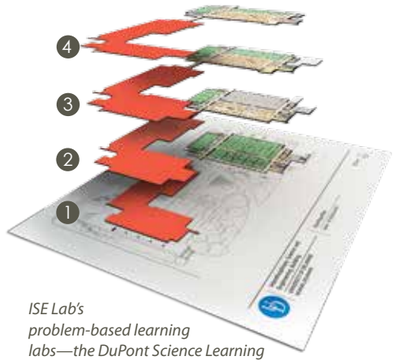
"That really is at the heart of science—knowing what is going to be a productive question," Allen says.

Next year, Allen will teach her Introductory Biology class in one of ISE Lab's four problem-based learning instructional laboratories. In each suite, two teaching laboratories adjoin a classroom, separated only by glass walls, so students can discuss a problem and then immediately test a solution.

This both physically and symbolically shifts the current paradigm. In traditional classroom settings, a faculty member or teaching assistant describes the week's experiment prior to the scheduled laboratory component, which takes place at a different time, often on a different day and in a different building.

PROBLEM-BASED LEARNING LABS

DUPONT SCIENCE LEARNING LABORATORIES



ISE Lab's problem-based learning labs—the DuPont Science Learning Laboratories—will elevate students' experience with the scientific method of inquiry, hypothesis building and idea testing as they address real problems.

Allen, a longtime UD professor became director of the Center for Teaching and Assessment of Learning after returning from a three-year leave of absence serving as a program director for the National Science Foundation's Division of Undergraduate Education.

Professional scientists and engineers, like those Allen worked with at NSF, are expected to think thesis-oriented thoughts. She believes problem-based curricula help students think the same way.

"You have an idea or an opinion and you can marshal evidence toward it. And, not only that, but you understand what the counterarguments are and you can counter them," she says.

For years, the University has worked to revamp its science and engineering curricula to emphasize real-world problem solving. Such curricula will best utilize the DuPont Science Learning Laboratories in ISE Lab, says George Watson, dean of the College of Arts and Sciences.

"The inquiry, the hypothesis building, to test and anchor ideas, are important parts of science," Watson says. "If laboratory instruction doesn't elevate that, then it doesn't accomplish what we'd like it to for our students."

The PBL approach is intended to make the classroom experience more engaging, and in turn, help recruit and retain students in science and engineering majors.

The University of Delaware is nationally recognized as a leader in problem-based learning (PBL). The Institute for Transforming Undergraduate Education, established in 1997, teaches PBL techniques to educators.

Students attending class in ISE Lab will regularly be asked to write and communicate orally, present concepts to the class and work in diverse teams; they will develop skills they will use daily in the future workforce.

At a time when online course offerings are increasing and a good deal of learning can happen virtually, the faculty, including Watson, who worked on plans for ISE Lab, wanted to create spaces optimized for active learning to provide what online learning alone can't.

"Sometimes students don't think science is relevant because they are not studying it in the context that they should be," he says.

Many engineers study basic biology, chemistry, physics and calculus freshman year and may not see how that first-year instruction connects to their career objectives. Many change majors. Watson says custom curricula fuse that connection by including examples and homework from students' chosen majors.

UD already has some of these courses in place; for instance, the mathematical sciences department offers special sections of calculus specifically for biology majors, featuring problem sets that connect the equations to a biological function.

So what do students think of problem-based learning? The student evaluations of Prof. Hal White's Introduction to Biochemistry course this past spring provided telling responses. White helped pioneer PBL at UD.

A student wrote: "I was apprehensive at first, but this course was very rewarding. The only course where the instructor has to tell the class to leave."—*Andrea Boyle Tippett*

Preparing the workforce

John Jungck knew what UD was up to long before he arrived on campus. As a professor at Beloit College in Wisconsin, well versed in interdisciplinary, hands-on learning techniques, he knew the University by reputation for its leadership in problem-based learning (PBL), which emphasizes real-world problem-solving.

Last fall, Jungck became the director of the interdisciplinary learning laboratories in ISE Lab, a PBL-focused wing that has been named the DuPont Science Learning Laboratories.

"In order to do your work in today's age, it takes a village, it takes a team. How do we create a culture for our students that better reflects the kind of professional practice that occurs out there?" Jungck says. "When you talk to industry leaders, they're looking for problem solvers, team workers, people that can cross those boundaries and have an intelligent discussion with their peers."

Jungck says the inclusion of the word "interdisciplinary" in ISE Lab's name challenges faculty members on campus to rethink the way they teach.

"Architecture and schedules change people," he says.

No classroom inside ISE Lab holds more than 48 students. There are no lecture halls. Desks with wheels allow for flexibility of seating arrangements, easily transitioning from group to individual work and back again. All include the latest in educational technology. Some will have 3-D projectors. Using them, students can slice into a brain, look inside a molecule, examine geological formations in a stream or travel through an artery right from their seats. For young people raised on video games, these projectors help reinforce concepts in a manner they are accustomed to, as they explore unfamiliar material and over time morph from students into future members of the 21st-century workforce.—*Andrea Boyle Tippett*

1,200

That's how many students will be taught in ISE Lab's classrooms throughout a given day at UD.

ACTIVE LEARNING

Mobile classroom furniture will allow teams of students to collaborate more easily.

EVAN KRAPE

Brian Freedman *(center) meets with a family affected by autism at UD's Center for Disabilities Studies in Newark, Del.*

Helping families affected by autism to thrive

by Christina Mason Johnston and Alison Burris

Every parent knows that raising a child can be stressful. However, parenting a child with autism spectrum disorder (ASD) can be all the more difficult. When a child has difficulty communicating with others and establishing typical relationships and exhibits repetitive behaviors or has restrictive interests, it can result in increased stress throughout the family.

1 in 88

American children have autism spectrum disorder (ASD).

SOURCE: *Centers for Disease Control*

It's a serious issue in the United States. The Centers for Disease Control and Prevention (CDC) estimates that about 1 in 88 American children have ASD, a tenfold increase in prevalence in the last 40 years.

The challenge of caring for a child with ASD isn't limited to within the family itself. Parents find that the lack of social, professional and societal support adds another layer of strain in their lives.

Brian Freedman, director of the Transition, Education and Employment Model (TEEM) unit in UD's Center for Disabilities Studies, was interested in exploring whether the increased stress had a negative impact on a family's stability.

"Early on, I observed firsthand that many families of children with ASD show amazing resiliency and desire to advocate for their child," Freedman remarks. "After seeing this resiliency—and the accompanying stress—through my clinical work, I decided to explore the internal and external challenges that families face with a child with autism."

Freedman, together with a team of researchers from Kennedy Krieger Institute and Johns Hopkins University, first conducted a study examining divorce rates. It was published in 2012 and was cited more recently in the article "Love in the Time of Autism" in *Psychology Today*.

"Despite a commonly quoted statistic that indicated an 80 percent divorce rate among parents of children with ASD, we could not identify an evidence-based source. We did not observe a difference between the marriage rates of parents of children with ASD and other parents. We also discovered that an increased severity of autism symptoms did not correlate to more marital strife," says Freedman.

That does not mean there is not additional stress. A second element of Freedman's research, conducted in collaboration with colleagues at Loyola University Maryland, examined the relationship of siblings in a family with ASD, compared to families with a child with Down syndrome. Siblings of children with ASD reported more challenges in such relationships compared to siblings of children with Down syndrome. Furthermore, greater relationship challenges also were linked with a higher likelihood of sibling anxiety.

Freedman has used the results of this research to develop interventions that can increase a family's overall quality of life, decrease their stress and help them to live fulfilling lives.

Through his work at the Center for Disabilities Studies (CDS) in UD's College of Education and Human Development, Freedman has fostered a variety of programs that provide support for children, families and young adults with developmental disabilities. Freedman oversees UD's college program for students with intellectual disabilities (Career & Life Studies Certificate–CLSC), offers support groups for families of young adults with ASD and other developmental disabilities, and contributes to the CDS-led Delaware Statewide Plan for Improving Services/Support for Individuals with ASD.

Through his work with families, Freedman has found that raising a child with ASD is often compounded by challenges in obtaining adequate medical, psychological and educational services. Children with ASD experience high rates of sensory processing problems, and new research suggests a potential linkage between ASD and gastrointestinal (GI) issues.

These children may also exhibit co-occurring mental health challenges, such as anxiety and aggression, which can lead to additional issues for families. Freedman and his colleagues at Kennedy Krieger Institute and Johns Hopkins University found that children with ASD are nine times more likely than other children to visit an emergency room for psychiatric reasons.

"Limited access to outpatient mental health services often leads children with ASD to seek treatment in the emergency room," Freedman explains. "Due to the limited availability of knowledgeable providers and a lack of insurance coverage for behavioral health services, these issues may go untreated until they become a major health and safety concern for the family."

Freedman hopes his findings will serve as a resource for other practitioners—and emerging professionals who take his undergraduate Families and Developmental Disabilities course in the Department of Human Development and Family Studies.

"I have always greatly admired families of children with ASD," says Freedman. "At the end of the day, I'd like to create an atmosphere for these families in which they can thrive, by knowing how to support themselves and one another and working with a community of service professionals who understand their needs."

Chemical engineer investigates autism disorders | *by Karen Roberts*

Prasad Dhurjati, professor *of chemical and biomolecular engineering*

Prasad Dhurjati is a chemical engineer whose background includes systems engineering, biotechnology and artificial intelligence. Yet recently, the UD professor has been investigating autism spectrum disorders—neurodevelopmental disorders characterized by cognitive, behavioral and social impairments.

Autism, he explains, has been cited as being linked to gastrointestinal symptoms and is thought to be caused by a combination of genetic predisposition and environmental factors.

After analyzing the available literature, Dhurjati realized that researchers often studied the digestive bacteria and other suspected causes of autism separately. He wondered if a systems biology approach—focusing on how the parts connect to the whole system—could be used to model the connectivity of key contributors to the development of autism spectrum disorders.

"Chemical engineers build reactors to convert chemical molecules into useful products, but when you think about it, one of the best reactors is what I call the human body's gut reactor—the digestive system," Dhurjati says. "It contains thousands of bacterial microbes and cells; it derives energy and nutrients from food and excretes waste. But what happens if one or more of the hierarchical connections in this complex ecosystem breaks or becomes damaged? How does that affect the disease process?"

Dhurjati is working to map out these connections with Myron Sasser, a former UD professor of plant pathology, whose work has involved investigating microbes that cause diseases in plants. In 1991, Sasser founded Microbial Identification Incorporated (MIDI), a biotechnology company based in Newark, Del., that has developed a database of over 5,000 unique fatty acid signatures to identify microorganisms.

The duo's model proposes a circular relationship between digestive system bacteria, oxidative stress and intestinal permeability. Key bacterial players could include desulfovibrio, bifidobacteria and clostridia.

While it is certain that these aren't the only connections to be made, Dhurjati believes a multifaceted approach and combination treatment to address all factors at once may produce better results and minimize interrelated effects.

He says the next step is to make the model more quantitative, so that variables can be added or taken away and the associated effects measured. He believes feedback from others in academia, industry or health care could lead to an improved hybrid computer model that would enable simulation and testing on a "virtual patient."

"There are many unanswered questions; we are simply raising questions of connectivity from the systems level in hopes of inspiring others to rethink their approach and continue to study this problem from different vantage points," he says.

To learn more, read the article by Colin A. Heberling, Dhurjati and Sasser published in the March 2013 issue of the *Journal of Medical Hypotheses,* a publication of Elsevier.

In a recent interview about the research on WDDE, Delaware's National Public Radio station, Martha Hebert, a pediatric neuroscientist at Massachusetts General Hospital, assistant professor of neurology at Harvard Medical School and author of *The Autism Revolution* (2012), called Dhurjati's paper "a vital stepping-stone in the long path from research to treatments for autism."

first person

The Split Personality of an Environmental Historian

by Adam Rome

I have two scholarly personalities. On the one hand, I am Dr. Earth Day. I study the history of environmental activism in the United States, and I think much of that history is heartening: Since the mid-19th century, a growing number of Americans have fought to control pollution, conserve natural resources, and protect wild places and creatures.

On the other hand, I am Mr. Apocalypse. Despite all that environmental activists have accomplished in the last 150 years, we still face potentially devastating environmental problems, and I am keen to explain why that's true.

At the start of my career, Dr. Earth Day and Mr. Apocalypse worked so closely together that I didn't appreciate the split. My first book, *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of American Environmentalism*, was a story of both success and failure.

The heart of the book tells how homeowners, experts and government officials began to decry the environmental costs of the explosive growth of suburbia after World War II. Septic tanks failed, and suburbanites were shocked to see detergent foam flowing from kitchen faucets. Home construction on steep hills led to deadly landslides. Eroded soil from tract-house construction sites silted up nearby lakes. For many reasons, floods became more frequent in fast-developing areas.

In every case, the critics sought government action to address the problems they saw. The result was an unprecedented effort in the 1960s to protect open space and regulate development. That was the good news in the book. But of course sprawl did not stop in 1970—or 1980 or 1990 or 2000. That was the bad news. In my conclusion, I considered why Americans haven't done more to support green development.

Though Dr. Earth Day and Mr. Apocalypse cooperated for a time, they soon went their separate ways. In my second book, my booster personality took charge. I decided to write a history of the first Earth Day, and the story turned out to be even more amazing than I expected. In September 1969, Senator Gaylord Nelson of Wisconsin promised to organize "a nationwide teach-in on the environment" in the spring and his call to action ultimately inspired more than 12,000 Earth Day celebrations across the nation.

Those events had a freshness and intensity that are difficult to imagine today. Because Earth Day 1970 was unprecedented, the organizers had to plan everything from scratch, and the organizing work often was life-changing.

Tens of thousands of people spoke on Earth Day—and many had never spoken publicly about environmental issues before. The discussions at Earth Day teach-ins sometimes were soul-searching: Many participants were struggling to get to the roots of "the environmental crisis."

The events truly made history. Earth Day built a lasting eco-infrastructure—national and state lobbying organizations, environmental studies programs, environmental beats at newspapers, eco-sections in bookstores, community ecology centers. Thousands of organizers and participants decided to devote their lives to the environmental cause. Earth Day gave birth to the first green generation.

But every day is not Earth Day, as Mr. Apocalypse likes to say. After five years of feel-good research, I now am ready to let my darker personality be my muse. My third book aims to answer a simple yet discomfiting question: Why do we have environmental problems?

Some of the reasons are quite recent, and some go back a long time. We accept environmental degradation as the price of progress. For centuries, most Americans believed that taming the wilderness was a religious and patriotic duty, and that idea still has considerable power. We have come to imagine that "nature" is just a small group of amenities, not the complex totality that sustains all life. The culture of consumerism encourages us to have infinite desires—and those desires press harder and harder on a finite planet. We believe that the world is ours to use as we see fit: We are the Lords of Creation. Though we love some aspects of nature, we hate others, and we have worked relentlessly to destroy the elements of nature that we find hateful. We value the Earth primarily as a source of wealth.

That list is just a start, so the biggest challenge of the project will be picking the most important reasons why we have environmental problems.

And then what? I'm sure that Dr. Earth Day and Mr. Apocalypse will pull me this way and that way when I begin to ponder a fourth book. At least both personalities are constructive. Because the environmental challenges we face often seem overwhelming, we need the kind of hope that Dr. Earth Day offers. But we also need to see clearly what's wrong, and pointing to difficult truths is the forte of Mr. Apocalypse. Though having multiple personalities isn't usually ideal, I can't complain.

ABOUT THE AUTHOR: Adam Rome is a member of both the history and English departments, and he teaches courses in environmental history and environmental non-fiction. His first book, *The Bulldozer in the Countryside,* won the Organization of American Historians' Frederick Jackson Turner Award. *The Genius of Earth Day* was published this past spring. Rome earned his B.A. from Yale and his Ph.D. from the University of Kansas.

PHOTO OF ADAM ROME: AMBRE ALEXANDER ILLUSTRATION: DAVID BARCZAK WITH CONTENT FROM NASA.GOV

Geography of memory

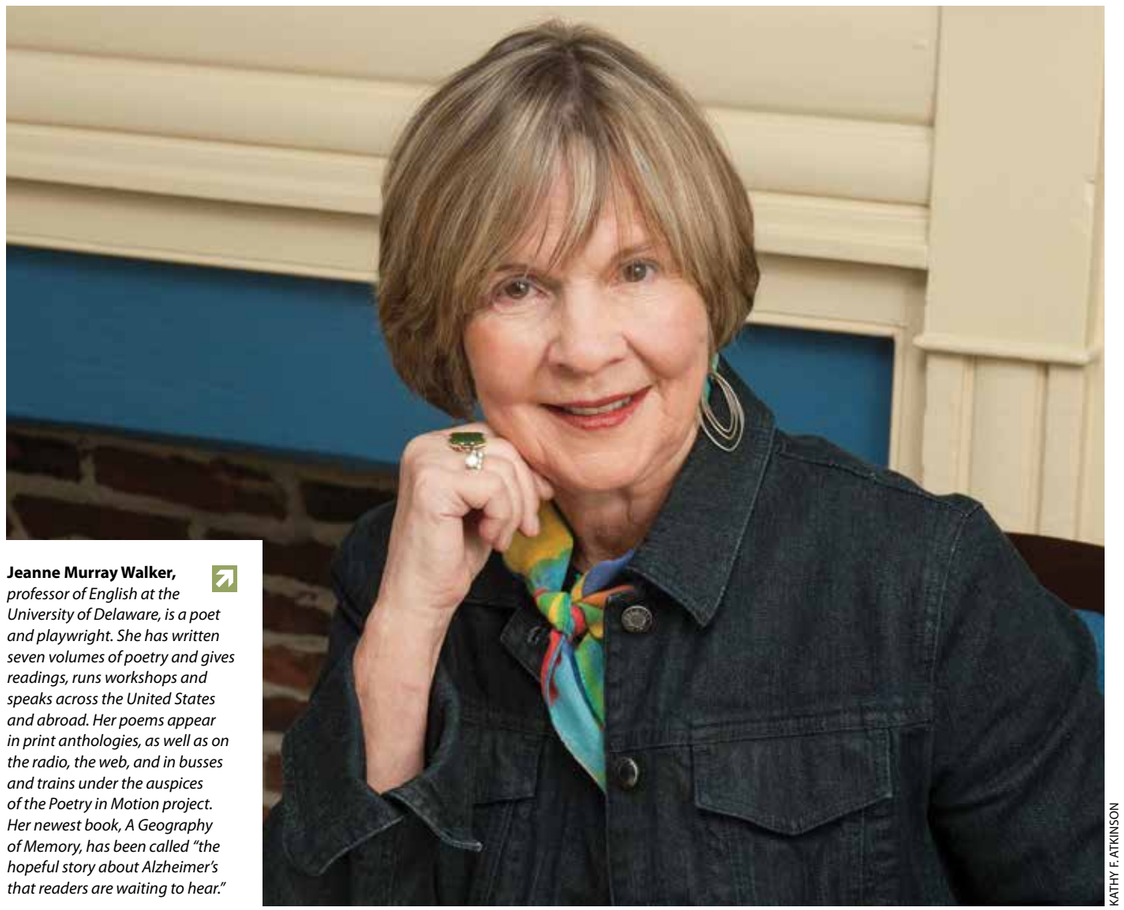
UD author's memoir explores her family's experience with a perplexing disease

by Kelley Bregenzer

Jeanne Murray Walker smiles as she recalls how her mother, who suffered from dementia, foiled every doctor she visited.

"She was never technically diagnosed with Alzheimer's," says Walker, professor and head of creative writing in the Department of English. "The doctors would give her the Alzheimer's test, but she always found some clever way to subvert it."

Erna Aderhold Murray Kelly,
Walker's mother, is pictured above.



KATHY F. ATKINSON

Jeanne Murray Walker, *professor of English at the University of Delaware, is a poet and playwright. She has written seven volumes of poetry and gives readings, runs workshops and speaks across the United States and abroad. Her poems appear in print anthologies, as well as on the radio, the web, and in busses and trains under the auspices of the Poetry in Motion project. Her newest book, A Geography of Memory, has been called "the hopeful story about Alzheimer's that readers are waiting to hear."*

Walker's memoir, *The Geography of Memory: A Pilgrimage Through Alzheimer's*, is a deeply personal account of her mother' battle with the bleak disease. Walker describes the difficulties, as well as the significant gifts, that came along with taking care of her mother.

"The conversation about Alzheimer's in this country is ruled by hysteria," Walker says. "No wonder people are sometimes so terrified of the disease that they abandon their aged parents. This memoir offers a less catastrophic view than most books about Alzheimer's."

Walker weaves together three different strands in the memoir. One strand focuses on the day-to-day challenges she faced as a caregiver. A second strand narrates pieces of her own history as an adolescent—memories triggered by spending time with her mother. The third strand is a series of reflections on the topic of memory.

"Caregivers encounter many problems, including problems with time, problems with money, problems with geography. There is no textbook to solve these problems," says Walker.

On top of practical problems, Walker confronted the disturbing "role reversal" that happens when a child must take care of a parent.

For instance, Walker worried about her mother's finances, while her mother, a notoriously private woman, fought to keep her personal information from her daughters.

The memoir recounts Walker's growing realization that the bond forged by caring for her mother was leading to new insights into both herself and her mother.

"My mother frequently said things that appeared not to make any sense in the situation, but I came to realize they were sometimes perceptive and revealing metaphors about her past," she explains.

In addition to exploring the dynamic relationship with her mother, Walker reflects on how her relationship with her sister also changed as a result of the family's confrontation with Alzheimer's.

After spending years separated by geography, Walker found that her increasingly frequent trips from Philadelphia to Dallas to visit her mother and sister brought their worlds closer together.

This new connection did not always go smoothly. Years earlier, when Walker had moved to the East Coast and her sister followed their mother to Dallas, a divide formed between the sisters. They lived completely different lives in culturally different areas.

"After you live for years in different regions of the country, you don't know each other as well as you did as children," she notes.

Faced with the unpredictable task of taking care of their mother, Walker realized that although she and her sister had chosen different paths, they now walked together on the same journey.

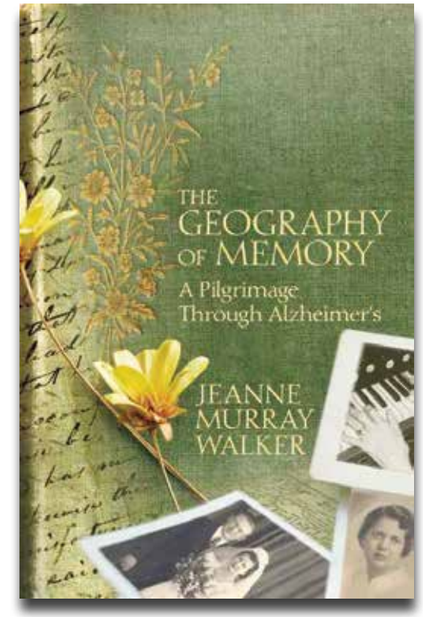
More than 20 million adult children in America take care of a parent with Alzheimer's. Many of them share the task with a sibling. *Geography of Memory* tells the story of how siblings might struggle with one another over the task, but can ultimately reach peace and a new relationship.

"Taking care of my mother, I got to know my sister again," says Walker. "It was a surprise and a gift."

Ironically, at the time of Walker's mother's death, the family was once again separated by geography. The memoir begins in a Paris hotel room, where Walker must decide either to fly back to Dallas for her mother's burial or stay and continue teaching a study abroad class in London.

While writing this researched reflection on the subject of memory, Walker received a sabbatical and a travel grant from the dean of the College of Arts and Sciences at UD. She flew back to Dallas to doublecheck the accuracy of her own memories.

"I am not only grateful for the financial support," she says, "But to be given such an expression of faith in the project was a real boost."



"My mother was a vibrant, funny woman, who faced remarkable challenges," *says Walker.*

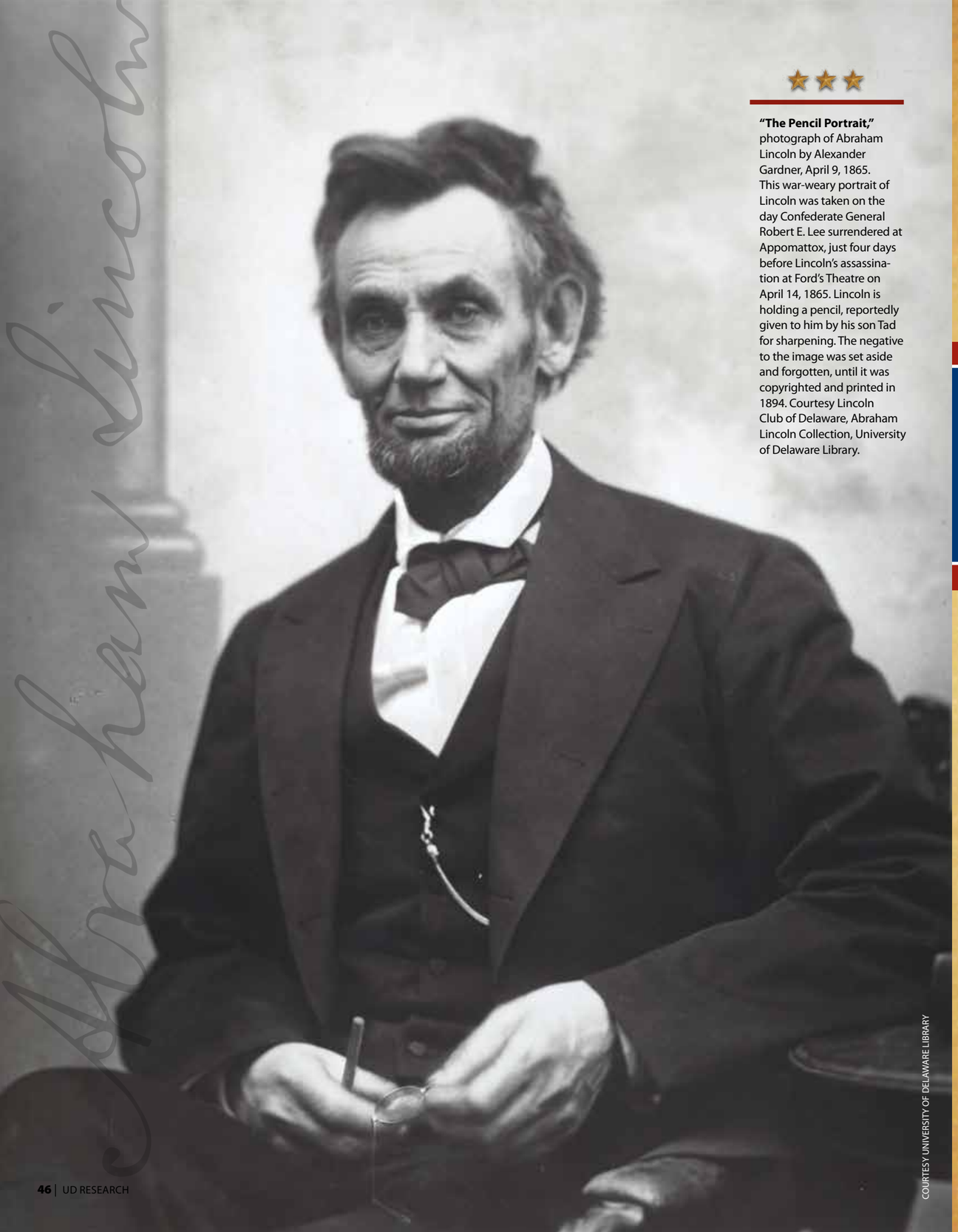
Ultimately, Walker wrote the memoir to honor her mother.

"My mother was a vibrant, funny woman, who faced remarkable challenges," says Walker, "a woman of great fortitude and also a woman of faith."

Walker found it difficult to write one of the last chapters of the memoir. She was not sure she wanted to record her mother's final, startling incoherence.

She decided to tell her mother's story just as she lived it.

"Now I can say that as my mother journeyed more deeply into the land of Alzheimer's, she was always still a person," she writes, "still herself, still my mother."



"The Pencil Portrait," photograph of Abraham Lincoln by Alexander Gardner, April 9, 1865. This war-weary portrait of Lincoln was taken on the day Confederate General Robert E. Lee surrendered at Appomattox, just four days before Lincoln's assassination at Ford's Theatre on April 14, 1865. Lincoln is holding a pencil, reportedly given to him by his son Tad for sharpening. The negative to the image was set aside and forgotten, until it was copyrighted and printed in 1894. Courtesy Lincoln Club of Delaware, Abraham Lincoln Collection, University of Delaware Library.

COURTESY UNIVERSITY OF DELAWARE LIBRARY

An act of LIBERTY

"When you are dead and in Heaven, in a thousand years that action of yours will make the Angels sing your praises I know it."

— Hannah Johnson, mother of an African American soldier, writing to President Abraham Lincoln about the Emancipation Proclamation, July 31, 1863

COURTESY U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION

Marking the Emancipation Proclamation's 150th anniversary

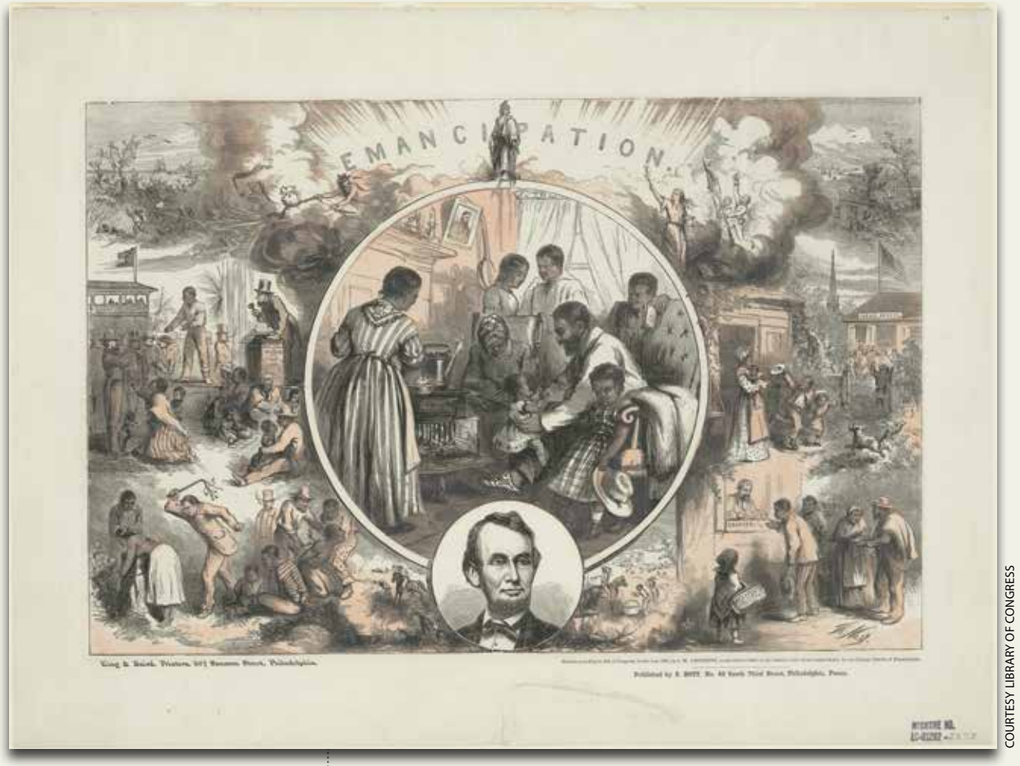
By Ann Manser

Marking the 150th anniversary of such a pivotal American document as the Emancipation Proclamation clearly seemed to require input from a large number of academic experts across a range of disciplines, said Anne Boylan, professor of history at the University of Delaware.

Fortunately, she said, the UD faculty has that kind of breadth and depth of specialization in a variety of subjects that relate to slavery, emancipation and the domestic and global legacies of both. As a result, the initial idea of organizing a symposium or hosting a few lectures expanded into a semester-long series of events, UD's Emancipation Semester, held during spring 2013.

"The University of Delaware has some renowned scholars on these subjects, not just historians but also experts in literature and public policy and other areas," said Boylan, who also is a professor of women and gender studies and who was instrumental in creating the Emancipation Semester. "When you look at this larger picture of scholarship that all fits together, we decided to bring it into a semester focusing on emancipation."

Anne Boylan, *professor of history and women and gender studies, was a major force in creating UD's Emancipation Semester this past spring.*



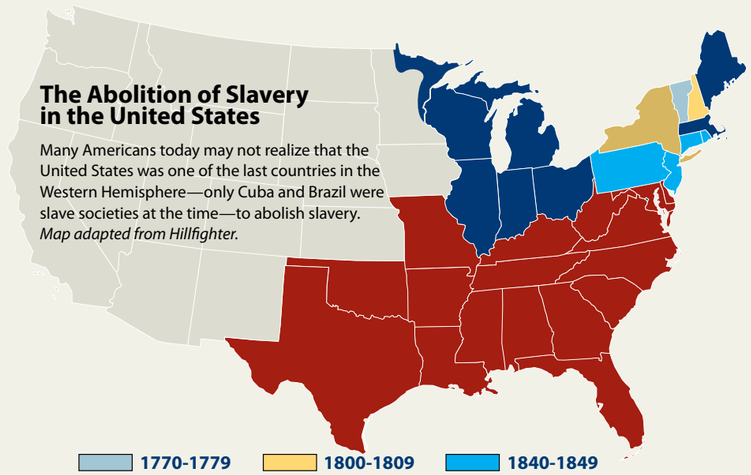
COURTESY LIBRARY OF CONGRESS

Celebrating an Act of Liberty

This Thomas Nast illustration, first published in *Harper's Weekly* on Jan. 24, 1863, celebrates the Emancipation Proclamation and imagines its dramatic impact on the South. At left, slaves are being whipped and sold. At right, black children go to public school, and black farmers earn pay for their work. At center, a black family enjoys life together in front of a stove labeled "Union" and before Abraham Lincoln's portrait. *Source: Emancipation Digital Classroom*

The Abolition of Slavery in the United States

Many Americans today may not realize that the United States was one of the last countries in the Western Hemisphere—only Cuba and Brazil were slave societies at the time—to abolish slavery. *Map adapted from Hillfighter.*

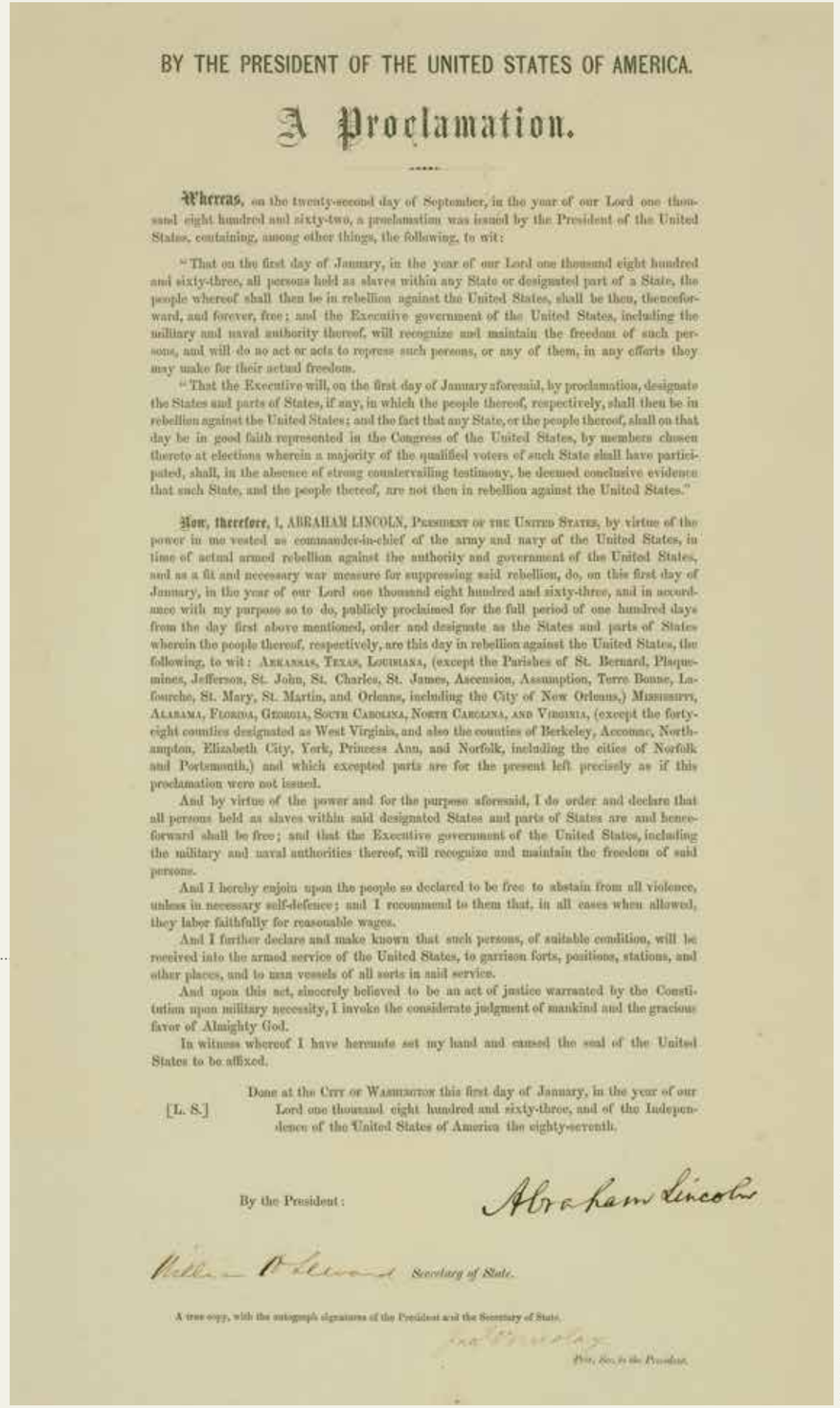


Emancipation Proclamation

Among the most significant items in the Lincoln Collection at the University of Delaware Library are one of 20 copies in existence of the Emancipation Proclamation (shown at right)) and one of only four copies of the 13th Amendment—both signed by Lincoln.

On Jan. 1, 1863, President Abraham Lincoln issued the Emancipation Proclamation, which declared that slaves in the Confederate states, with the exception of Tennessee, southern Louisiana and parts of Virginia, were now free. It also announced the Union's intention to enlist black soldiers. By 1865, black soldiers made up 10 percent of the Union army.

Visit UD Library's The Lincoln Collection



BY THE PRESIDENT OF THE UNITED STATES OF AMERICA.

A Proclamation.

Whereas, on the twenty-second day of September, in the year of our Lord one thousand eight hundred and sixty-two, a proclamation was issued by the President of the United States, containing, among other things, the following, to wit:

"That on the first day of January, in the year of our Lord one thousand eight hundred and sixty-three, all persons held as slaves within any State or designated part of a State, the people whereof shall then be in rebellion against the United States, shall be then, thenceforward, and forever, free; and the Executive government of the United States, including the military and naval authority thereof, will recognize and maintain the freedom of such persons, and will do no act or acts to repress such persons, or any of them, in any efforts they may make for their actual freedom.

"That the Executive will, on the first day of January aforesaid, by proclamation, designate the States and parts of States, if any, in which the people thereof, respectively, shall then be in rebellion against the United States; and the fact that any State, or the people thereof, shall on that day be in good faith represented in the Congress of the United States, by members chosen thereto at elections wherein a majority of the qualified voters of such State shall have participated, shall, in the absence of strong countervailing testimony, be deemed conclusive evidence that such State, and the people thereof, are not then in rebellion against the United States."

Now, therefore, I, ABRAHAM LINCOLN, President of the United States, by virtue of the power in me vested as commander-in-chief of the army and navy of the United States, in time of actual armed rebellion against the authority and government of the United States, and as a fit and necessary war measure for suppressing said rebellion, do, on this first day of January, in the year of our Lord one thousand eight hundred and sixty-three, and in accordance with my purpose so to do, publicly proclaimed for the full period of one hundred days from the day first above mentioned, order and designate as the States and parts of States wherein the people thereof, respectively, are this day in rebellion against the United States, the following, to wit: Arkansas, Texas, Louisiana, (except the Parishes of St. Bernard, Plaquemines, Jefferson, St. John, St. Charles, St. James, Ascension, Assumption, Terre Bonne, Lafourche, St. Mary, St. Martin, and Orleans, including the City of New Orleans,) Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, and Virginia, (except the forty-eight counties designated as West Virginia, and also the counties of Berkeley, Accomac, Northampton, Elizabeth City, York, Princess Ann, and Norfolk, including the cities of Norfolk and Portsmouth,) and which excepted parts are for the present left precisely as if this proclamation were not issued.

And by virtue of the power and for the purpose aforesaid, I do order and declare that all persons held as slaves within said designated States and parts of States are and henceforward shall be free; and that the Executive government of the United States, including the military and naval authorities thereof, will recognize and maintain the freedom of said persons.

And I hereby enjoin upon the people so declared to be free to abstain from all violence, unless in necessary self-defence; and I recommend to them that, in all cases when allowed, they labor faithfully for reasonable wages.

And I further declare and make known that such persons, of suitable condition, will be received into the armed service of the United States, to garrison forts, positions, stations, and other places, and to man vessels of all sorts in said service.

And upon this act, sincerely believed to be an act of justice warranted by the Constitution upon military necessity, I invoke the considerate judgment of mankind and the gracious favor of Almighty God.

In witness whereof I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the City of Washington this first day of January, in the year of our Lord one thousand eight hundred and sixty-three, and of the Independence of the United States of America the eighty-seventh.

[L. S.]

By the President:

Abraham Lincoln

William H. Seward, Secretary of State.

A true copy, with the autograph signatures of the President and the Secretary of State.

Asst. Secretary of State.

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Leland Ware

"It was a very important symbol that may have turned the tide of the Civil War." —Leland Ware

President Lincoln issued the Emancipation Proclamation on Jan. 1, 1863, as an executive order declaring that all slaves held in the Confederate states at war with the Union were freed. Because the proclamation didn't apply to border states like Delaware, for example, where slavery continued but which never seceded to join the Confederacy, it was in many ways only symbolic, said Leland Ware, UD's Louis L. Redding Chair and Professor for the Study of Law and Public Policy.

"But it was a very important symbol that may have turned the tide of the Civil War," Ware said in a talk at UD's Emancipation Symposium in April, one of the culminating events of the semester.

Other featured speakers at the symposium were UD faculty members Peter Kolchin, Henry Clay Reed Professor of History, and Jonathan Russ, associate professor of history.

Kolchin specializes in 19th-century U.S. history, the South, slavery and emancipation, and has written comparative histories of U.S. slavery and Russian serfdom. Throughout history, he said, "War frequently weakened slaveholder regimes," and that happened in the American Civil War as well.

"It increasingly became a war about slavery," Kolchin told the symposium audience. "If not for the Civil War, the United States might have outlasted Brazil" as the last Western nation to abolish the practice.

Russ, who specializes in the history of Delaware and of modern American business, spoke about the legacies of emancipation in 19th- and 20th-century Delaware. He began his talk by telling the audience, "Delaware is a peculiar place" that "plays a central role in the history of American emancipation."

Before the Civil War, he said, Delaware had Quaker and Methodist traditions that helped African Americans establish churches and community organizations, and the state remained loyal to the Union.

But, he noted, "Delaware was not at all progressive when it comes to race relations," with some 1,800 slaves held during the Civil War and not freed until the 13th Amendment—which the state never ratified until 1901—took effect nationwide in December 1865.

Events held earlier in the semester included the history department's regularly scheduled History Workshop series of presentations and a campuswide course, with weekly speakers, co-sponsored by the departments of Women and Gender Studies and of Black American Studies. The workshop series and the course were open to the public; both focused on the theme of emancipation and its many dimensions.

A small sampling of the UD experts who participated in one or both of the series were P. Gabrielle Foreman, Ned B. Allen Professor of English, whose lecture concerned the poetry written on clay vessels by a then-slave known as Dave the Potter; J. Ritchie Garrison, professor of history and director of UD's Winterthur Program in American Material Culture, who spoke about black regiments that fought in the Charleston, S.C., area during the Civil War; Adrian Lopez-Denis, assistant professor of history, who discussed the legacies of abolition in the Spanish Caribbean; and Arica Coleman, assistant professor of Black American Studies, whose talk was titled "Black Slavery and Emancipation in Indian Country."

Also during spring semester, the University of Delaware Library featured an exhibition, "Emancipation and Its Legacies," where visitors could view documents and materials from the Lincoln Collection in the library's Special Collections.

Dig Deeper

As part of its Emancipation Semester website, the UD Department of History has developed a resource webpage with history podcasts and other multimedia, lesson plans and links to other helpful sites. To learn more, visit

sites.udel.edu/emancipationsemester


DUANE PERRY

Speakers at UD's Emancipation Symposium included, from left, Brett Gadsden, a professor of African American studies at Emory University; Natasha Trethewey, U.S. poet laureate and Robert W. Woodruff Professor of English and Creative Writing at Emory; and UD professors Peter Kolchin and Jonathan Russ.

TEST YOUR KNOWLEDGE

BATTLE OF GETTYSBURG

The Battle of Gettysburg, July 1–3, 1863, involving more than 160,000 troops, was a major turning point in the Civil War. What do you know about the battle and the Pennsylvania town where it was fought? On the sesquicentennial of the historic conflict, we test your knowledge.

1. The battle resulted in staggering losses for both the Union and Confederacy. How many total casualties (soldiers killed, wounded, captured or missing) resulted from the battle?

a. 51,112 **b. 25,263** **c. 10,081**

2. A professor of religion and modern languages at Bowdoin College before the war, this colonel was one of the Union's most celebrated officers, leading the Twentieth Maine in the defense of Little Round Top.

a. A. P. Hill **b. Joshua L. Chamberlain** **c. Winfield Scott Hancock**

3. The geology of the Gettysburg area was a major factor in the battle and its outcome, with boulders and rocks, such as those that formed Devil's Den, scattered across the landscape. What kind of rock is it?

a. granite **b. coal** **c. jasper**

4. When were the last soldier's remains found on the battlefield?

a. July 4, 1898 **b. March 19, 1996** **c. January 1, 2013**

5. This horse was Confederate General Robert E. Lee's favorite. A gray gelding with a black mane and tail, he survived Gettysburg and many other battles and went with Lee when he became president of Washington College (later renamed Washington and Lee University) in Virginia after the war. In 1871, not long after Lee's death, the horse contracted tetanus after stepping on a nail and was buried on the campus.


THE NEW STUDENT'S REFERENCE WORK

a. Old Baldy **b. Traveller** **c. Virginia**


COURTESY LIBRARY OF CONGRESS

▲ *This photograph shows* **Abraham Lincoln** *(within brackets) just after he arrived at Gettysburg on Nov. 19, 1863. A few hours later, he would deliver the Gettysburg Address.*

6. The Union prisoners of war captured during the battle would be sent to Richmond, Va., where officers initially went to Libby Prison and the enlisted men to Belle Isle. Many were transferred to other prisons later, including Andersonville. Where were many of the captured Confederates imprisoned?

a. Fort McHenry **b. Elmira Prison** **c. Fort Delaware**

7. This statesman delivered a two-hour oration prior to Abraham Lincoln's famous address at the dedication of a new national cemetery at Gettysburg on Nov. 19, 1863. He later wrote to Lincoln: "I should be glad, if I could flatter myself that I came as near to the central idea of the occasion, in two hours, as you did in two minutes."

a. Edward Everett **b. William Lloyd Garrison** **c. Frederick Douglass**

◀ **Marie Tepe,** *a female Union soldier, was among the women who fought at the Battle of Gettysburg. She reportedly wore a .44 caliber pistol on her hip and a uniform she made herself.*

8. This woman wore a riding dress with two small pistols in her belt and was awarded the Kearney Cross for bravery at the Battle of Gettysburg. Who was she?

a. Lorinda Ann Blair
b. Clara Barton **c. Indian Eve**

9. These two soldiers ranked at the bottom of their respective West Point graduating class (a position called "the Goat"), but figured significantly in the battle. Who were they?

a. Robert E. Lee and Ulysses S. Grant
b. Abner Doubleday and Joseph Hooker
c. George Custer and George Pickett

10. Surviving veterans of the Battle of Gettysburg gathered in the Pennsylvania town on the battle's 50th anniversary in 1913 to reminisce and to be honored by various dignitaries, including President Woodrow Wilson. How many veterans were there?

a. 53,407 **b. 1,221** **c. 100,648**

ANSWER 1—a 2—b 3—a 4—b 5—b 6—c 7—a 8—a 9—c 10—a

The CURIOSITY SHOP

Can you identify these mystery objects?

Hillary Murtha, who earned her Ph.D. and M.A. in history at UD, knows what they are. You'll find them in her blog, The Meanings of Things. "It gives me a chance to do what I love: examine objects, research, interpret and write about them," she says. For more fascinating fun, check out **themeaningsofthings.org**.

OBJECT 1

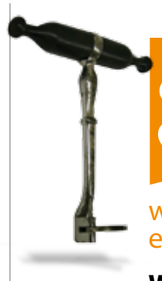
A specialized dining object, without which no proper Victorian laid table could be complete.

What it is: This is Edward Gleason's 1860 patented "magic castor." "Castors," so named because they cast their contents forth, originated in early 18th-century England. They began as simple stationary metal frames containing bottles for condiments: salt, pepper, oil, vinegar, sometimes mustard, and even soy sauce, new to Europe from the East. The singular term "castor" referred to the entire set of objects: metal frame and glass bottles. By the beginning of the 19th century, well-to-do Americans considered silver castors a necessary adjunct on their dining tables. *Image courtesy Brooklyn Museum, H. Randolph Lever Fund, 87.175.1-.7a-b.*

OBJECT 2

It is about 6 inches high and a little over 2 inches in diameter. It's made of pine, turned on a lathe.

What it is: This is an early example of a stethoscope. Although the idea that the sounds produced by organs in the human body can help a physician diagnose a patient's ailments dates as far back as the writings of Hippocrates in 350 B.C., it was not until the late 18th century that Western doctors began to examine their patients' bodies so closely. *Image courtesy of the North Carolina Department of Cultural Resources*



OBJECT 3

In the 19th century, a lot of people would have come into contact with this object, and they wouldn't have enjoyed the experience one bit.

What it is: This is an early example of a tooth extractor, also known as a "tooth key." It's 4.25 inches wide at the handle, and 5.25 inches long. *Image courtesy of the Museum of Early Trades and Crafts*

OBJECT 4

It raises the nap on woolen cloth and creates a soft, almost furry texture on one side.

What it is: This object is an example of a teasel cross, or, as it was also called, a teasel hand. Europeans have used the dried seed heads of the teasel plant to raise the nap on woolen cloth, and in the 18th century, the plant was introduced to the American colonies. Baize, the cloth traditionally used to cover billiard and card tables, is a classic example of wool that has been teased. *Image courtesy of the Museum of Early Trades and Crafts*

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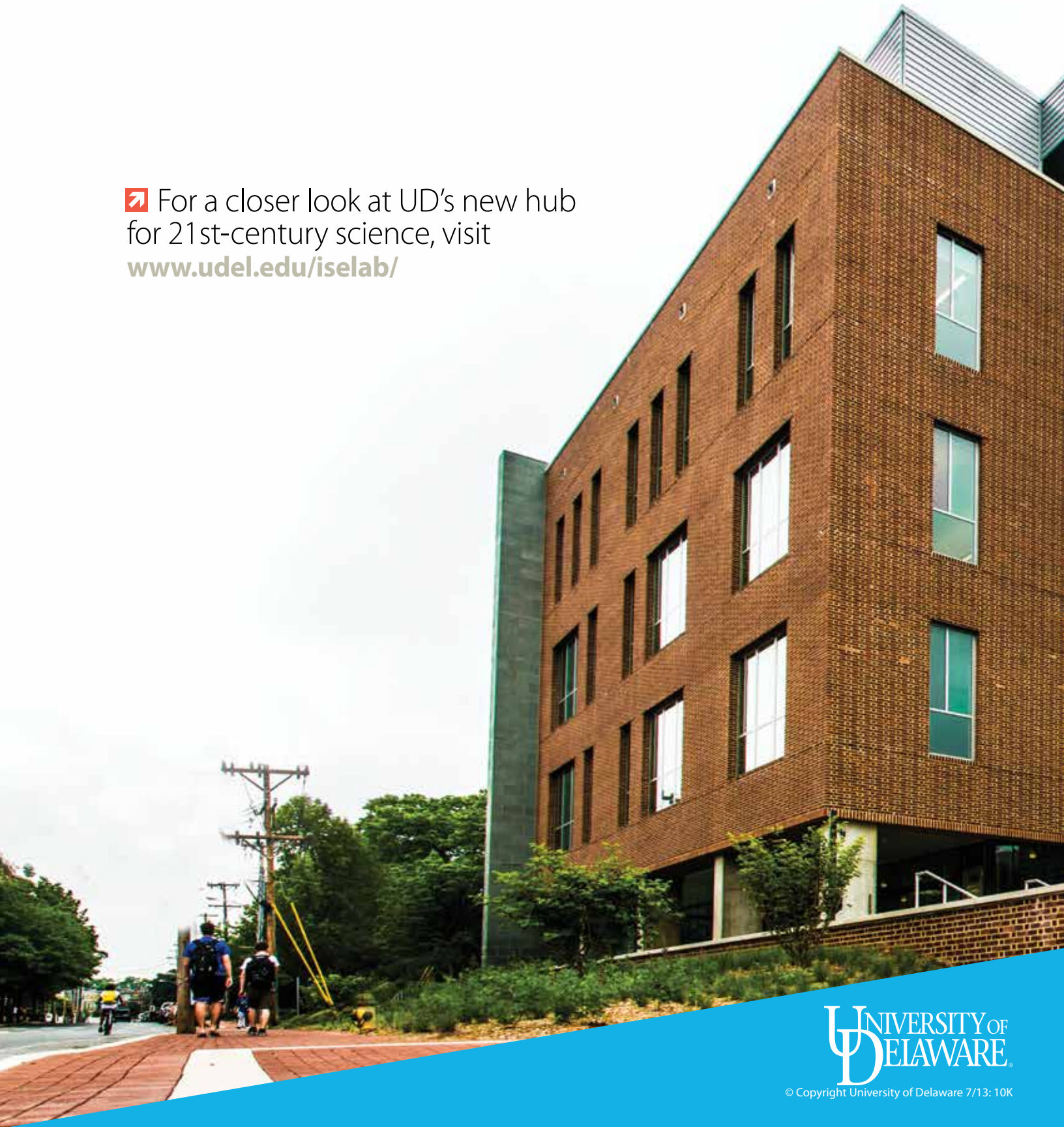

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