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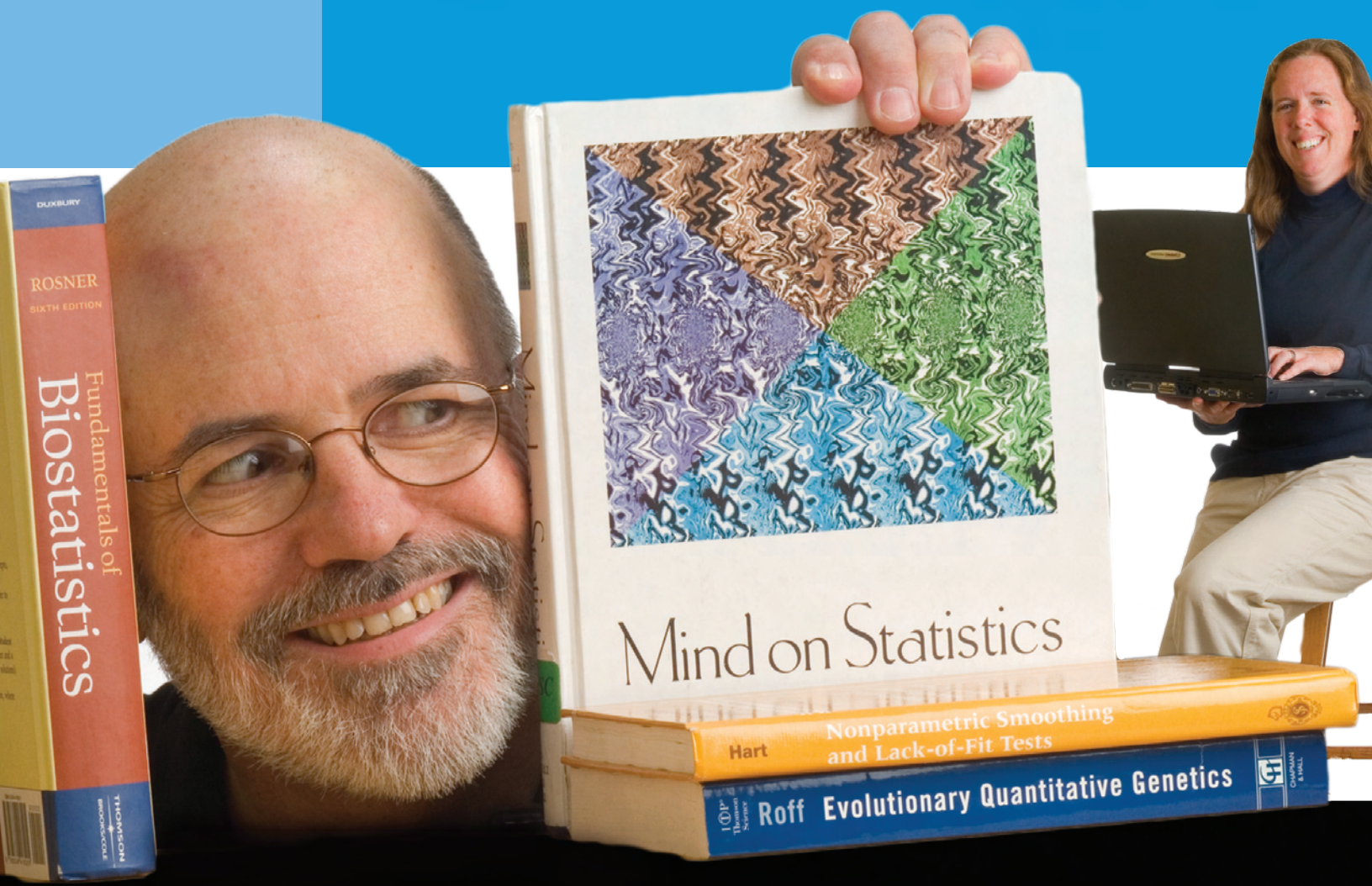

2007 APEX® AWARDS FOR PUBLICATION EXCELLENCE

EDITORIAL

SCIENCE ISSUES—Oceanographic Research

Humans have been a seafaring species since prerecorded history. As early as 3500 B.C. people were already building and routinely using boats to trade large volumes of goods across the seas. However, throughout all these years of crossing the waves, scientific study has barely penetrated more than a few dozen feet below the surface of the ocean. In depths of nearly seven miles, vast and complex environments lie in wait that absolutely must be studied, lest we miss out on some of the most important potential discoveries in generations.

Entire ecosystems exist on the ocean floor that few humans have ever seen. These biomes teem with life, home to everything from bacteria that thrive in boiling hot sea vents, to the legendary giant squid that grow to more than 60 feet long. A single expedition to the rich oceans off the coast of Antarctica recently discovered more than 600 new species. Scientists believe that anywhere from 100,000 to 100 million new species of plant and animal life still await discovery in the deep. It is safe to say we know more about the stars and planets hundreds of light years away than we do about our own oceans and seas.

Tragically, the government seems content with these colossal gaps in scientific knowledge. In 2008, the National Oceanic and Atmospheric Administration (NOAA), the primary U.S. agency for undersea research, received just $3.8 billion for all of its operations and research, a fraction of even the National Aeronautics and Space Administration's (NASA) paltry budget. This oversight is frustratingly myopic. Some of the exotic species of life under the waves would almost certainly yield new drug treatments and medicines, possibly even new energy or food sources. On a more global scale, the oceans can be one of the first indicators of global climate change. However, because they are so poorly understood, the warning signs could fly right past us.

In the spring of 2007, NASA unveiled a prototype robot designed to explore the oceans that may exist underneath the icy surface of Jupiter's moon Europa. Though its mission to outer space is decades off, it has already been used to explore the depths of the world's deepest sinkhole, El Zacatón in Mexico, and will dive into the Antarctic Lake Bonney next year. This robot, dubbed "Clementine," suggests just some of the promise that a greater focus on oceanic exploration holds.

The innate drive to explore the unknown is one of the most important facets of human nature. On the practical side that drive leads to discoveries that can revolutionize people's lives, such as when explorers returning from the New World brought back corn, a crop that now helps feed billions of people all over the planet. Exploration itself is a source of inspiration to millions of people, driving them to achieve new heights and accomplish feats never before mastered. That is why names such as Lewis and Clark, Sir Edmund Hillary, Amelia Earhart, Neil Armstrong, and Jacques Cousteau will forever be a part of history. Exploration is fundamental to the betterment of society, but we need greater focus on exploring the world around us, starting with our oceans.

Michael Lucibella, journalism '08
Coeditor
ml1438a@american.edu

Please submit letters to the editor to catalyst.au@gmail.com.

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Mission Statement:

A catalyst, as defined by scientists, facilitates chemical reactions by bringing together substances that might not interact in its absence. Similarly, *Catalyst* is one place where all the sciences come together to relay exciting scientific developments happening at AU in the AU community and beyond. *Catalyst* is a semiannual magazine created to promote discourse and keep us up to date about how science at AU affects and inspires us all. Our mission is to: serve students and faculty in the sciences as a means to inspire, inform, and promote discourse; share news and accomplishments of students and faculty; inform students of timely and valuable opportunities; raise the profile of the sciences at AU; and expose students outside of CAS to exciting science classes.

Our success will be measured by how useful and informative you find this publication. So we want to hear from you!

Editors:
Grenye O'Malley, biochemistry '09
catalyst.au @gmail.com

Michael Lucibella, journalism '08
ml1438a@american.edu

Faculty Advisor:
Christopher Tudge
ctudge@american.edu

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ON THE COVER | Inspired by the film *The Shining*, the cover features AU professors Robert Jernigan and Elizabeth Malloy of the Mathematics and Statistics Department. Photo by Jeff Watts

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Photo by Jason Aldag

Amit Kapadia

NEW LEVEL OF COLORING INSIDE THE LINES

By Tony Romm, journalism '10

SEEING THE STARS WAS ALL IN A DAY'S work for **Amit Kapadia (CAP/MATH '07)** this past summer.

A double major in physics and mathematics, Kapadia was one of 20 students across the world invited to participate in a paid summer internship program in 2006 hosted by the Space Telescope Science Institute (STScI), a NASA-affiliated telescope operations center in Baltimore, Maryland.

Specializing in public outreach, Kapadia worked to locate and publish images taken by the Hubble Space Telescope.

"When [scientists] take observations, they have filters on the telescope for certain wavelengths," Kapadia said. "My job was to search the Hubble archives, [select] images and, essentially, recolor them, creating color composites to make the images appear as they really do."

But turning incomplete Hubble images into detailed depictions of the stars was no easy task, Kapadia explained. Possessing a background in art and a strong interest in science and math—not to mention some adept Photoshop skills—Kapadia finalized two images, both of which appear on the STScI Web site and Kapadia's personal Web page. The team released a picture a month.

Kapadia said that the help he received from his advisor, Nathan Harshman, a physics professor at AU, was invaluable in securing the position.

"I originally found the internship because of Professor Harshman," Kapadia said. "He provided resources for internships and supplied recommendation letters. I stumbled upon the internship while searching a Web site he suggested."

With his internship completed, Kapadia now focuses his efforts on his classes, including Group Theory in Physics, an independent study Kapadia said was also influenced by Harshman.

The study focuses on quantum systems and their rotations. The subject matter is a "foundation of atomic physics, chemistry, and nuclear physics," Harshman explained.

"I had received a grant from Research Corporation that allowed me to hire undergraduates, [and Kapadia] worked with me for a month," Harshman said. "As that research progressed, he found some of the connections to group theory very interesting."

Kapadia credited Harshman's expertise as another impetus for his independent study.

"I approached Professor Harshman with the idea [for the independent study], and he offered encouragement as well as endless amounts of references," Kapadia said. "He is actually an expert in group theory, so I knew he would be willing to do this with me."

"A lot of the texts are at the graduate level, so it is a lot to get through," Kapadia added. "But I like it."

Kapadia's interest, combined with his previous internship, could open quite a few doors for careers in the near future, Harshman said. Kapadia is eligible for jobs in areas as diverse as computer technology or the military-industrial research complex.

Kapadia, however, has more flexible options in mind.

"I want to work for a year and then go to grad school," Kapadia said, noting that

Supernova Remnant E0102 in the Small Magellanic Cloud

he wanted the year break to consider his options and find a career that makes full use of his math and physics skills. "I'm really interested in theory," he said. "Academia also sounds appealing, though it's very competitive."

His internship has helped him in other areas as well.

"My [work has] been good logic training," said Kapadia. "Even when I write papers, now, I can make more concise, logical arguments. Math and physics have helped me quite a lot."

Regardless of his career choice, Kapadia said his math and science skills have prepared him to maximize whatever future opportunities the stars may provide.

Photo courtesy of NASA, STSci, and the Hubble Heritage Project

CONTROLLING LIFE MAY CONTROL WEIGHT

By Inna Arnaudova, broadcast journalism '09

ARE THERE WAYS TO REDUCE THE RISK OF being overweight other than healthful nutrition and exercise?

An American University graduate student is studying whether participation in group therapy can help young girls prevent weight gain. **Deborah Glasofer (PSYCH)**, a doctoral candidate in clinical psychology, is conducting the study with the Unit of Growth and Obesity at the National Institute of Child Health and Human Development (NICHD).

"With all the research coming out about child and adult obesity, it is important to target the issue from a prevention point of view," says Glasofer.

She examines whether an increase in social and eating self-efficacy through group therapy will successfully prevent weight gain. Self-efficacy, according to her research advisor at American University, David Haaga, is "the adolescents' expectations that they can cope with stressors, manage their weight, etc."

Glasofer's hypothesis is that participation in the Weight Gain Prevention Program for Adolescent Girls will improve this self-efficacy. This builds on what she calls a "not very well-established concept" that boosting general self-efficacy can affect weight control.

"If controlling our self-efficacy helps us control weight gain, it is important to work on it," says Glasofer.

The program participants are girls between 12 and 17 years old whose weight is slightly above average. Researchers determined that these adolescents were also at risk of being overweight in the current environment of high-calorie diets and sedentary lifestyles.

Glasofer's research data are collected through behavioral observation and self-reports about the three types of self-efficacy: social, eating, and general. She also uses objective measures such as weight and body fat composition.

Glasofer says "it is important to know what to target" when dealing with the problem of obesity.

"Rates of obesity among adults, adolescents, and children are increasing in the U.S.A., and obesity can lead to psychological as well as a host of physical problems," says Haaga. A National Health and Nutrition Examination Survey from 1999 to 2002 showed that 16 percent of people 6 to 19 years of age are overweight. According to NICHD, the number of overweight children and adults has tripled in the past 30 years.

Glasofer says it is essential to act before obesity reaches a crisis level.

Glasofer is in her fourth year at American University. She received her bachelor's degree from Duke University in 2001. Later, she was a research assistant in the Eating Disorders Clinic at the New York State Psychiatric Institute for two years, where she helped women suffering from anorexia nervosa, a psychiatric eating disorder characterized by low weight, fear of weight gain, and a distorted body image.

Glasofer runs the groups in the prevention program together with Marian Tanofsky-Kraff, a postdoctoral fellow at NICHD.

REVISING HYPOTHESES, REALIZING DREAMS

By Jihane Abou Chabke, MA print journalism '08

ERIKA TROVATO (BIO) DID NOT LAND IN THE world of medicine by pure chance. The field has always fascinated her, and she finds it the best way to "apply her skills and grow as a person."

Currently a researcher at the National Cancer Institute of the National Institutes of Health in Bethesda, Maryland, Trovato is pursuing her master's in science at American University. At the institute she is one of four scientists looking into the significance of a certain gene in skin cancer. This unprecedented research involves observing different inflammation pathways as related to this disease.

"In cancer," Trovato said, "one of the known side effects is inflammation: that is when the immune system is reacting to skin cancer by sending in all of its different components."

The team she is working with—including John Simmons, Jyotsna Pandey, and Katie DeCicco-Skinner, also Trovato's AU advisor—started out looking at a gene, known as Map3k8, that team members thought was a mutated form of a cancer gene. They assumed that removing this gene from the body would prevent inflammation. To their surprise the tumors multiplied.

As a result, the team had to revise its original hypothesis and now thinks that Map3k8 is a tumor suppressor gene. The team is continuing its research into the gene using mouse models.

The frustration of such unexpected and constantly changing results does not seem to discourage Trovato. Keeping the main goal in mind is what helps any researcher overcome frustration and be flexible enough to shift gears frequently, she said.

"I think that in science, the most important thing is to remember the big picture," she said, "that you are a small part in a large venue, that you are working towards something that could potentially help millions and millions and millions of people."

This sensitivity and compassion, said DeCicco-Skinner, Trovato's mentor, are two traits that will enable Trovato to have a "wonderful bedside manner as a physician," in addition to her being "incredibly ethical, organized, disciplined, and self-motivated." Trovato's research is enabling her to learn about cancer from a biological and genetics perspective before she attends medical school and learns about it from a treatment perspective, according to DeCicco-Skinner.

Indeed, Trovato's next plan is to apply for medical school and specialize in dermatology.

After studying biology in undergraduate school, completing 24 science credits as part of a postbaccalaureate program at AU, and tackling the research side of medicine, Trovato said she is ready to apply for medical school.

"I'm young, and I want to do it now," she said. "I don't want to be 45 and realize that this is what I really wanted to do and didn't get to realize my life dream. Med school seems to be the best avenue where I can apply my skills. And being a very compassionate person, I want to be able to apply this in the best setting."

Photo by Michael Lucibella

Erika Trovato

SELF-IMAGE DOESN'T AFFECT ONLY YOU

By Robert Soos, CAS '09

CAN THE WAY WE FEEL ABOUT OUR BODIES affect how we react to social interactions? Research done by **Nicholas Forand (PSYCH)**, a third-year PhD student in clinical psychology, would certainly support that idea.

Forand described the research process he used to study the effect: "We tested a sample of individuals about their body image and then had them report on their daily social interactions for a week. Once we gathered our data, we compared the answers of people who were highly invested in their bodies and those with negative body image to the average person."

The first group Forand looked at had high body image investment. These individuals heavily valued the way their body looked and spent time trying to improve it. The second group contained individuals who disliked their bodies. Forand hypothesized that in this group, the evaluation group, "individuals' social interactions would be affected because they expected negative evaluations."

Forand tested how these two perspectives on the world shaped the way people reacted to interactions. He collected his data through a process that lasted one week. It began with subjects taking a general body image questionnaire. Then, for the next week, they kept a Palm Pilot with them. After a social interaction, subjects pulled out the Palm Pilot and answered another questionnaire. This questionnaire provided detailed information on how they perceived and reacted to the social interaction.

The goal was to assess how body image affected the way people experienced both positive and negative interpersonal interactions.

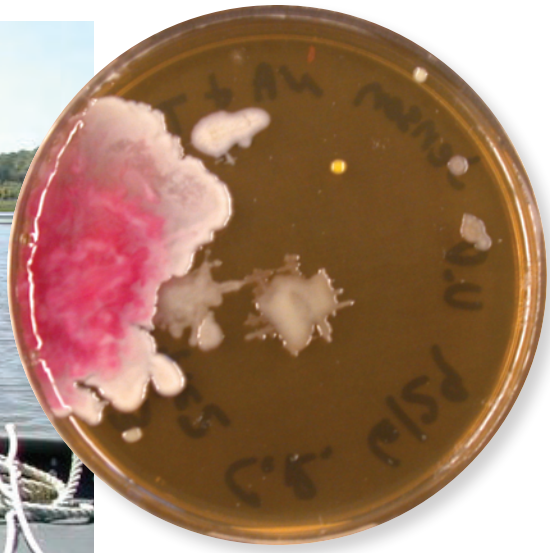
The evaluation group, those who had rather low body image, experienced more negative interpersonal reactions. "They actually perceived interactions as being colder and more negative than the average person, but didn't experience reactions to these perceptions (as in changes in mood or self-esteem) any different than average people," Forand reported.

Interestingly, the investment group—individuals heavily invested in their bodies—tended to feel extra positive or negative about themselves in response to interpersonal interactions. "It makes sense," said Forand. "Those are the individuals that care very much about what their body looks like, and when they get a positive reaction, it makes them feel better." Forand called the investment group "hypersensitive" to social interactions.

Forand believes his research will provide a better idea of how interpersonal functioning is affected by a negative body image. This research could lead to discoveries in the relationship between these responses and the development of psychopathology. Perhaps connections exist between an individual's interpersonal interactions and the emergence of an eating disorder or depression.

Photo by Caroline Fortunato

Ken Jensen



Bacterial colonies from Jensen's samples grown on an agar plate.

RESISTANT BACTERIA: FARM TO RIVER TO YOU

By Sasha Khan, MA SIS '09

AS AN UNDERGRADUATE STUDENT TAKING immunology and microbiology classes, **KEN JENSEN (BIO '07)** knew biology was his passion. It was this curiosity to discover the unknown about the smallest bits of life which led Jensen to apply to the master's program in biology at American University.

Now, thanks to two grants—the Helmlinge Grant from the biology department and the Mellon Grant from the dean of CAS—Jensen's research focuses on bacteria that most people pay no attention to until they get sick.

Jensen is researching bacteria in the Anacostia and Chester rivers (with AU biology professor Karen Bushaw-Newton) by isolating water samples from four different sites from each river where the bacteria are resistant to the antibiotic tetracycline. The Anacostia River is heavily polluted with industrial waste, and the Chester River is contaminated with agricultural and farm runoff. Tetracycline is most commonly used as a growth hormone in farm animals. This antibiotic makes its way into the environment through run-off or other means and into the rivers.

Jensen conducts this experiment by putting a small water sample on a nutrient medium infused with tetracycline for 72 to 96 hours and then inspecting the samples to see which ones have growing bacteria. Samples with growing bacteria contain antibiotic-resistant microbes. Once the bacteria are isolated, Jensen looks for eight different genes that code for resistance to the antibiotic.

"This is pertinent to show that as the next generations of stronger drugs are developed, bacteria will eventually find a way to be resistant to it," Jensen said.

Jensen thinks the cycle of producing stronger and stronger antibiotics will continue and that antibiotic-resistant bacteria are bound to find their way into the environment. He is also comparing the genes of the bacteria found in the two rivers to understand any similarities between the two.

"It's interesting how we don't even give a second thought to this issue until we get sick, and these genes can go into bacteria that cause disease which will make them even more resistant to antibiotics," Jensen said.

After graduating, Jensen plans to work and train at the National Institutes of Health.

STUDENT GIVES DIGITAL MEDIA A BOOST

By Hugo Mendoza, MA journalism and public affairs '08

AMERICAN UNIVERSITY GRADUATE STUDENT **MARISSA STUPCA (MATH)** is helping develop a new sampling technique, called the Projection Method, that could change how some digital media are developed.

Sampling processes read chunks of data and then reconstruct the data using a mathematical formula. Different theorems are used to do this, and they are developed depending on the bandwidth needed. Stupca explains: "Bandwidth is the amount of frequency needed to capture the entire signal. For sound, we usually use the range of human hearing since we have no reason to look at frequencies beyond that. However, pictures rely on a much greater amount of frequency, thus need an increase in bandwidth to accommodate them."

One theorem employed in sampling is called the Shannon Method, and another is the new Projection Method invented by Stupca's mentor, Stephen Casey, a professor in AU's Department of Mathematics and Statistics. With this new formula, "the number of samples taken is dependent on the bandwidth, so if the bandwidth increases, the [new] formula adapts by taking more samples," said Stupca.

The traditional Shannon Method currently used in digital media such as cell phones, the Internet, and compact disc players is fixed and too inflexible to meet the demands of today's consumer. The main problem with this formula is that "it is set on a bandwidth and cannot change to meet additional demands," said Stupca.

The Projection Method uses a more flexible formula developed in part to fill the demand for expanded cell phone use among consumers. Stupca hopes that it will one day be introduced into the market.

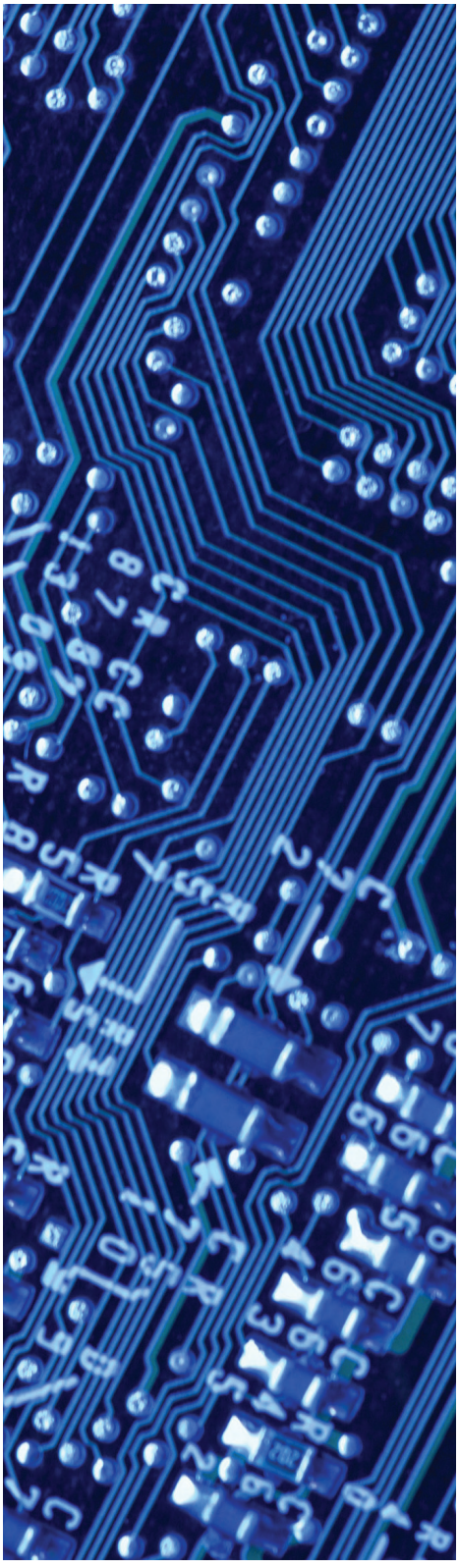
"This new Projection Method would change to meet the increased demand in bandwidth, which comes with using your phone for more than one thing," such as capturing video, taking photographs, recording audio, and playing MP3 files.

Consumers today want to do more than receive and place calls with their cell phones, said Stupca. "They want to talk on the phone; they want to send a photo; they want to do everything all at once."

The new sampling method will enable multipurpose cell phones and other communications devices to utilize more bandwidth as needed, and the quality of a photo taken with a cell phone, Stupca said, could be improved because the sampling rate adjusts automatically using all of the bandwidth available.

Stupca earned a bachelor's degree in mathematics from Syracuse University in 2005 and graduated from American University in May 2007 with a master's in mathematics. As part of her final project, she presented her work to students, faculty, and staff at AU's annual Robyn Rafferty Mathias Student Research Conference in March 2007.

"It's been really neat to work with something that's not even out there for anyone else to look at yet," she said.



ANSWERING "WHAT ARE THE CHANCES?"

By Kristen Luppino, mathematics/political science '10

NEIL PERKINS (STAT '07) HAS WORKED hard to get where he is today.

"No matter where you start from, if you're flexible, you're smart, and you roll with the punches, you'll end up in the right spot," said Perkins.

Perkins began his academic career while he was a soldier stationed at Fort Bragg, North Carolina. While there, he began taking night classes toward a degree in business administration at Campbell University in Fayetteville, North Carolina. After he received his bachelor's, he pressed on and earned a master's in mathematics from Fayetteville State, also in Fayetteville, North Carolina. While there, one of his mentors put him into contact with AU's math and statistics department. Perkins enrolled in AU's doctoral program. During his first year here, he began an internship at the National Institutes of Health to fulfill one of the requirements in his program. He said he felt productive while there and enjoyed his work, and so he continued working while earning his degree and ultimately authored a paper about his experience. Perkins said he enjoyed having an impact on his field.

Perkins works with the area under curves to determine the effectiveness of biomarkers. Biomarkers are indicators doctors use to test the likelihood of disease susceptibility. Cholesterol, for example, is used to identify the chances of a patient having a heart attack. A good biomarker is as accurate as possible and has the fewest false positives and false negatives. When diagrammed, a larger area under the curve means fewer false results and more accurate discrimination.

Perkins's work aims to give patients better care by providing the most accurate medical predictions possible. His work is funded by the NIH in the division of Child Health and Human Development under his mentor, Enrique Schisterman.

So, when Perkins is not mountain biking, competing in an adult hockey league, or playing with his two-year-old son, he is helping prevent and treat illnesses early by perfecting the prediction of diseases.

SCIENCE OF BIODIESEL: WHY AU'S SWITCH TO BIODIESEL IS ENVIRONMENTALLY (AND FISCALLY) FRIENDLY

By Claire Roby, environmental science '09

NEXT TIME AN AU SHUTTLE BUS DRIVES past, check for the requisite black cloud of smoke billowing out the back. Because of a groundswell of support for using biodiesel on campus, it may not be there.

Beginning this semester, AU's entire diesel shuttle bus fleet has been fueled with a biodiesel mixture. Biodiesel is a fuel made from a vegetable oil and petroleum mixture rather than pure petroleum. The fuel mixture that AU began with is called B20, which indicates a 20/80 mixture of vegetable oil and petroleum oil. According to Lindsay Madeira, then AU's sustainability coordinator, burning B20 causes a 15.7 percent reduction in carbon dioxide emissions, a global warming–causing greenhouse gas. B20 will also lead to an 18 percent reduction in particulate matter, the source of that black tailpipe cloud.

Each week a tanker truck comes to campus so that AU's buses can fill up. This is a time-saving change from the previous system of driving seven shuttle buses to Silver Spring each morning for fuel. Additionally, Mark Feist, assistant director for grounds, support services, and vehicle maintenance in Facilities Management at AU, calculates that AU stands to save about $7,000 every year under this new system.

AU's road toward alternative fuels has been a long one. Facilities Management has been watching the local options for years. More recently, Eco-Sense's Bikes & Biodiesel proposal for a more sustainable transportation system rallied students, faculty, and staff in support of a rapid switch to biodiesel. The group held many events last year highlighting the need for a more responsible transportation policy.

At one such event in March, called The Science of Biodiesel, interested students heard from Madiera and Andrew Brandt, a member of the National Biodiesel Board, that biofuels do not contribute to global warming because they are effectively "carbon neutral." Carbon released in biodiesel combustion equals the carbon that would be released had the plants degraded naturally. Conversely, when fossil fuels are burnt they release carbon into the atmosphere that had been sequestered underground for millions of years and would not have been released naturally. The combustion of fossil fuels leads to a net increase of carbon in the atmosphere while biodiesel does not.

Other students had a more hands-on experience with biodiesel at another March workshop sponsored by SIS and taught by Madeira. Undergraduate and graduate students made small test batches of biodiesel through a chemical process known as transesterification while CAS Professor Albert Cheh, who talks about biodiesel in his chemistry courses, stopped by to observe the process.

The students, faculty, and staff who have devoted time to learning about alternative fuels and helping the university revamp its transportation system are united by the common belief that global warming is a critical issue facing society and that AU has a responsibility to help create a healthy future for the planet.

Photo by Pete Roma

Juan Dominguez

TOO DOWN TO GET IT ON

By Kenneth Chamberlain, MA interactive journalism '08

SEXUAL BEHAVIOR IS NOT WHERE MOST researchers start looking to understand mental disorders such as drug addiction or depression. Juan Dominguez is different.

The brain mechanisms that are "responsible for the regulation of behaviors that maintain survival of the individual and species have been preserved through different species; sexual behavior is no different," said Dominguez, assistant professor of psychology at American University.

His goal as director of the university's Behavioral Neuroscience Laboratory is to uncover the "neurochemical and molecular mechanisms that mediate sexual behavior," discovering whether these same mechanisms are altered in addiction, depression, and other disorders associated with motivation.

Some of the symptoms of depression, for example, include a lack of interest in activities—including sex—that were once enjoyed, according to the National Institute of Mental Health. More specific to Dominguez's work, however, is the effect some treatments for depression can have on an individual's libido.

Although "people not undergoing such treatment might not see this as a problem," Dominguez said, "studies indicate that compliance with taking medication is decreased as a result of this side effect; patients' personal lives are impacted."

Society is also impacted. According to Mental Health America, a nonprofit advocacy group in Alexandria, Virginia, depression that is left untreated is as harmful as heart disease or AIDS to the U.S. economy, costing more than $43.7 billion in absenteeism from work (more than 200 million days lost from work each year), lost productivity, and direct treatment costs.

As a result of his research on the effects of antidepressants and other medications on sexual behavior, "pharmaceutical companies are often interested in data that I've published," Dominguez said. The Behavioral Neuroscience Laboratory, which the university funds through a grant from the Andrew W. Mellon Foundation, is also embarking on a specific study of the "neural mechanisms responsible for impaired libido" as a result of these medications, an area Dominguez studied before coming to AU. He received his PhD in behavioral neuroscience from the State University of New York at Buffalo.

Dominguez applies his knowledge of psychology to become an effective professor. "Not surprisingly," he said, "material [on behavioral neuroscience] fascinates me, but others may find it pedantic and dry. As a teacher, the thing that is most rewarding is when my students see the material as truly exciting, when I see that sparkle that tells me, 'Hey, this makes sense, I now know something that I did not know before.'"

"It is important to bring the material to life by interacting with the class, by truly challenging your students, and by engaging them in the process of critical thinking. In neuroscience there is a complex process termed neural

plasticity. An overly simplistic description of this term suggests that your brain is malleable and ever changing, so that whenever you experience something new the connections in your brain are different as a result of it. When students enter my class, I tell them that my goal is to change their brain . . . It's fun!"

Dominguez enjoys AU's balance between teaching and research, as well as its students. "As a researcher I am required to stay informed," he says. "This leads to my students also staying informed of the latest findings." His research is also helped because "teaching helps me stay focused on the bigger picture."

That bigger picture includes how sexual behavior can be used to better understand the nature of, and how to develop possible treatments for, addictive disorders.

Gender differences are also a key factor. Researchers have long known there are differences between the brains of males and females, Dominguez said. These differences include the mechanisms responsible for regulating reproductive behavior and how individuals react to illicit drugs. The "psychostimulant effects of drugs of abuse are different between males and females," Dominguez said. "Generally, females experience a stronger effect" than males.

Dominguez said that understanding these differences may benefit the development of drug addiction treatments. Although "where in the brain these differences are regulated is not entirely understood," it is part of the laboratory's work to try to map these differences.

STRING THEORY A BOON FOR MATHEMATICS

By Pavneet Singh, computer science/physics '10

AFTER EARNING HIS PHD FROM THE University of Oklahoma and a year of postdoctorate work at Stanford, Artur Elezi entered the young field of string theory, writing his final doctoral thesis on its mathematical aspects. He still focuses most of his research on string theory and on mirror symmetry–related problems.

"String theory basically means that the most elementary particles of the universe are one-dimensional loops called strings and not discrete particles" such as electrons, protons, neutrons, and quarks, Elezi explains. The different vibrations of these strings can produce all kinds of waves that cause the four basic forces of the universe: electro-magnetism, gravity, and strong and weak nuclear forces. He adds that to fully explain the universe, the theory requires ten dimensions, rather than the traditional four, the remainder of which are hidden.

Since its inception two decades ago, string theory has often been criticized within the scientific community. Critics such as Peter Woit, author of *Not Even Wrong*, have noted that string theory produces no substantial predictions that can be proved experimentally. Its supporters, including Elezi, maintain that it is still the "best theory in town."

Elezi says that while he is sensitive to criticisms, he is unconcerned whether string theory will win out in the long run. "It is for the physicists to lose sleep over it . . . . String theory has been a gift to math in disguise."

Because the theory is so complex, theorists "overflow" with predictions, leaving mathematicians to actually prove all their statements. Elezi says physicists' theories sometimes seem to come out of the blue, but when mathematicians set about actually trying to prove them, they are able to substantially advance the field of mathematics. Had it not been for string theory, some of the most challenging problems in mathematics would have taken much longer to be solved, if at all.

Elezi also has innovative views on how a math class should be conducted in a liberal arts institution like American University. After teaching here for five years, he says he has realized that many students take only one math course in their entire college life.

"We should make this experience of students so comfortable and pleasant that when they talk to their kids, they don't tell them that math is really terrible and that they had an awful college experience with it, but that it is really fun and exciting if taken in the right spirit," Elezi says.

Asked what techniques he uses to excite students, Elezi picks up a copy of Jerry Seinfeld's *Seinlanguage* from his table and says with a smile, "I read this to them for the first five minutes." To further inspire his students, he on occasion holds "Mathematics Jeopardy," and once organized a play titled *To Infinity and Beyond*, written and performed by one of his classes.

BRAIN DEVELOPED AT AU NOW STUDIES BRAIN DEVELOPMENT

By Grenye O'Malley, biology '09

AFTER TWO DECADES IN THE FIELD, **BEATRIZ LUNA (PSYCH '85)** still credits her AU professors as some of the greatest inspirations and role models of her career.

Luna is director of the Laboratory for Neurocognitive Development at the University of Pittsburgh, an associate professor of psychiatry and psychology, as well as an experimental psychology alumna from American University.

Luna's current research explores changes in the human brain from adolescence to adulthood. During early childhood, the brain develops the basic structure for adulthood and the capacity for important functions such as abstract thought, planning, and cognitive flexibility. Executive functioning and cognitive control—the ability to direct and apply mental skills—continue to change during adolescence.

Luna and her colleagues use eye movement measures and fMRI (functional magnetic resonance imaging) studies to detect the pattern of brain activation during voluntary response suppression and spatial working memory tasks. They have found these activities improve during adolescence and that other areas such as the cerebellum are used only for these tasks in adult brains. During adolescence the brain is undergoing synaptic pruning—the process of reducing overproduced and weak neurons to create more efficient configurations of connections—and myelination—the creation of myelin, an insulating part of neurons which increases the speed of impulses.

The lab is also constructing a template of normal development which can be used to assess abnormal development. Luna's focus is important because adolescence is when serious neuropsychiatric disorders such as mood and substance abuse disorders begin. They will also use the template to study autism and ADHD.

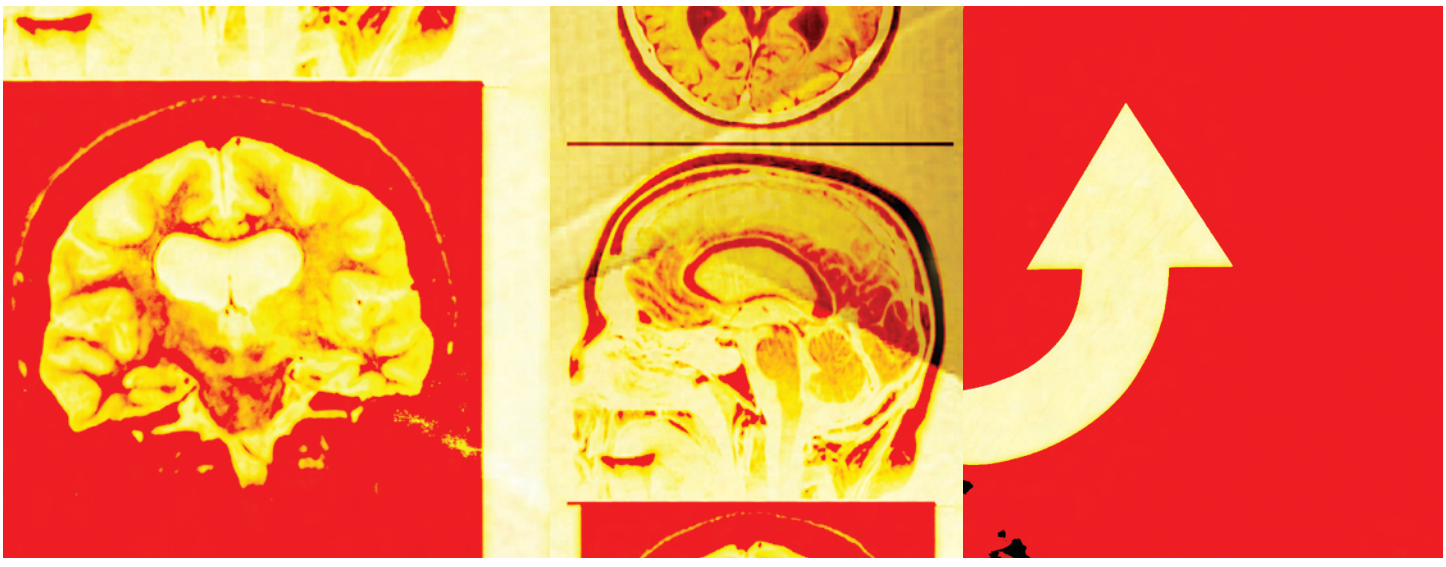
Luna became interested in adolescent neuropsychology after her postdoctoral work on the neural basis of schizophrenia and mood disorders. Since these disorders develop during adolescence, she decided to combine developmental psychology and neuroscience to research this under-studied area.

Luna studied clinical psychology at Duquesne University for her MA and developmental psychology at the University of Pittsburgh for her PhD after receiving her BA at American University.

The early part of her education had a great impact on her. Luna was exposed to lab work and was part of a publication in Professor Anthony Riley's psychology and toxicology lab while at American University. "We looked at hippocampal involvement in timing behavior," Luna said. "Very cool stuff."

By working in Riley's lab, Luna appreciated the hard work and creativity that is needed. In addition, "his classes were amazingly energetic and inspiring and made science look fun," she said. She says that he "has been one of the greatest inspirations in my career" and thanked him when she was awarded the Presidential Early Career Award for Scientists and Engineers in 2005.

Luna's success in the science field was also influenced by her nonscience background at AU. Jeffrey Reiman, a philosophy professor, let Luna research philosophers such as Edmund Husserl who explored ideas which she uses in her scientific inquiry today. Luna developed the way she thinks in her lab partly from him. "His classes," she said, "forced me to question all my preconceptions and truly opened my mind to looking at problems in a scientific and nonjudgmental way."



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2007 APEX® AWARDS FOR PUBLICATION EXCELLENCE

Catalyst Wins APEX Award

The *Catalyst*, the student-run science magazine produced by the College of Arts and Sciences, has won a 2007 APEX Award for Publication Excellence. The winning entry, honored in the category of print magazines and journals up to 32 pages, was the fall 2006 issue. Continuing the tradition of movie-theme covers, that issue featured three biology graduate students recreating a *Charlie's Angels* poster, but with a science twist.

Catalyst was founded in fall 2004 to inform readers about American University's many excellent science and math programs.

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