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AMERICAN UNIVERSITY SCIENCE

EDITORIAL

Science Issues—Hadron Particle Collider

Amid incredible media attention, the Large Hadron Collider project got under way in a 17-mile underground tunnel beneath the French and Swiss border on September 10, 2008. After a few days of initial success, a faulty electrical connection halted the experiment on September 19, but scientists hope to have the accelerator repaired and running again this spring. However, safety concerns and dire warnings about the project caused many to oppose it last September, and now that it has been shut down, these concerns are again being raised.

The Large Hadron Collider (LHC) is a $9 billion project designed to simulate the conditions of the Big Bang by smashing particles together. This is achieved by sending two proton beams through the tunnel in opposite directions, recreating the makeup of the universe less than a millionth of a second after the Big Bang. Scientists will then be able to examine the "hot soup" of particles to determine how the universe evolved.

Several theories are expected to be confirmed or refuted by the experiment, including the possibility of other dimensions. Scientists will also be looking for the theoretical Higgs boson particle, also known as the "God" particle, which is crucial to explaining why matter has mass. Also, because the experiment is completely exploratory, researchers look forward to unpredicted discoveries.

However, critics of the project believe that the risks outweigh the potential benefits. Before the project was begun in September, critics filed a lawsuit over concerns that the collider could create black holes with the potential to swallow the planet. Physicists, while admitting that the project could create a black hole, assert that any hole created would be so small and weak it would dissolve almost immediately without any effects. The opponents of the project, whose lawsuit was denied, have been dismissed as just another group frightened by science in a long history of doomsday hysteria.

Now that the LHC has been switched on for a few days in September without causing the destruction of the Earth and has even experienced an electrical problem without any mishap, it seems that it is time to put aside our fears of the unknown and watch for the exciting advances to physics that this machine will undoubtedly reveal.

Kathryn Thornborough, *Coeditor*

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!

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ON THE COVER | Inspired by the film *Forrest Gump*, the cover features AU biology professor and *Catalyst* advisor Christopher Tudge. Photo by Jeff Watts

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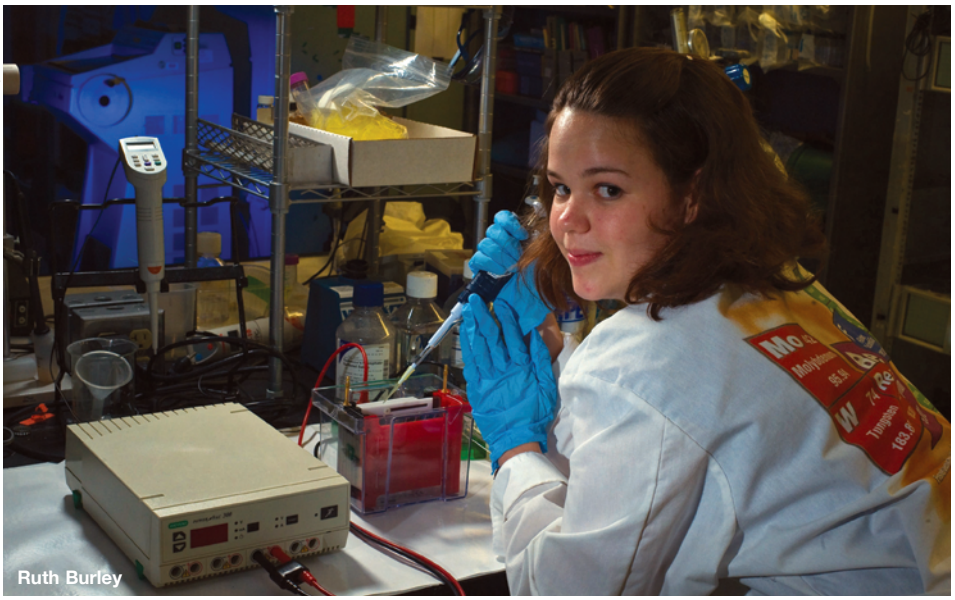
Photo by Jeff Watts



Ruth Burley

THAT LOOKS FISHY TO ME

By Shirin Karimi, literature and premedical studies, '11

To the eyes of a human, small fish may seem trivial at first glance, often cast aside as county fair prizes and expendable pets. Yet for Ruth Burley, a master's degree candidate in biology, fish may be a crucial tool in understanding diabetic retinopathy, the leading cause of blindness from diabetes. This progressive condition affects the blood vessels in the eye, leading to symptoms of retinal swelling or retinal scarring, resulting in retinal detachment and, ultimately, blindness. Diabetic retinopathy takes approximately 20 years for symptoms to develop, and since no cure has yet been found the only way to treat the condition is by regulating blood sugar, using lasers to blunt the effects of new vessel growth, and using certain drugs that combat capillary growth. Yet research like Burley's may change the outlook for diabetic retinopathy.

Burley is continuing her studies at the same institution that helped fuel her passion for biology. Interestingly enough, her foray into research was propelled by a feeling that many college students feel at the conclusion of the spring semester: boredom. She wanted to stay on campus somehow and the biology department provided a solution. "The summer after sophomore year, I applied for the Dean's Undergraduate Research Award," Burley recounted. After she won the grant, Burley started her research in Professor Lynne Arneson's lab, which involved inducing hyperglycemia (high blood sugar) in zebrafish and looking for the expression of the protein vascular enodothelial growth factor (VEGF), which is involved in new capillary growth.

In Arneson's lab, Burley extracted samples of messenger RNA (mRNA) from the zebrafish eyes using an RNA isolation kit. With the mRNA isolated , she used reverse transcription to convert the mRNA product to a cDNA product and then amplified the quantity available for testing with a process called polymerase chain reaction. Next, using a process called gel electrophoresis, a procedure which separates DNA or RNA product based on sequence length, Burley ran her cDNA product to verify VEGF expression. "If I have VEGF protein expressed, it will appear as a band on the gel at the maker length which corresponds to the VEGF sequence length," Burley explains.

Ever since that formative summer, diabetic retinopathy has guided Burley's research career. Since hyperglycemia is a characteristic symptom of diabetes, Burley would observe the changes seen in the hyperglycemic zebrafish over a month and analyze these changes to see if the effects resemble those experienced by humans with diabetes.

Burley hopes zebrafish can be used as a model for humans in understanding the cellular basis of diabetic retinopathy since this specific species of fish is inexpensive, easy to take care of, and undergoes stages of development from the embryonic stage that are very similar to that of humans.

As a senior, she concentrated on another protein called glial fibrillary acidic protein (GFAP), a protein located in the retinal Müller glial cells that provides support and strength to glial cells. Since Burley knew from her literature research that GFAP expression increases within glial cells due to trauma, she wanted to see "if GFAP expression increases as a result of diabetic retinopathy." The results of this experiment eventually culminated in Burley's senior honors capstone project.

Burley graduated last May with her undergraduate degree in biology and wasted no time in continuing her research on diabetic retinopathy in the zebrafish model in the five-year combined BS/MS program. With a $500 grant from the biology department, she began researching in Professor Victoria Connaughton's lab for her master's thesis. Continuing her work concerning GFAP, Burley uses a procedure known as immunocytochemistry, which identifies protein expression in types of tissue. Using both hyperglycemia-induced zebrafish and untreated (control group) zebrafish, Burley cut the eye into slices, then stained and incubated the slices with antibodies so that they fluoresce in the presence of GFAP. Once the fluorescing antibodies are bound to the protein of interest in the retina of the zebrafish, Burley can examine the changes in the retinal tissue and compare the hyperglycemic fish to the control group. Her previous test for GFAP allowed her to distinguish if GFAP expression

The common zebrafish may be a crucial tool in understanding diabetic retinopathy, the leading cause of blindness from diabetes.

was occurring. With Burley's new work she hopes to identify where the expression of GFAP is occurring within the retina.

Burley, however, does not spend all of her time conducting research. She is also busy working as a receptionist in an ophthalmologist's office. Luckily, her employer provides very useful information on the condition that Burley has spent the past three years studying. Currently, she has been spending time researching pericytes, cells that surround the endothelial cells, preventing any permeability of the retina vessels. The ophthalmologist informed Burley that diabetic retinopathy causes an immediate decrease in pericytes, resulting in a leakage of the albumin, a protein in your blood, into the retina. "What we are hoping to do is use trypsin digest (the enzyme trypsin is a type of digestive enzyme found in the intestines) to expose the vasculature of the zebrafish eye," Burley explains.

"In healthy individuals, you have a 1:1 ratio of pericytes to endothelial cells." By examining the vasculature of the zebrafish eye, the ratio of the pericytes to endothelial cells can be calculated and compared in hyperglycemic and control animals. Burley will begin these experiments in the spring.

Since her research projects will conclude this year, the next step for Burley is a career in medicine. This spring, she plans to apply to medical schools and is contemplating specializing as a general practitioner. In the words of her master's thesis advisor, Professor Connaughton: "Ruth has great potential as a scientific researcher. She is very comfortable in the lab and she is a thorough and careful scientist." Whatever scientific career she decides to pursue, Burley certainly knows no bounds.

AMERICAN UNIVERSITY AND BIOREMEDIATION: GREEN SOLUTIONS TO AGE-OLD PROBLEMS

By Jordan Maidman, history and premedical studies, '11

American University was founded in 1893, thanks to the efforts of Congress and Bishop John Fletcher Hurst. American opened its doors in 1914 after years of construction, enrolling 28 students into the university's first classes. Two years and only two commencement addresses later, American University welcomed the U.S. military to use the campus at the height of the First World War. Here at AU, some of the most important steps in America's war effort were made. Here, the U.S. Army developed advanced research techniques, modern camouflage, and defenses against chemical weapons used on U.S. troops. After the war, the U.S. Army took steps to either remove any harmful chemicals, or bury them in order to shield from local residents their harmful effects.

Since then, the majority of chemicals buried by the Army Corps have denatured and pose no threat to either people or the environment. Yet unbeknownst to Army officials after World War I, arsenic remained that could have environmental complications.

However, 80 years later, and a decade's worth of environmental and green technology at our fingertips, the modern Army Corps of Engineers and its regulatory partners, the U.S. Environmental Protection Agency and the District of Columbia Department of the Environment, are rehabilitating affected parts of the campus and region through testing, soil analysis, and, when needed, soil removal. An additional means is through a non-harmful, non-chemically induced, all-natural technique which the environmentally conscious U.S. Army has introduced as a way to help clean up the areas near our campus and to experiment with for possible use in the future.

How are such environmentally friendly techniques possible? The answer is bioremediation. Cristina Cardona, a graduate student in the environmental science master's degree program, currently does research with Edenspace Systems Company (www.edenspace.com) in Virginia, which researches and promotes bioremediation, a technique of removing harmful chemicals and metals from the environment without damaging natural flora and fauna. Cardona resoundingly criticizes previous techniques often used to remove ground contamination: "There have been a variety of techniques used to remove the arsenic. They've used dredging, which is this technique by which you basically dig up the soil and truck it to a landfill. It's really harmful to the environment."

Instead, Cardona favors bioremediation, which focuses primarily on both human and environmental health. "We use this plant called a brake fern, which is found in Florida. A scientist at the University of Florida discovered that this fern was able to pull arsenic from the soil into the fronds." As part of the remediation effort in the Spring Valley neighborhood adjacent to American University's campus, Cardona facilitates the use of the brake fern to remove arsenic from the soil. Every few days during the growing season, she goes to the spots where the ferns are planted, checks a tensiometer (a device that checks arsenic and water levels in the soil), looks at the digital readout, and determines the health of the ferns. Cardona weeds the ferns just to make sure nothing else can affect the results of this process. Finally, the plants are harvested, and the arsenic levels in the fronds are tested.

The process of bioremediation of arsenic begins when brake ferns are cultivated in Florida and transported overnight on trucks to Washington, D.C. The ferns are immediately transplanted into the ground in the contaminated areas. During the

week, Cardona cares for the plants with a monitored sprinkler system. During the planting period, she also uses commercial fertilizer on the ferns to assure the healthiest possible plants for maximum uptake of arsenic. Each fern survives from May until October, after which the weather gets cold and unpredictable (a harsh environment for a plant that thrives in perpetually warm, humid Florida). This is when the ferns are harvested and their fronds tested for arsenic levels.

The Environmental Protection Agency has mandated that the ground contain no more than 43 parts per million of arsenic. However, of the three sites Cardona works on, she said, "one has over 100 parts per million of arsenic," a high amount for this region. While several techniques have been tried, bioremediation is clearly the most benign to the environment. In some of the sites where these ferns are planted, arsenic levels are far below the EPA mandated level, with some measurements under 20 parts per million of arsenic. Bioremediation has proven effective in other studies, and the ferns are readily able to draw in the arsenic. Additionally, the ferns do not constitute an invasive species due to their carefully regulated planting, which prevents them from spreading. So Cardona is confident the ferns can likely reduce the arsenic levels to below even one part per million if they are planted and maintained properly for long enough.


Cristina Cardona

Photo by Jordan Maidman

While arsenic may not affect the plants, herbivores (including squirrels, rabbits, and deer) that live in and around Washington, D.C., may eat the plants in which arsenic has accumulated. They can die from bioaccumulation, a process by which animals gradually accumulate a harmful toxin by eating many things with smaller traces. Another potential serious health concern is the possibility of arsenic seeping into D.C.'s water supply. While arsenic in the ground will be extremely harmful only if the soil or plants from the ground are consumed, arsenic in the water supply could potentially affect a much bigger group. Arsenic, especially when found in the water supply, is dangerous due to adverse effects on kidney function, and it can lead to pancreatic and renal cancers. Water testing on and around the AU campus and in the local reservoir has revealed no arsenic contamination, however.

Preventing this possible scenario is one of the big payoffs for this research. "I am currently doing research in Virginia about the water supply in Fairfax. Their water supply is full of runoff and pollutants," said Cardona, who intends to pursue a PhD in environmental science and may work toward a career with the Environmental Protection Agency. Given the apparent success of the experiment in American University's backyard, the state of Virginia may well benefit from bioremediation.

GETTING OUT OF DODGE

DAVID MENASCHE AT THE GODDARD SPACE FLIGHT CENTER

By Brittany Horowitz, public communication '12

If you overheard a young man talking about lasers and NASA, you might assume he was discussing a science fiction movie. However, if that person were David Menasche, he would just be recapping the events of his summer vacation.

After only a year at American University, Menasche is already quite accomplished in his field. Last year, Menasche, now a sophomore in the physics department, received the Benson T. Chertok Memorial Scholarship for Academic Excellence and Undergraduate Research. One of his professors, Nathan Harshman, said,

"The opportunity to work with the laser group at Goddard was awesome. My advisors helped me immeasurably, both to learn about the research culture and to develop new technical skills. Learning to build a laser was by far one of the coolest things I've done this year—the internship was an awesome experience."

David Menasche

"David was a great student in PHYS-210. He seemed to be leaning forward in his chair, into the lecture, the whole time."

During the reception recognizing Menasche's scholarship, Harshman suggested that Menasche further his interest in physics by applying for a summer internship position at the National Aeronautics and Space Administration's Goddard Space Flight Center in Greenbelt, Maryland. Menasche applied and got the position.

From May to August 2008, Menasche worked at Goddard as a research assistant to AU professor Demetrios Poulios. Because Menasche lacked an extensive research background, his involvement in the project began simply by learning about fiber-optic lasers. After familiarizing himself with the field, he began to work on one of the instruments in a series of laser vegetation imaging sensors, or LVIS.

The sensor is placed in an aircraft, which flies over the target area and collects data. The LVIS emits a laser beam and records the returned signal from the surface of the terrain, creating data that are useful for sonar ranging, terrain mapping, and cloud formation finding. Menasche worked on a project designing and constructing a package for the sensor.

Photo by Brittany Horowitz

David Menasche

"The opportunity to work with the laser group at Goddard was awesome," Menasche said. "My advisors helped me immeasurably, both to learn about the research culture and to develop new technical skills. Learning to build a laser was by far one of the coolest things I've done this year—the internship was an awesome experience."

By working with NASA after only a year in college, Menasche proved that even students just starting out in their field can gain valuable experience beyond the walls of AU.

NEW SCIENCE RESOURCES AT THE UNIVERSITY LIBRARY

An update on science teaching and research resources from the University Library

By Patricia J. West, reference and instruction librarian

SELECTED NEW BOOKS

Across the Boundaries: Extrapolation in Biology and Social Science, by Daniel P. Steel. Oxford, New York: Oxford University Press, 2008

Animal Subjects: An Ethical Reader in a Posthuman World, edited by Jodey Castricano. Waterloo, Ontario: Wilfrid Laurier University Press, 2008

Ecotoxicology: A Comprehensive Treatment, by Michael C. Newman and William H. Clements. Boca Raton, Florida: CRC Press, 2008

Electromagnetism and the Structure of Matter, by Daniele Funaro. New Jersey: World Scientific Publishing, 2008

Geoforensics, by Alastair Ruffell and Jennifer McKinley. West Sussex, England: John Wiley & Sons Ltd., 2008

Just Genes: The Ethics of Genetic Technologies, by Carol I. Barash. Westport, Connecticut: Praeger, 2008

Out of the Blue: A History of Lightning, by John S. Friedman. New York: Delacorte Press, 2008

Stephen Jay Gould: Reflections on His View of Life, edited by Warren D. Allmon, Patricia H. Kelley, Robert M. Ross. Oxford, New York: Oxford University Press, 2008

NEW VIDEOS

Flock of Dodos: The Evolution and Intelligent Design Circus, New York: Docurama Films, 2007

Judgment Day: Intelligent Design on Trial, Boston, Massachusetts: WGBH Educational Foundation, 2007

Living Weapon, Boston, Massachusetts: WGBH Educational Foundation, 2007

NEW ELECTRONIC JOURNAL SUBSCRIPTIONS

Nature

Proceedings of the National Academies of Science

Science

Look for this new AU library science resources column in future issues of *Catalyst*.

To make suggestions for additional purchases or subscriptions, or to submit questions, please contact Patricia West, reference and instruction librarian, AU library, pjwest@american.edu or 202-885-3841.

INVENTORS AND SCIENTISTS: AU ALUM DEFENDS YOUR RIGHTS

By Chelsea Babcock, biology '12

In Miami, Florida, Mark Terry fights for the rights of every client who steps through his doors. But Terry doesn't just defend people—he defends their ideas. Terry is a patent attorney, and along with other associates within his law firm, he upholds U.S. patent law to protect the ideas that drive innovation and industry. As an attorney at his firm, Terry & Company, Terry works to provide legal counsel regarding intellectual property assets of companies and individuals. But Terry didn't get his start in college as a pre-law student. Instead, his experience in American University's math and statistics department, and his graduation with a math-stat major, led him to the field of patent law and on to become the lead attorney at his own law firm.

At the core of Terry's work is the concept of intellectual property and its protection. Intellectual property isn't a tangible item; it is an intangible product someone can own, like a song, design, or schematic. Intellectual property drives innovation and profits for many of the world's industries and entrepreneurs and requires as much protection as a physical item from being stolen. To protect these invaluable assets, Terry focuses on legally protecting them through patents. Without a patent, an idea or design can be used by anyone without consequence. To prevent an invention from being stolen, Terry helps his clients obtain patents or defends people in court whose patents have been infringed. But how did Terry go from being a math-stat major to a successful patent lawyer? The answer lies in his educational journey, starting when he graduated from American University, and the in-depth knowledge of science and mathematics needed to carry out his everyday work.

After growing up in South Florida, Terry attended American in 1991 and graduated in 1995 with a degree in mathematics and physics. He attended AU because he loved the aura of the big city and the political atmosphere surrounding both D.C. and American University. Originally, Terry was a political science major. Then he took Calculus I with Professor John Nolan. "Something just turned me off about [political science]; I realized that math and science were just more my thing." Soon after, Terry met Professor Dan Kalman in his modern algebra course, and it was Kalman who solidified Terry's new math-stat major. "Professor Kalman opened my eyes to other [professions] and I thought, 'Hey, companies actually do hire mathematicians.'"

When Terry graduated from American, he entered Louisiana State University to earn a degree in electrical and computer engineering and worked as a software engineer for Trident Systems. At Trident, Terry developed software programs for the Defense Department. Later, he worked as a patent examiner and a patent associate for D.C. area firm Sterne, Kessler, Goldstein and Fox before moving to Florida, where he started working as a patent associate for the firm Holland & Knight. Along the way, Terry earned his JD from George Mason School of Law with a concentration in intellectual properties. After years at these firms, Terry started his own firm, Terry and Company, which he has been running for seven years. For Terry, his mathematics degree from American helped propel him toward the ultimate goal of becoming a patent attorney. From the beginning, a prospective patent attorney must have a degree in mathematics or the sciences to obtain proper licensing. But the very nature of the job begs for in-depth knowledge in

the scientific fields. Terry used his training in math and science to gain the position he holds today, and his background continues to serve him well whenever he meets with inventors to assess possible new products. “If I didn’t have a math degree I wouldn’t know what they [the inventors] were talking about,” he says.

As a patent attorney who works with companies that come up with new technological ideas, Terry uses his knowledge of mathematics and computer science to protect his clients’ ideas by filing for a patent. The process of obtaining a patent is fairly complex, and as a result Terry has only one or two new clients a day. The process of obtaining a patent begins with Terry meeting directly with the inventor to discuss his or her particular idea to determine what makes it different from other inventions, how the inventor came up with the idea, and other related subjects. After preparing an application and submitting it to the United States Patent and Trademark Office (USPTO), the USPTO has up to 20 years to examine it. During that time, a patent examiner studies the proposal to see whether a patent for the idea already exists. A client who thinks a patent application has been wrongfully rejected has the option of filing a lawsuit in response.

In his time as a patent attorney, Terry has worked on a wide variety of fascinating cases. From obtaining a patent for a toy company for the invention of a “Jesus astronaut” to working with new technology that shows the best way to drive to a destination and leave the smallest carbon footprint, Terry says his job is never dull. In fact, the carbon footprint technology is one of Terry’s favorite eco-friendly patents. The carbon footprint program works similarly to Google Maps or Map Quest. You simply type in the address of your destination, and then the program will calculate which route results in the smallest amount of carbon dioxide in the atmosphere. The program also takes into account speed limits, the degree of traffic congestion, and the amount of foliage.

While being a patent attorney means seeing some of the coolest ideas for the future before they hit the mainstream, the job can also be very difficult. Terry’s career requires late nights and hard work, and deadlines are the most stressful part of his job. “Sometimes I will be working on a patent and then somebody will call me up and say that they actually need that patent the very next day,” Terry says. “If I miss an opportunity to submit a patent then we lose the right to file it.” It can also be tricky determining whether a patent already exists for a particular invention. One tool to help determine an invention’s status is a technical Web site used only by professionals. However, Google has recently developed a Web site called Google Patents. The new patent search engine allows the use of Google’s search


Photo by Chelsea Babcock

Mark Terry

engine for anything relating to inventions and patents, making the process much simpler and far more accessible, not only for attorneys like Terry but also for the general public.

Terry, who spoke to AU students last fall about patent-related issues, thinks American can take steps to start getting patents for its current research. While he is concerned that AU is not protecting its research ideas, he also cites larger research institutes that American can emulate. Those institutes derive a large portion of their science budget from capital generated from various university patents. In any case, Terry sees a bright future for American and all its science departments. “I’m already making plans to come back,” he says.

SHOW HIM THE DATA: PROFESSOR ALAN SILBERBERG

By Kathryn Thornborough, psychology '09

Photos by Kate Thornborough

Although his courses are concerned with learning theory and the evolution of behavior, Professor Alan Silberberg teaches his students more than just psychology. His 37 years of research at AU have been spent challenging conventional claims, and in his classes he introduces this style of thinking to his students. Instead of "show me the money," Silberberg's mantra is "show me the data."

After graduating from Yale and completing graduate studies at the University of Pennsylvania, Silberberg began his research career looking at Skinnerian reinforcement schedules in pigeons and rats. Although he uses a research approach common among primatologists, today he continues to work mainly with rats, pigeons, and the occasional human.

"I spend my time trying to figure out whether I believe what I'm hearing," Silberberg says. This approach has led him to do research in many different fields of psychology and even other disciplines. "I just say, 'Hey, that interests me,' and I go do it," says Silberberg. Often that interest is sparked when he sees alternate explanations for phenomena that have been attributed to a particular theory.

One of his recent studies, for example, questions popular conceptions about addiction, which Silberberg is not convinced exists. Using rats, he tested the reinforcing power of cocaine versus food, or an inessential versus an essential good. Silberberg found that cocaine was a much weaker reinforcer than food, rebutting the claim that addictive substances provide more powerful reinforcement than nonaddictive substances.

To explain another of his experiments, Silberberg shows a specially designed box on his desk. Testing the existence of empathy in rats, a quality previously demonstrated in primates, Silberberg had placed two related rats (a mother and daughter) in the box, which has a clear plastic partition dividing it in half. This partition allows the rats to see into the other half of the box and also leaves a

small gap between the floor of the box and the bottom of the dividing wall. One rat was given much more food than it could possibly eat on its own, while the other rat had very little. Silberberg watched to see whether the "rich" rat would display empathy by pushing a few pieces of food under the partition to her daughter, the "poor" rat. Unfortunately for the daughter rat, the answer was no, rats do not show empathy.

Silberberg's research and way of viewing the world also color the classes he teaches. It is uncommon to hear laughter in a classroom at 8:30 in the morning, but students in Silberberg's Behavior Principles course can expect just that. Lectures on Pavlovian conditioning and operant theory are interspersed with stories about the amazing abilities of animals, like pigeons trained through reinforcement to guide missiles. As Silberberg says, he's "really most of all into having fun."

Silberberg's teaching style and varied research reflect his eclectic interests. Rather than conducting programmatic research, he has chosen to simply do what he finds interesting, pursuing knowledge for knowledge's sake and challenging unfounded claims. His advice to students is, both inside and outside the classroom, "whenever you're told something, ask the person how they know it's true."

Photos by Caitlin Hillyard

GREEN CHEMISTRY: PROFESSOR DOUGLAS FOX

By Caitlin Hillyard, broadcast journalism '11

As society becomes more and more environmentally conscious, more attention is given to major sources of pollution, like cars, coal-burning factories, and unrecyclable waste. However, many other hazards, like household cleaners and plastic furnishings, are less commonly known polluters.

Douglas Fox, a chemistry professor at AU, is using his expertise to combat pollutants. He specializes in an environmentally friendly field called "green chemistry." Fox, who is originally from Cleveland, Ohio, earned his bachelor and doctoral degrees from Michigan Technological University, where he studied chemistry and chemical engineering.

"Even though I was in chemical engineering and chemistry, in the back of my mind I still wanted to do something environmental," recalls Fox. This desire most likely stems from his love of nature

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GREEN CHEMISTRY

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and spending time outdoors.
After receiving his doctorate, Fox completed a two-year fellowship at the Naval Research Laboratory, followed by two years of work at the Naval Academy. For the past three years, Fox has been teaching at American University, where he has conducted his research in green chemistry.

"The logic behind green chemistry is that preventing pollution and toxic waste is always better than having to clean it up later," Fox explains. His work is helping to solve the problem by developing solvents, salts, and plastics that are either made of natural components or that are less toxic than those being used currently. Fox's aim, and the goal of green chemistry in general, is to "reduce the impact that humans have on the environment by [addressing the problem] at the source."

A major concern of green chemistry is mediating the struggle between industry and environmentalism. According to Fox, green chemistry must "balance the desire of helping the environment with making it cost effective so that industry will want to make the changes. Sometimes environmentalists go too far and sometimes industry goes too far, and so to try to mediate that, this green chemistry was established."

Fox's research focuses on three areas: solvents, ionic liquids, and plastics.

"The logic behind green chemistry is that preventing pollution and toxic waste is always better than having to clean it up later."

The solvents Fox studies are less toxic than commonly used petroleum-based solvents. Several solvents created from natural components are already in common use, such as Pine-Sol, which is derived from pine resin. Fox's current focus, however, is on corn-derived solvents with special uses, like degreasing and dissolving printer ink.

He also works on ionic liquids, which are salts that melt at or below the boiling point of water. Because these salts have no measurable vapor pressure, they cannot be absorbed into the air, which makes them preferable to more toxic compounds that can contaminate the atmosphere.

The third focus of Fox's research is polymer noncomposites, or plastics. For this research, Fox has received a $270,000 grant from the National Institute of Standards and Technology.

The goal of his NIST-funded research is to modify cellulose, an organic compound found in plants, to make it blend better with polymers, the type of molecule that makes up plastic. Fox has also been experimenting with adding clay to polymers.

"Eventually I would like to go into biodegradable polymers, but that's really a much longer-term goal. The initial thing is to try and replace current additives with what would be environmentally benign or naturally derived types of additives," explains Fox.

As part of his partnership with NIST, Fox will invite an AU undergraduate student to work with him this summer at the NIST laboratory in Gaithersburg.

"The sciences here make a great opportunity for you [AU students] to actually work in a government lab with notable scientists and learn what it's like to conduct research," Fox says.

He adds that AU's newly established Department of Environmental Science and his research fit in well with the university's green focus. Fox encourages students, as well, to engage in environmental activism by writing to lawmakers to educate them about cost-effective environmental options.

Fox also does his part to preserve the environment in his life outside the lab. In addition to being an avid recycler, Fox has helped the efforts to clean up Roosevelt Island and re-mulch the cherry trees near the Tidal Basin.

LOOKING FOR AN INTERNSHIP OR CAREER IN SCIENCE? TRY THESE

FRIENDS OF THE NATIONAL ZOO *ZOOGOER* EDITORIAL INTERNSHIP

This ongoing internship lets students work directly on the National Zoo's monthly publication, the *Zoogoer.* Interns do research for the magazine, write content for the Web, and help with the zoo's public relations office.

Qualifications: Students or recent graduates with majors in journalism, English, biology, and other such fields.

Deadline: June 15 for the fall internship, and October 15 for the spring.

To Apply: Submit the application form, along with a cover letter, résumé, two writing samples, and two references to:

Editorial Internship, Zoogoer
FONZ Communications
P.O. Box 37012 MRC 5516
Washington, DC 20013-7012

Web site: http://nationalzoo.si.edu/undergradinternships/FONZ/Zoogoer.cfm

NATIONAL ZOO ANIMAL MANAGEMENT INTERNSHIP, BIRD AREA

Do you have a passion for nature and all things wild? This National Zoo internship has hands-on care and maintenance for the zoo's exotic birds. The program features one-on-one care of animals and time with professional zookeepers.

Qualifications: Undergraduate students with a love for nature, the outdoors, and the ability to work in a team environment.

Deadline: Ongoing for the fall.

To Apply: Submit the application form, along with a cover letter, résumé, two writing samples, and two references to:

Bird Unit Internship
c/o Paul Tomassoni
National Zoological Park
P.O. Box 37012 MRC 5523
Washington, DC 20013-7012

Web site: http://www2.umdnj.edu/neuroweb/summer_prog/index.htm

SMITHSONIAN NATIONAL MUSEUM OF NATURAL HISTORY INTERNSHIP

For students with a passion for biology and other natural history–related fields, the National Museum of Natural History provides a chance to step behind the scenes of the museum to work with cutting-edge scientists.

Qualifications: Competitive undergraduate students with majors in biology, chemistry, and related fields looking for hands-on lab work.

Deadline: Ongoing for the summer and fall

To Apply: Contact a project sponsor directly through the Web site and submit all required application documents.

Web site: http://www.nmnh.si.edu/rtp/other_opps/internship_summary.html

NASA UNDERGRADUATE STUDENT RESEARCH PROGRAM

NASA's summer internship program provides the opportunity to work on practical problems with applications to future NASA missions. Internships are available for fall, spring, and summer terms.

Qualifications: Open to sophomores, juniors, and seniors with majors in math, computer science, physics, chemistry, or biology. Minimum 3.0 GPA.

Deadline: March 6 for the fall 2009 session; spring 2010 session deadline TBA.

To Apply: Access the online application from the program's home page.

Web site: http://www.epo.usra.edu/usrp/

NATIONAL COUNCIL FOR SCIENCE AND THE ENVIRONMENT EARTH PORTAL INTERNSHIP

The National Council for Science and the Environment is looking for motivated students to take part in its Web outreach program, Earth Portal, to educate the public about threats to the environment.

Qualifications: Familiarity with Microsoft Office, writing and editing skills, and a broad range of interest in current environmental issues.

Deadline: Ongoing

To Apply: Send a cover letter, résumé or CV, and three references to Maggie Surface at msurface@ncseonline.org.

Web site: http://ncseonline.org/01about/cms.cfm?id=1144

NATIONAL INSTITUTES OF HEALTH SUMMER INTERNSHIP PROGRAM

This prestigious internship lets interns work side by side with leading scientists. Includes a number of summer activities, including a lecture series by distinguished NIH researchers.

Qualifications: Undergraduate students with an interest in biomedical research who have completed at least general biology and general chemistry.

Deadline: March 1

To Apply: Access the online application at the program's home page. Requirements include a résumé or CV, record of coursework and grades, a cover letter describing particular research interests, and two references.

Web site: http://www.training.nih.gov/student/sip/info.asp

U.S. DEPARTMENT OF ENERGY SCIENCE UNDERGRADUATE LABORATORY INTERNSHIPS

For undergraduates interested in math and physics, the U.S. Department of Energy is hosting internships at a number of facilities across the country and in Washington, D.C.

Qualifications: Full-time student with an interest reflecting the work done at the lab of your choice. Must be available to work 20 hours per week or as lab requires, with a GPA of 2.5 or above.

Deadline: Ongoing

To Apply: Apply online at the program's home page, or contact a specific lab regarding application requirements.

Web site: http://www.scied.science.doe.gov/scied/sci_ed.htm

ENVIRONMENT AMERICA INTERNSHIP

With the tagline "When was the last time your term paper saved a national treasure?" this program offers a field internship, legislative internship, and a media internship.

Qualifications: A strong commitment to the goals of Environment America, strong writing skills, debate and public speaking skills, and enthusiasm for the environment.

Deadline: Ongoing

To Apply: Submit a résumé and cover letter to Paul Carison, internship coordinator, at dcinternships@environmentamerica.org.

Web site: http://www.environmentamerica.org/jobs/available-positions/internships

CATALYST WANTS YOU

Want to contribute to *Catalyst?*

We need editors (any major) for *Catalyst*. This is usually for one year (both the spring and the fall issues).

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We need photographers. All stories require photographs to bring them to life. Put your creative talents to work.

If you are interested in any of these roles, please contact the current editors or the faculty advisor listed in the front of the magazine.

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