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BIOFEEDBACK

THE FISCHELL DEPARTMENT *of* BIOENGINEERING
A. JAMES CLARK SCHOOL *of* ENGINEERING

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A NEWSLETTER FOR ALUMNI AND FRIENDS OF THE FISCHELL DEPARTMENT OF BIOENGINEERING AT THE A. JAMES CLARK SCHOOL OF ENGINEERING, UNIVERSITY OF MARYLAND, COLLEGE PARK.

IN THIS ISSUE:

Fischell Dept. of Bioengineering Welcomes 5 New Faculty Members

In the past year, the Fischell Department of Bioengineering at the A. James Clark School of Engineering, University of Maryland, has had the privilege of welcoming five new faculty members into its ranks.

Professor **Philip Bryan**, who received his Ph.D. from the University of Tennessee and Oak Ridge National Laboratory in 1979, uses genetic, biochemical, and biophysical methods to investigate fundamental questions of protein folding and enzymology. These studies are the foundation of a hierarchical progression in which fundamental understanding of folding and enzymology translates into principles of protein engineering and engineering principles translate into protein-based nanomachinery. The ability to engineer proteins with switchable functions led Bryan to create a spinoff company, Potomac Affinity Proteins, which uses switchable proteolytic enzymes in a powerful, all-purpose method for protein isolation and purification.

Associate Professor **Edward Eisenstein**, who received his Ph.D. from Georgetown University in 1985, investigates a variety of questions involving plants, including their remarkable capacity to produce a complex array of interesting compounds, their response to pathogens and disease, and the feasibility of engineering their biosynthetic apparatus for applications ranging from human health to biofuel production. His research interests include gene-metabolite relationships in medicinal plants, exploring the molecular basis for plant disease resistance, and plant metabolic engineering. He serves on the editorial boards of several journals and the review panels for various scientific agencies, and was previously appointed acting president of the University of Maryland Biotechnology Institute (UMBI).

Both Bryan and Eisenstein were previously appointed to the UMBI faculty, where they were members of the Center for Advanced Research in Biotechnology (CARB). In their new

LEFT TO RIGHT: NEW FACULTY MEMBERS SILVINA MATYSIAK, PHILIP BRYAN, AND EDWARD EISENSTEIN.

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chair's MESSAGE

WILLIAM BENTLEY

WE'VE GOT SO MUCH TO SHARE, WE NEEDED EXTRA PAGES TO FIT IT ALL IN!

Packed into this issue of *Biofeedback,* you'll find the latest news about special events, big grants, innovative educational programs, student accomplishments, new research, entrepreneurship, and—perhaps the biggest news of all—the five new faculty members that have joined the department since the spring!

Our collaborations with federal laboratories and hospitals are expanding, from a partnership with the National Cancer Institute *(see p. 3)* to doctors from the Georgetown Medical School, MedStar Health, the University of Maryland Medical Center, and the Washington Hospital Group, who served as mentors to our undergraduates on their senior design projects *(see pp. 10-11).*

Unfortunately, we are also very sad to report the passing of a good friend of the department, University of Maryland CIO Dr. **Jeffrey Huskamp**, husband of our Director of Operations, **Sandra Huskamp**.

Before Jeff's passing, he and Sandra established the Jeffrey C. and Sandra W. Huskamp Endowed Bioengineering Scholarship, which reflects their immense dedication to the advancement of the Fischell Department of Bioengineering, the A. James Clark School of Engineering, and the University of Maryland.

"Jeff believed the impossible just takes a little longer," says Sandra. "That's the way he lived his life. Jeff's passion was to provide students and faculty with the best information technology environment to nurture their success, from building excellence in the technology infrastructure to exploring and implementing innovative uses of technology in teaching

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FACULTY, from page 1

roles, they will both also serve as affiliate faculty in the recently-established Institute for Bioscience and Biotechnology Research.

Assistant Professor **Silvina Matysiak**, set to arrive in October 2010, received her Ph.D. from Rice University in 2007. Before joining the University of Maryland, she was a postdoctoral fellow at the University of Texas at Austin. Matysiak researches mechanisms of protein folding and misfolding associated with Alzheimer's and Parkinson's diseases, protein assembly in biomedically relevant systems, and how solvent organization affects cooperative transitions in biological systems. She is developing multi-scale simulation techniques and models to characterize biomolecular systems at multiple time and length scales. At UMD, she plans to study the allosteric regulation of proteins, which is crucial in drug design, and molecular recognition events associated with neurodegenerative diseases.

Professor **Gregory Payne**, who received his Ph.D. from the University of Michigan in 1984, was formerly appointed to the UMBI, where he was the director of the Center for Biosystems Research. He is a pioneer in the use of chitosan in sensors and biomedical devices, and an expert in biofabrication techniques that utilize stimuliresponsive biological polymers and enzymes. His work on electroaddressing enables biological components to be integrated into lab-on-a-chip devices for diagnosing disease at the point of care, detecting pathogens at the restaurant/market and discovering drugs in the lab. He is also creating methods to fabricate soft matter for applications in regenerative medicine. Payne has been a long-time collaborator with Clark School faculty, including BioE Professor and Chair **William Bentley**. He is currently one of the five co-PIs of the Biochip Collaborative, an interdisciplinary effort to "translate" the communication between biological and microfabricated systems.

Associate Professor **Benjamin Shapiro**, a National Science Foundation CAREER Award winner and Fulbright Scholar, received his Ph.D. from the California Institute of Technology in 1999. He joins us from the Department of Aerospace Engineering. Shapiro holds joint appointments with the Institute for Systems Research and the Maryland NanoCenter, and is affiliated with the Applied Math and Scientific Computation Program. As the director of the Control of Miniaturized Systems for Mechatronic, Biological and Clinical Applications Laboratory, he focuses on the modeling, design, and control of micro- and nanoscale systems, with applications in electronics, biology and medical practice. His current projects include manipulation of cells and quantum dots by micro flow feedback control; directing drugs to tumors, the inner ear and other disease sites by magnetic control; and spatial mapping of genes and gene expression across tissues, including the visualization of genetic variations surrounding cancerous lesions.

LEFT: BENJAMIN SHAPIRO. RIGHT: GREGORY PAYNE ▶

MURO WINS $1.72M NATIONAL INSTITUTES OF HEALTH R01 GRANT

Assistant Professor **Silvia Muro** has been awarded a $1.72 million, 5-year National Institutes of Health (NIH) Research Project Grant to develop new therapies for the treatment of rare genetic diseases that affect the lungs and brain. The Research Project Grant Program, also known as R01, is the NIH's oldest and one of its most prestigious. It funds investigator-initiated, health-oriented research that supports the mission of the NIH.

Because they are uncommon, genetic disorders have a disproportionately high cost of treatment. While our ability to detect and diagnose them has improved, in many cases safe and effective treatments for the diseases they cause are not yet available.

"Progress has long been hampered by the fact that treating genetic diseases is perceived by some to be 'unprofitable,'" says Muro, "so support of non-profit federal, academic, and private organizations developing new therapies is crucial. As insurance companies consider the high cost of suboptimal treatments for these often chronic or fatal conditions, which average $100,000 a year per person, patients may be in danger of not getting the help they desperately need."

Muro and her research group have chosen to focus on the treatment of lysosomal storage disorders, which are triggered by one of the most common types of genetic defects in humans and can result in more than 40 life-threatening diseases.

A lysosome is a hollow, spherical cell organelle (an organ-like unit within the cell wall) that contains enzymes (specialized proteins that accelerate or enable chemical reactions). Lysosomes are designed to break down the lipids (fats), carbohydrates, and other proteins cells require for food, making them easier to digest. They can also break down viruses ingested by the cell, other organelles that are "old" or damaged, or the cell itself when it dies.

Lysosomal storage diseases are those in which a genetic defect results in a

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UNIVERSITY PARTNERS WITH NATIONAL CANCER INSTITUTE

BENTLEY TO PROVIDE NANO-BIO DRUG DELIVERY EXPERTISE IN CLOSE COLLABORATION

How do cancer cells migrate from one organ to another? Why do certain cells become malignant? And how can drug treatments identify new cancer growths? In the battle against cancer, tough questions like these demand science that extends beyond traditional cell biology.

University of Maryland and A. James Clark School of Engineering researchers with sought-after expertise in computational biology, bioengineering, physics and math—including Fischell Department of Bioengineering Professor and Chair **William Bentley**—hope to provide answers through a new partnership with the National Cancer Institute (NCI), part of the National Institutes of Health.

An agreement signed at the university on May 19 established the Collaborative Research and Graduate Partnership Program in Cancer Technology between the University of Maryland and the NCI's Center for Cancer Research. The program, only the second of its kind affiliated with the NCI, will send Maryland graduate students to the NCI laboratories in Bethesda, Md., for training and will provide for professional and academic exchanges between university faculty and NCI researchers.

"The opportunity for University of Maryland faculty and graduate students to work with the world's top cell biologists and cancer scientists at the National Cancer Institute is tremendous," says University President **C.D. Mote, Jr.** "Such expertise undoubtedly will lead to new diagnostic tools and treatments. The University is thrilled by this collaboration and its far-reaching implications for future research."

Collaborative efforts between Maryland faculty and NCI researchers will include genomics and gene sequencing, pinpointing genetic markers that might predict why certain cells become malignant, quantitative analysis, and the development of advanced models that can be used to study both healthy and cancerous cells.

Bentley is lending his expertise in bioengineering and nanotechnology, using the university's sophisticated nanofabrication laboratories to expand knowledge in areas like targeted drug delivery and microphotonics that can be used in cell imaging.

"My group is developing a simultaneous eradication and detection system," he says of his role in the project. "We're developing a targeted means of drug delivery that brings drugs to kill cancer cells and delivers contrasting agents that can help identify any new growths."

Bentley welcomes the opportunity not only to interact with a world-class research facility like the NCI, but also to have an impact on the treatment and cure of a devastating disease.

"Our bread and butter is research," he says, "but if you can get to a point where you can translate that research into a new treatment, then that's the best possible outcome."

Story courtesy of and adapted from the press release by Tom Ventsias, University of Maryland Communications and Marketing.

NATIONAL® CANCER INSTITUTE

R01 GRANT, from page 3

shortage or absence of a particular enzyme the lysosomes need in order to function. In one example, Niemann-Pick disease, this deficiency leaves the body unable to digest a certain kind of lipid, which builds up in the cells until they rupture and die, ultimately leading to major organ failure. Children born with Niemann-Pick disease typically do not survive to adulthood.

Currently, lysosomal diseases can be treated with enzyme replacement therapy (ERT), but success has been limited. "In the decade since its clinical implementation, it's become apparent that ERT's effectiveness is restricted to a few diseases that affect the liver, spleen, and kidneys," Muro explains. "We haven't yet perfected enzyme delivery to and into the tissues of the heart, lungs, and brain." Her group is developing patent-pending technology that will provide more controlled, precise and efficient treatments by exploiting the natural transport pathways these organs use to move molecules into their tissues. Because their research in part focuses on the difficulty of moving therapeutics across the blood-brain barrier, their results could one day also be applied to diseases that affect the central nervous system.

"Our hope is to prolong and improve the quality of life for patients and their families, and also alleviate the economic burden on the healthcare system," Muro says.

BioE Professor and Chair **William Bentley** says Muro's grant is another great example of what can be accomplished by Clark School faculty. "R01s are the most relevant grants given by the NIH to individual labs, and they're usually won by established investigators," he says. "That Silvia's proposal, originally submitted only seven months after she joined our faculty, was accepted on its first submission without requests for revisions, is a wonderful and difficult accomplishment. I hope it encourages all of our young faculty to put themselves out there and promote their work."

◀ LEFT: SILVIA MURO

TRENT BRADBERRY

RECONSTRUCTING HAND MOVEMENTS USING BRAIN SIGNALS

Fischell Department of Bioengineering graduate student (now alumnus) **Trent Bradberry** (Ph.D. '10), advised by Associate Professor **José Contreras-Vidal** (kinesiology, neuroscience and cognitive science program, and affiliate professor, Graduate Program in Bioengineering), published research in the March 3 issue of the *Journal of Neuroscience* which for the first time demonstrates that it is possible to decode and reconstruct 3-D hand movements from brain signals recorded through the use of noninvasive electroencephalography (EEG) technology. The new technique could someday enable those who have lost motor function to operate brain-controlled prostheses, computers or wheelchairs using a headset with scalp sensors that sends signals from the brain to the device. Bradberry's collaborators and co-authors on the project are Contreras-Vidal and **Rodolphe Gentili** (assistant research professor, kinesiology).

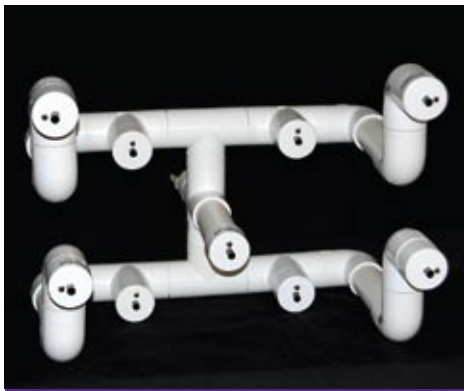
"Until now," says Contreras-Vidal, "this was not thought possible—people assumed EEG data was too limited."

The findings are significant because they open the door to the development of safe, portable, brain-controlled assistive devices for the neurologically-impaired or physically disabled. Prior to this study, researchers have used non-invasive but non-portable magnetoencephalography (MEG) technology and invasive methods that implanted sensors in the brain to reconstruct hand motions.

The team placed an array of 34 EEG sensors on the scalps of five participants to record their brains' electrical activity. Volunteers were asked to reach from a center button and touch eight other target buttons in random order at least ten times each. Bradberry and his colleagues recorded their brain signals and hand motions in order to interpret the brain activity that occurs when a person decides how to move. They found that one sensor in particular provided the most accurate information. It was located over a part of the brain called the primary sensorimotor cortex, a region associated with voluntary movement. Useful signals were also recorded from another region of the brain called the inferior parietal lobule, which is known to help guide limb movement.

"Our results showed that electrical brain activity acquired from the scalp surface carries enough information to reconstruct continuous, unconstrained hand movements," says Contreras-Vidal. "We are currently working with [controlling] robotic arms and wearable upper limb exoskeletons, but our findings could also lead to improvements in existing EEG-based systems that are designed to allow people to control a computer cursor with their thoughts."

The information gathered by the ongoing study, he adds, could also help doctors understand how the progression of



THE REACHING APPARATUS USED TO STUDY THE FINGER PATHS FROM A CENTER BUTTON TO EIGHT OTHER BUTTONS IN RANDOM ORDER. WHILE VOLUNTEERS TOUCHED THE BUTTONS, RESEARCHERS RECORDED THEIR BRAIN SIGNALS AND HAND MOTIONS. AFTERWARD, THE RESEARCHERS ATTEMPTED TO DECODE THE SIGNALS AND RECONSTRUCT THE 3-D HAND MOVEMENTS.

neurological disorders such as Parkinson's disease affect the brain's ability to control the body's movements.

Bradberry's groundbreaking research has been covered by *Scientific American,* NPR's *Science Friday,* and TV Globo News (Brazil). The project was supported by the Paris-based La Fondation Motrice.

Story courtesy of and adapted from the press release by Leon Tune, UMD Communications and Marketing.

BENTLEY GROUP FEATURED IN *NATURE NANOTECHNOLOGY*

New research on a self-assembling, all-biological tool engineered to locate specific bacteria and synthesize molecules capable of triggering communication between them, was featured in the January 2010 issue of *Nature Nanotechnology*. The paper, "Engineered biological nanofactories trigger quorum sensing response in targeted bacteria," was authored by Dr. **Rohan Fernandes** (Ph.D. '08, bioengineering), graduate student **Varnika Roy** (molecular and cell biology), graduate student **Hsuan-Chen Wu** (bioengineering), and their advisor, Professor and Chair **William Bentley**.

In 2007, Fernandes, Bentley and their colleagues proposed a new way to fight bacterial infections using nanofactories, engineered molecules that could alter the exchange of signaling molecules, a form of cell-to-cell communication known as quorum sensing. When a certain quantity of signaling molecules is present, it indicates to a population of bacteria that a quorum, or specific quantity of them, has been reached, and they will respond with a predetermined action that could lead to a disease state. Slowing or stopping the communication that leads to pathogenic activity could shut down an infection in progress, while "tricking" bacteria into action before an actual quorum has been reached—that is, before they're organized enough to do harm—could provoke a natural immune system response capable of stopping them without the use of drugs.

Because nanofactories are designed to affect communication instead of trying to kill the bacteria, they could help treat illness in cases where a strain of bacteria has become resistant to antibiotics. Nanofactories could also reduce or eliminate the side effects associated with antibiotics because they can be guided directly to the infection site rather than having to travel throughout the body. The Bentley Group envisions the use of nanofactories as the next big step in antimicrobial treatment.

Their latest nanofactory design is, according to Bentley, a leap forward. "This is a completely new, all-biological version," he says. "Our original nanofactories contained magnetic particles, and were guided to a target site using magnetic fields. Once on site, they manufactured and delivered molecules that affected communication in any cells they encountered. The new nanofactories are self-guided and targeted. We've demonstrated for the first time that they're capable of finding a specific kind of bacterium and inducing it to communicate, a much finer level of automation and control."

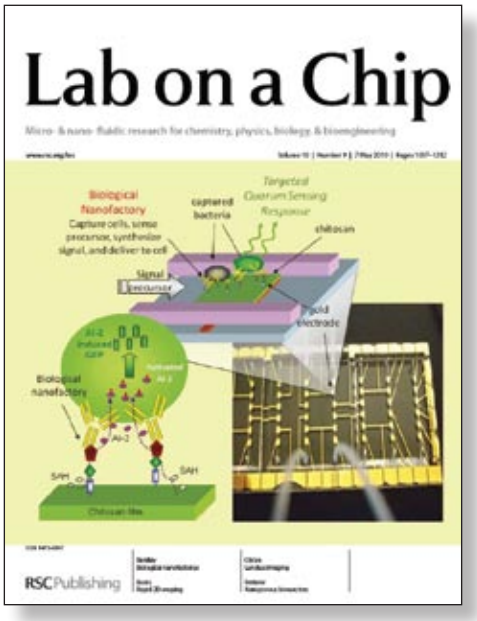


Image reproduced by permission of William E. Bentley and the Royal Society of Chemistry from Fernandes et al. Lab on a Chip, 2010, 10, 1128 – 1134.

The nanofactories' ability to alter cell-to-cell communication isn't limited to fighting infections. "Quorum sensing and signaling molecules are actually used to accomplish a lot of things," Bentley explains. "Sometimes disease develops because communication is *not* taking place—a good example is digestive disorders that involve an imbalance of bacteria in the digestive tract. In that case, nanofactories could be used to start or increase communication instead of disrupting it."

The new nanofactories self-assemble when their components are bound together in a controlled chemical reaction facilitated by a protein. They consist of an antibody, which is used for targeting and designed to latch onto the surface of a specific type of bacterium; and a three-step sensing, synthesis and assembly module. The module identifies raw materials near the targeted cell that it can collect and use to manufacture a "universal" signaling molecule known as autoinducer 2 (AI-2), which is used by over 70 species of bacteria.

In tests, the biological nanofactories were introduced to a mixed cell culture in which no quorum sensing was taking place. The nanofactories attached themselves to cells of the correct type, manufactured AI-2 from surrounding molecules, and delivered it to the bacteria's cell surfaces. The presence of AI-2 prompted the cells to start signaling, responding as they would during normal quorum sensing.

The Bentley Group and their colleagues' nanofactory research has received increasing attention and coverage. After being featured in *Nature Naotechnology,* the nanofactories made the inside cover of *Lab on a Chip* ("Biological nanofactories facilitate spatially selective capture and manipulation of quorum sensing bacteria in a bioMEMS device," 2010, 10, 1128–1134). That paper was subsequently reviewed in *Highlights in Chemical Technology.*

LEFT TO RIGHT: FERNANDES, ROY, AND WU ▶

SHAH RECEIVES STEM CELL FUNDS

Assistant Professor **Sameer Shah** received the only 2010 Maryland Stem Cell Research Fund grant awarded to a principal investigator on the University of Maryland College Park campus. The project will receive up to $115,000 per year over two years. Shah was one of 42 total recipients statewide, and one of 19 investigators who received an Exploratory Grant, which is given to scientists new to stem cell research, and to those proposing new and novel approaches in the field.

Shah, the director of the Neuromuscular Bioengineering Laboratory, will explore how factors in the mechanical environment in which stem cells grow, such as tension or load-bearing, affect their ability to differentiate into functional motor neurons. The creation of new motor neurons from stem cells has the potential to treat spinal cord injuries and a variety of neurodegenerative disorders, including amyotrophic lateral sclerosis (ALS, also known as Lou Gehrig's disease), primary lateral sclerosis, bulbar palsies, and progressive and spinal muscular atrophy. In order for this type of treatment to be effective, new motor neurons that develop from stem cells must eventually achieve functional connectivity with target muscle fibers; in other words, they must be capable of reconnecting with muscles that are no longer being stimulated and successfully transmit commands to contract.

"The cells' mechanical environment is important for a couple of reasons," says Shah. "During development, motor neurons are under tension as the muscle, bone, and other tissue around them grow—it's something they need in order to mature. You could think of this as the neurons being tethered to something under mechanical stress, which they feel by association. For example, if you have two bungee cords side by side that are connected to each other in the middle, and you pull on one of them, the second one will also be stretched, coming along for the ride. Neurons in adults are also under tension, and may be placed under even more tension as we move around. For these reasons, any treatment strategies involving stem cells need to factor in mechanical aspects of their environment when they are implanted and as they mature."

BIOE UNDERGRADS SHINE AGAIN IN BIOETHICS CONTEST

Freshmen **Miranda (Mandy) Hagen**, **Katherine Ip**, and **Mariya Sitnova** were three of the five finalists in the Institute of Biological Engineering's (IBE) annual bioethics essay contest. Hagen took third prize for her essay "Addressing Public Concerns about Synthetic Biology," while Ip and Sitnova received Honorable Mentions. The students presented their essays at the IBE's annual conference in March, where the winners were decided.

Over the three years the IBE has run the contest, bioengineering majors from the University of Maryland have dominated it, representing eleven of the fifteen total finalists and scoring two first place, a second place, and two third place wins.

Each of the essays entered into the contest answered the question, "In the context of synthetic biology, how should the public's concerns regarding safety and ethics be heard and integrated?" Synthetic biology, also known as synbio, is a relatively new but controversial field of study in which scientists create new biological components of life "from scratch" or redesign existing systems for new or improved uses.

Hagen's essay argues that those working in the field of synthetic biology, particularly those in leadership roles, need to recognize and address the public's concerns as a matter of policy, as well as make it clear that they consider the ethical implications of their work very seriously. The difficulty in gaining public acceptance, she says, tends to spring from a lack of information.

"The research needs to be widely available and needs to contain thorough descriptions of how it could influence the world, both positively and negatively, as well as understandable methods and detailed descriptions of the results and unbiased analysis," she writes. "A well-informed public…will not make judgments based on hearsay or rumors." Hagen hopes that a proactive effort to educate the public could help prevent beneficial synbio projects from being held back by the same ethical issues that affect stem cell research.

Hagen was "thrilled" to be part of the conference. "It was encouraging to see so many people near my own age getting involved in bioengineering and making a difference in the world," she says. "The conference was also a wonderful networking opportunity. One professor from Penn State even e-mailed me after the conference to compliment my speech and ask if I was interested in joining his iGEM [International Genetically Engineered Machine competition] team for this summer. All of this, combined with touring Boston and visiting MIT, made for an extremely rewarding experience."

AYYUB WINS OUTSTANDING ASPIRE STUDENT RESEARCH AWARD

Fischell Department of Bioengineering senior (now incoming graduate student) **Omar Ayyub** (B.S. '10), advised by Professor **Peter Kofinas**, was the recipient of the 2010 Outstanding ASPIRE Student Research Award for his work on polymer-based hydrogels that can selectively bind hemoglobin. ASPIRE, A Scholars Program for Industry-Oriented Research in Engineering, run by the A. James Clark School of Engineering, offers students the opportunity to move beyond the classroom by working with engineering faculty or staff on real-world engineering projects.

Ayyub worked in collaboration with Kofinas and former Fischell Fellow **Dan Janiak** (Ph.D. '09) on developing and improving polymers capable of recognizing and capturing specific peptides, proteins, and larger macromolecular structures such as viruses. Ayyub introduced positive and negative charges into the hydrogels in an effort to increase their selectivity and specificity. The work could lead to inexpensive alternatives for protein purification, especially in the production and purification of vaccines. Ayyub co-authored and published two papers about the results, including one in the high-impact journal *Macromolecules.*

The research conducted in Kofinas' Functional Macromolecular Laboratory appealed to Ayyub, and his decision to join the group shaped his Clark School

ALLON MEIZLIK

experience. "Dr. Kofinas was my ENES 100 professor the second semester of my freshman year," he explains. "I decided to visit his web site and read about his research. I immediately spoke to him in hopes of becoming an undergraduate researcher in his lab. The experience convinced me to switch my major to bioengineering."

Working on the project has been rewarding for him. "My favorite experience would have to be the first time I saw positive results during an experiment, and knew that our theory had an effect in reality."

This is the second year in a row a student from Kofinas' lab has won the ASPIRE research award. In 2009, junior **Adam Behrens** (Department of Chemical and Biomolecular Engineering) won for his work on blood-coagulating hydrogels.

BIOE MAJOR ADDRESSES SPRING 2010 GRADUATES

Fischell Department of Bioengineering senior **Allon Meizlik** (B.S. '10) was selected to address graduating students, faculty, family and friends at the A. James Clark School of Engineering Spring 2010 Commencement ceremony.

Meizlik reflected on his time at the Clark School, including his attempt to build a hovercraft in his Introduction to Engineering Design course—an experience, he said, that taught him some of the most important lessons he and his fellow students needed to learn about teamwork and the meaning of success, which didn't always include building something that worked.

"Our experiences over the past four years have prepared us to take risks and reap the rewards," Meizlik said. He went on to praise the support and inspiration faculty and students provide to each other, and a learning environment that taught him and his classmates not only to succeed, but also how to deal with and benefit from the experience of failure. "It is an engineer's privilege to better the world," be said, "[but] I think that we have had the added privilege of being engineers here, at the A. James Clark School of Engineering."

Meizlik will join Accenture in Philadelphia this fall as a consultant in their Technology Growth Platform division. He spent his summer traveling with friends and visiting his family.

"The past four years have been amazing," he says of his undergraduate experience. "I've made great friends inside and outside of the classroom and have learned a lot about engineering along the way. I was honored to speak at Commencement and be able to share the excitement of the day with all of our family and friends."

KOFINAS KEYSTONE TEAM WINS SPRING 2010 HOVERCRAFT COMPETITION

A team of students advised by Professor **Peter Kofinas** won the Spring 2010 ENES 100: Introduction to Engineering Design autonomous hovercraft competition. Their hovercraft was the first to complete this particular course without faults during an official timed and scored trial at the finals.

ENES 100 and the hovercraft competition are part of the Clark School's Keystone program, which is dedicated to excellence in the teaching of fundamental engineering courses. The program serves as a national model for increasing engineering student retention and graduation rates.

Each semester, teams of engineering students from all majors design and build hovercraft equipped with fans, a steering system, an on-board computer, and sensors. The vehicles, which average about three feet in length, are not remote controlled—they must guide themselves through a course while accomplishing tasks along the way. Each team tries to program its hovercraft to complete the course within a specified amount of time without bumping into its walls.

"We had a very challenging product specification which required the hovercraft to locate and depress a switch, navigate under a gate, and then complete a four turn track," says Keystone Instructor **Kevin Calabro**. "Small changes in battery charge, rotation, and friction can yield very different performances for these craft each time they run."

"ENES 100 has really been a great opportunity for us as a predominantly freshman team because we learned the process of developing a product early in our engineering education," says **Emily Dumm**. "There were times when we didn't know what to do next or if the hovercraft would work out at all, but as a team, we took the process one step at a time and solved each problem as it came up. This has been really fun for all of us and I think we've all gained a lot from it, from teamwork experience to a taste of engineering success."

Team Legend member **Thom Lashier** agrees. "Winning the competition represented months of work and extra hours in the lab trying to get Ms. Magoo [the hovercraft] to work perfectly."

"The best part about all this," teammate **Keegan Brenneman** adds, "is that nobody can take away from us that we were the first team to ever run this course successfully at the finals."

TEAM LEGEND. LEFT TO RIGHT: KEYSTONE PROFESSOR **PETER KOFINAS**, **PAUL YAGINUMA** (UNDECIDED), **STEVEN MURRAY** (CIVIL ENGINEERING), **KEEGAN ERIC BRENNEMAN** (UNDECIDED), **SUDIP BHATTACHARJEE** (UNDECIDED), **EMILY DUMM** (UNDECIDED; HOLDING HOVERCRAFT), **KRISTOPHER SHEA** (CIVIL ENGINEERING), AND **JOE KREFT** (MECHANICAL ENGINEERING). NOT PICTURED ARE **RICHARD BAIK** (BIOENGINEERING), **ADDISON GOODLEY** (BIOENGINEERING), AND **THOM LASHIER** (CIVIL ENGINEERING).

student AWARDS

Congratulations to the following students, who were recognized at the Clark School's 2009-2010 Honors and Awards Ceremony held this spring. They have all demonstrated outstanding academic and research performance, and have made contributions to the Department and field. Complete award citations are available on our web site at: **www.bioe.umd.edu/news/news_story.php?id=4843**

DEPARTMENT AWARDS

THE ASABE, AMERICAN SOCIETY OF AGRICULTURAL AND BIOLOGICAL ENGINEERS' STUDENT HONOR AWARD

Presented by the American Society of Agricultural and Biological Engineers (ASABE) on the basis of academic achievement, service to the department, student branch participation, and other extracurricular activities.

Awarded to Jessica Tsaoi

THE WASHINGTON, D.C.-MARYLAND SECTION OF ASABE, AMERICAN SOCIETY OF AGRICULTURAL AND BIOLOGICAL ENGINEERS' SCHOLARSHIP

Presented to outstanding students based on academic achievement and contributions to the department and student ASABE branch.

Awarded to Omar Ayyub and Jennifer Lei

THE FISCHELL DEPARTMENT OF BIOENGINEERING'S OUTSTANDING JUNIOR AWARD

Presented by the Chair on the basis of outstanding academic achievement and contributions to the department.

Awarded to Kathleen Jee and Zachary Russ

THE FISCHELL DEPARTMENT OF BIOENGINEERING'S OUTSTANDING SENIOR AWARD

Presented by the faculty on the basis of academic achievement and contributions to the profession and the department.

Awarded to Erik Li and Pratiksha Thakore

THE FISCHELL DEPARTMENT OF BIOENGINEERING'S OUTSTANDING RESEARCH AWARD

Presented by the faculty on the basis of significant contributions to research, the department, and the field of bioengineering.

Awarded to Chetan Pasrija

THE FISCHELL DEPARTMENT OF BIOENGINEERING'S OUTSTANDING VOLUNTEER AWARD

Presented to an excellent student who has contributed many hours of service to others.

Awarded to Andrew Demaio

THE FISCHELL DEPARTMENT OF BIOENGINEERING'S OUTSTANDING CITIZEN AWARD

Presented to an excellent student who has contributed significantly to the community, department, university, and profession.

Awarded to Elizabeth Kim

CAPSTONE DESIGN AWARDS SPONSORED BY MRS. SUSAN FISCHELL

See our coverage of the Senior Capstone Design projects on pp. 11–12 to learn who won our annual Capstone Design Awards.

alumni NEWS

ALUMNA LU JIANG RECEIVES CHINESE GOVERNMENT AWARD

Lu Jiang (Ph.D. '09, biological resources engineering), formerly advised by Professor **Yang Tao**, received a Chinese Government Award for Outstanding Self-Financed Ph.D. Students Abroad. The prestigious, highly selective award recognizes top international Chinese doctoral students in all areas of study. Jiang was one of 500 students selected from over 100,000 candidates in 29 countries. She received a $5000 cash prize and was recognized at a reception held at the Education Affairs Office of the Chinese Embassy in Washington, D.C. in May 2010.

"I feel very lucky that I [studied] at the University of Maryland," Jiang wrote in an e-mail to the department. "Winning this award would have not been possible without the excellent training I received from both [Tao's] Bio-Imaging & Machine Vision Laboratory and the department. I would like also give my thanks to Dr. Tao and all the [people] who helped me in many ways during my Ph.D. studies."

At Maryland, Jiang worked on advanced imaging and data mining technologies for applications in food and medical safety. During her years as a graduate student, she published over ten journal articles, a book chapter, and seven conference papers, and was also the recipient of a 2008 Ann G. Wylie Dissertation Fellowship. Her work about hyperspectral imaging in automated walnut sorting was reported by *Vision System Design* magazine, which serves the machine vision industry.

Jiang is currently a research fellow at the Johns Hopkins University Medical School, where she specializes in breast cancer imaging research.

▼ DR. LU JIANG

ALSO IN ALUMNI NEWS...

Dean Berlin (M.S. '09) attended the Organizing for America's National Health Care Forum, which highlighted President **Barak Obama**'s presentation and response to questions from a group of about 50 people. Dean has been featured in one of the administration's TV spots for its health care plan, and was very active in the Obama campaign and its follow-up efforts.

Jeff Goldberg (B.S. '98, biological resources engineering) is the founder and CEO of Cali Bamboo, a provider of a wide variety of eco-friendly bamboo building products, including rugs, paneling, floors, window blinds, thatch, and fences. The company was recently recognized by the San Diego Business Journal as one of the California's fastest-growing companies.

Jennifer Hong (Ph.D. '10) and her collaborators published a paper describing a new method of combining two substances that individually have generated interest for their potential biomedical applications: a phospholipid membrane "bubble" called a liposome and particles of hydrogel, a water-filled network of polymer chains. Their combination forms a hybrid nanoscale vesicle (spherical container) that may one day travel directly to specific cells such as tumors, pass easily though the target's cell membranes, and then release a drug payload. To manufacture the vesicles, the researchers adapted a technique known as COMMAND (COntrolled Microfluidic Mixing And Nanoparticle Determination) in which the phospholipids self-assemble around the hydrogel molecules as they mix at the junction of two microfluidic streams. The newly formed vesicles are then irradiated with ultraviolet light to polymerize the hydrogel precursors they carry into a solid gel, strengthening the final product.

See J.S. Hong et. al. Microfluidic directed self-assembly of liposome-hydrogel hybrid nanoparticles. Langmuir, *2010, 26 (13), pp. 11581–11588.*

student AWARDS *continued*

CLARK SCHOOL AWARDS

OUTSTANDING ASPIRE RESEARCH AWARD

Presented by the Maryland Technology Enterprise Institute to the ASPIRE (A Scholars Program for Industry-Oriented Research in Engineering) student who has carried out the most successful research project. *See story, p. 6.*

Awarded to Omar Ayyub

THE CENTER FOR MINORITIES IN SCIENCE AND ENGINEERING SERVICE AWARD

Presented to an engineering student who demonstrates dedicated service to the center and the university community and commitment to promoting diversity in engineering.

Awarded to Olufemi Sokoya

THE KIM A. BORSAVAGE AND PAMELA J. STONE STUDENT AWARD FOR OUTSTANDING SERVICE

Presented to an engineering student for outstanding service and dedication to the Clark School.

Awarded to Allon Meizlik

THE KEYSTONE DESIGN CHALLENGE AWARD

Presented to the freshman engineering design teams that build an autonomously controlled hovercraft that completes a specified course in the minimum amount of time. *See related story, p. 7.*

Miranda Hagen, part of Team Red October, was a winner in the Fall 2009 Keystone Design Challenge.

DEAN'S DOCTORAL RESEARCH AWARD

Presented to a top Clark School doctoral student for high quality engineering research. *See story, p. 12.*

Awarded to Matthew Dowling

OTHER AWARDS

THE INSTITUTE OF BIOLOGICAL ENGINEERING'S ANNUAL NATIONAL BIOETHICS ESSAY AWARDS

Third Place: Miranda Hagen
Honorable Mentions: Katherine Ip and Mariya Sitnova

See story, p. 6.

SENIOR MARSHAL FOR UNIVERSITY COMMENCEMENT

The Senior Marshal program recognizes graduating seniors who have demonstrated the highest levels of scholarship, service to the campus community, extracurricular involvement, and personal growth. Senior Marshals help facilitate and guide Commencement's student processional, and are recognized at the ceremony.

Elected Marshal: Steven Graff

THE ZAIN AWARD

Presented to a student of Molecular and Cell Biology from a developing country for excellence in research. *See story, p. 12.*

Awarded to Varnika Roy

2010 Capstone Projects

DEVICES FOR DIAGNOSTICS, IMPROVED TREATMENTS AND PERSONAL HEALTH

Bioengineering seniors presented their final projects and demonstrated their prototypes at the May 2010 Capstone II finale, the culmination of two semesters of research and testing, market analysis, challenges and successes. This year our teams and their faculty advisors partnered with physician mentors from Georgetown Medical School, MedStar Health, the University of Maryland Medical Center, and the Washington Hospital Group.

Mrs. **Susan Fischell** is the creator and sponsor of our annual Capstone Design Awards. In this competition, launched in 2009, the top three project teams as selected by a panel of judges win monetary prizes donated by Mrs. Fischell and are invited to present their work to the public at the Fischell Festival. *(See related story, pp. 14-15.)* Winners of the 2010 Capstone Awards are noted in the project descriptions below.

Our seniors would like to thank their on- and off-campus mentors, the department's lab and administrative staff, the faculty, our judges, and friends in outside academia and industry for the advice and supplies they donated that helped these projects succeed.

THORLABS' QUANTA: PORTABLE QUANTIFICATION IMAGING SYSTEM

Team: *Jonathan Ament, Hsiang Lan Chan, Daniel Fam, Steven Graff, and Ziad Mahmassani*

Faculty Advisor: *Assistant Professor Yu Chen*
Mentor: *Dr. Suraj S. Venna, Washington Hospital Center*

Skin cancer is the is most common form of cancer diagnosed in the United States. Dermatologists and other doctors use both visual examination and biopsies to determine whether a skin lesion is cancerous, but a biopsy—taking a tissue sample by cutting away a small part of it—is required for a firm diagnosis. Since visual examinations are not quantitative and biopsies can be painful, the ThorLabs team worked on a new medical device called QUANTA, which can be used to provide skin cancer diagnoses using non-invasive laminar optical tomography. QUANTA applies light from a laser diode to the suspect area of skin, and senses the reflective differences between benign nevi (birthmarks, moles) and malignant or precancerous lesions. The device is designed to be portable and easy enough to use in any doctor's office.

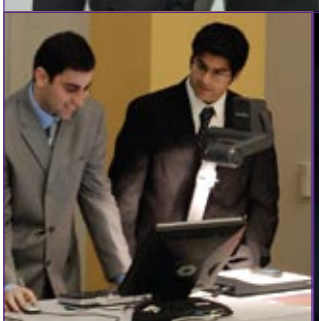
D.E.W.C.: DIAGNOSTIC ELETRO-PHYSIOLOGICAL WIRELESS CATHETER

2RD PLACE, 2010 CAPSTONE AWARDS

Team: *Joseph Davis, Farnoosh Farahi, Amanda Gravenhorst, Mads Matthiesen, and Tiffany Westo*

Faculty Advisor: *Assistant Professor Ian White*
Mentors: *Dr. Amit Shah and Dr. Manish Shah, Washington Hospital Center*

Arrhythmia, a condition in which the heart experiences abnormal contractions, is often treated with a surgical procedure called a catheter ablation. Two small, flexible tubes (catheters) are inserted into the chest. One, the guide catheter, is used by the surgeon to visually navigate through the patient's heart. Radiofrequency energy, transmitted through the second, is used to destroy (ablate) the tiny amounts of heart muscle identified as the origin of the problem, allowing the heart to beat normally again. Currently, the diagnostic information the surgeon receives from the guide catheter is processed by a junction box tethered to the device. This complex system of controls and wires requires intensive setup and is difficult to use. The D.E.W.C. team designed a guide catheter that transmits the same information wirelessly. The signal is amplified, digitized, and sent to a data acquisition system that provides the surgeon with a real-time display. The new device could reduce human error, the surgery time by as much as 45 minutes, and the cost of the procedure by $1000.



◀ TOP: THE MAGNETIC PARTICLE TEAM WITH THEIR MENTORS. BELOW, LEFT TO RIGHT: TEAM CAPRA MEMBER WITH PROTOTYPE, MEMBERS OF THE SAMET GROUP PRESENTING THEIR WORK, AND A LARGE-SCALE MODEL OF COSMA'S STENT WITH ITS PROTOTYPE CONTROL UNIT

THE SAMET GROUP POCKETDOC: EMERGENCY MONITORING SYSTEM

3RD PLACE, 2010 CAPSTONE AWARDS

Team: *Omar Bekdash, Dipankar Dutta, James Pan, James Reilman, and Dennis Truong*

Faculty Advisor: *Professor Art Johnson*
Mentor: *Dr. Ron Samet, UMB School of Medicine*

The PocketDoc is a portable device that supplements first response procedures by transmitting SpO_2 (saturation of peripheral oxygen in the blood) and heart rate information to EMTs before or when they arrive on the scene of a medical emergency, or to doctors before a patient reaches the hospital, saving time and lives in the process. The device, which is designed to be easy to use by people without medical training, can display this quantitative information in real-time on a smartphone by connecting to its serial port, then transmit the same data wirelessly to 911 dispatchers or medical personnel. It is also capable of storing a patient's medical history. The Samet Group envisions the device becoming as common as emergency defibrillators in high-traffic locations such as malls, airports, and military bases, and schools. The device could be offered as a "plug and play" product for consumer use, as well as in a professional version for more advanced data logging.

GLUCOACH: SMARTPHONE INTERFACING GLUCOSE METER AND APPLICATION (SIGMA) FOR DIABETES MANAGEMENT

1ST PLACE (TIE), 2010 CAPSTONE AWARDS

Team: *Omar Ayyub, Andrew DeMaio, Katie Farhang, Nii Mante, and William Richbourg*

Faculty Advisor: *Professor Yang Tao*
Mentor: *Dr. Michelle Magee, Washington Hospital Center*

The GluCoach-SIGMA team used a smartphone and the Android operating system's software development kit to create a go-everywhere, easy-to-use device that enables diabet-

▼ THE CLASS OF SPRING '10 WITH FACULTY AND STAFF

ics to track their insulin, blood sugar, meals, exercise and more. Managing diabetes requires diabetics to stick to routines, plan meals, check their glucose levels, and administer insulin. The tracking of all of this information sometimes becomes burdensome, resulting in forgetfulness or mistakes. Noting that people almost never forget their cell phones, the GluCoach team designed a glucose meter capable of transmitting readings over Bluetooth to a smartphone installed with a suite of software designed to analyze the data, calculate insulin requirements, and help a person maintain a healthy lifestyle by keeping all the information they need at their fingertips.

CAPRA: CAPNOGRAPHIC RESPIRATORY ANALYSIS

Team: *Jennifer Lei, Allon Meizlik, Hector Niera, Charlie Sun, and Jessica Tsaoi*

Faculty Advisor: *Associate Professor Hubert Montas*
Mentor: *Dr. Amit Shah, Washington Hospital Center*

Dyspnea (difficulty breathing or shortness of breath) is a symptom of a variety of cardiovascular and respiratory conditions, many of them serious or life-threatening. It is one of the top five reasons for emergency room visits. Because dyspnea is such a common symptom, patients may experience a delay in the diagnosis of their underlying problem, or could receive inappropriate treatment due to a misdiagnosis. The CAPRA team designed a device that can be fitted into existing ventilator equipment used by hospitals and EMTs that is capable of differentiating whether a patient's dyspnea is caused by asthma, COPD, or pulmonary edema. It uses a combination of capnography, the continuous analysis of the concentration of carbon dioxide exhaled, and signal processing to amplify, transform and analyze signal data picked up from a sensor. The results are displayed as visual waveforms, which take on distinct, easy-to-interpret shapes that are indicative of whether the cause is an obstructive disease.

COSMA: COLLAPSIBLE SHAPE MEMORY ALLOY STENT FOR BILIARY DRAINAGE

Team: *Jessica Bermudez, Dominique Franson, Elizabeth Kim, Megan Kuhn, and Pratiksha Thakore*

Faculty Advisor: *Associate Professor Elias Balaras*
Mentors: *Dr. Filip Banovac and Dr. Kevin Cleary, Georgetown Medical School; Dr. Robert E. Fischell; and Dr. Teng Li and Dr. Guangming Zhang, Department of Mechanical Engineering*

In the human body, the biliary tract is a network of ducts that transport bile from the liver through the common bile duct and to the small intestine, where it aids in digestion. If the biliary tract becomes obstructed (for example, by a tumor, gallstones, or inflammation), doctors may insert a thin, flexible tube called a catheter in order to drain excess bile. Multiple procedures may be required to insert, adjust, and remove the catheter, which increases cost, patient discomfort, and the risk of infection. Team COSMA designed a biliary catheter with a built-in stent—a tiny metal scaffold—made out of a shape memory alloy called nitinol. Initially, the catheter is very narrow, allowing doctors to insert it by making only a small incision. Once in place, voltage is applied to the catheter. When it reaches the portion containing the stent, the stent reacts by "unfolding," making the catheter wider and pushing open the blocked area of the biliary tract. When the catheter is no longer needed, heat is applied, which returns the stent to its collapsed state and the catheter to its normal diameter. Doctors are then able to remove the catheter through the same small incision site. The new product has the potential to make the procedure safer, more cost-effective, and less painful.

MAGNETIC PARTICLE STEERING BY ACTIVE CONTROL OF MAGNETIC FIELDS FOR THE PURPOSE OF DRUG TARGETING:

1ST PLACE (TIE), 2010 CAPSTONE AWARDS

Teeam: *Erik Li, John Lin, Chetan Parrija, Michael Tsai, and Jeffery Zhang*

Faculty Advisors: *Associate Professor Benjamin Shapiro and Assistant Professor Silvia Muro*

Many patients receiving chemotherapy for cancer become ill or die because of its side effects, a problem which has led doctors and scientists to explore how to accomplish more with fewer treatments. Magnetic drug delivery, in which magnetic fields are used to guide therapeutic magnetizable nanoparticles to specific regions of disease, is one possible solution. The Magnetic Particle Steering Team worked on ways to improve the delivery of drug-carrying magnetic nanoparticles to deep tissue tumor sites. They developed an algorithm to model and predict the nanoparticles' behavior, a high spatial resolution imaging system capable of tracking them en route, and a biomimetic synthetic vascular system that simulates blood flow in the human body, which they used to test their ability to guide their nanoparticles through specific channels. The team demonstrated that their improved delivery system can result in up to four times more therapeutics reaching the site of tumor per treatment, which translates into less chemotherapy and fewer side effects for the patient.

Our panel of judges included Professor **Leigh Abts** (College of Education/BioE), **Brian Lipford** (Partner and VP of Strategic Initiatives, Key Technologies Inc.), and Dr. **Jafar Vossoughi** (President, Biomed Research Foundation and adjunct faculty, BioE).

The Department would like to express its deep appreciation to Mrs. **Susan Fischell** for her generosity and vision in promoting and forwarding our students' work, and to our judges for their time.

◀ A MEMBER OF THE THORLABS TEAM WITH THEIR PROTOTYPE QUANTA DEVICE

▲ ABOVE: A SMARTPHONE RUNNING GLUCOACH USING THE ANDROID OPERATING SYSTEM

ROY WINS ZAIN AWARD

Graduate Program in Molecular and Cell Biology (MOCB) student **Varnika Roy**, advised by BioE professor and chair and MOCB affiliate professor **William Bentley**, has received the 2009 Zain Award in recognition of her research.

Roy works in Bentley's Biomolecular and Metabolic Engineering Laboratories, where she is involved in developing methods that can be used to interrupt cross species bacterial communication, also known as quorum sensing, which controls pathogenicity and increased virulence in many bacteria. *(See related story, pp.4-5.)* As an increasing number of bacteria species become resistant to antibiotics, disruption of the communications that cause them to do harm could be a new and effective way to treat disease, and could also lead to the next generation of antimicrobial drugs.

Roy is also a member of the Maryland Biochip Collaborative, where she is involved in studying quorum sensing and its inhibition in a controlled microfluidic environment.

The Zain Award, named for the late Professor **Zain-ul-Abedin** (Department of Biochemistry), is given annually to a MOCB student from a developing country for excellence in research. Zain, who was particularly interested in molecular biology, maintained an active international research program and was a dedicated educator throughout his career. Friends and family established the Zain Award in his honor in order to assist students from developing countries pursue careers in molecular biology.

STROKA WINS NIH GRANT FOR CARDIOVASCULAR RESEARCH

Graduate student **Kimberly Stroka**, advised by Assistant Professor **Helim Aranda-Espinoza**, received the National Institutes of Health (NIH) Ruth L. Kirschstein National Research Service Award. The award, a predoctoral fellowship which includes a stipend, tuition, and allowances for health insurance, travel, and materials, will fund her final two years of graduate school.

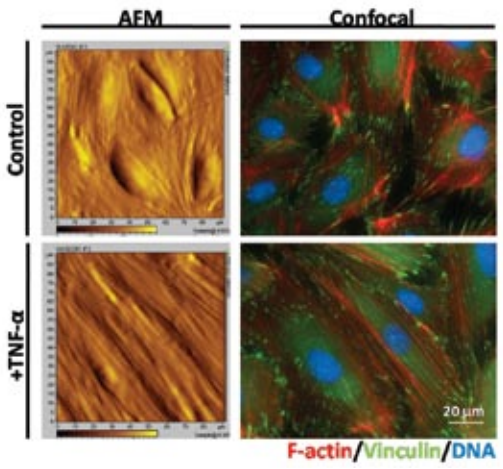
Stroka, who conducts her research in the Cell Biophysics Lab, won the fellowship for her proposal to study how artery tissue stiffened by atherosclerosis (a type of cardiovascular disease, CVD) affects how leukocytes (white blood cells) enter through the endothelium, the layer of cells lining blood vessels. While her proposal is mainly targeted at understanding the forces involved as leukocytes migrate along and transmigrate through the endothelium, someday her results may help to find better ways to predict the onset of potentially deadly conditions such as strokes and heart attacks.

The role of leukocytes in CVD is central in Stroka's study. Leukocytes are the soldiers of the human immune system, called to respond to injury and fight disease. But in an ironic twist, she says, their behavior may lead to CVD under certain conditions.

When leukocytes transmigrate into a blood vessel where endothelial cell walls have been damaged by low-density lipoproteins (LDL, popularly known as "bad cholesterol"), their response is to remove the problem by absorbing the LDL. "Unfortunately, the leukocytes aren't capable of breaking down the LDL, and this eventually leads to a pathological state," Stroka explains. "The leukocytes turn into what are called 'foam cells' and form a plaque beneath the endothelial cells. If this plaque continues to grow, it eventually becomes so large that it obstructs blood flow, which could lead to a stroke or a heart attack. So atherosclerosis is actually caused by an increase in the activity of the cells that are supposed to protect us."

Stroka will be studying the mechanical stresses that affect the damaged endothelial cells during the process: shear stress from the flow of blood above them and the stress exerted by the stiffening of the arterial tissue on which they rest. To accomplish this, she has devised a new, more accurate way of simulating healthy and diseased arteries in the lab that will allow her to both control and apply different combinations of forces to cultured endothelial cells. Using methods such as atomic force microscopy, traction force microscopy, and confocal microscopy, she plans to measure how these combinations of forces affect both the mechanical properties of the endothelial cells and also the process of leukocyte transmigration. The results could provide a clearer and more detailed explanation of the conditions leading to and progression of atherosclerosis.

"In the future," says Stroka, "we might be able to gauge the onset of atherosclerosis or an oncoming stroke based on the behavior of a patient's immune system, or develop new drugs to restore elasticity to the arteries.



THIS IMAGE SHOWS BOTH ATOMIC FORCE MICROSCOPY (AFM, LEFT SIDE) CONTACT IMAGES AND CONFOCAL IMAGES (RIGHT) OF ENDOTHELIAL CELL MONOLAYERS ON A STIFF SURFACE, UNDER BOTH CONTROL AND TNF-ALPHA-ACTIVATED CONDITIONS. TNF-ALPHA IS A TREATMENT THAT INDUCES THE INFLAMMATORY RESPONSE OF ENDOTHELIAL CELLS AND ALLOWS IMMUNE CELLS TO ATTACH TO THE SURFACE. THE AFM IMAGE ALLOWS STROKA AND HER COLLEAGUES TO OBSERVE THE TOPOGRAPHY OF THE ENDOTHELIAL CELL MONOLAYER, AND AT THE SAME TIME TAKE FORCE MEASUREMENTS WITH THE AFM TO QUANTIFY THE STIFFNESS OF THE CELLS. THE CONFOCAL IMAGE ALLOWS STROKA TO OBSERVE THE MAJOR SITES OF FORCE TRANSDUCTION, I.E. THE F-ACTIN CYTOSKELETAL NETWORK (RED) AND THE FOCAL ADHESIONS (GREEN). CELL NUCLEI ARE SHOWN IN BLUE.

In order to accomplish that, we need a quantitative understanding of leukocyte transmigration and the forces involved. It's going to be crucial to the development of better diagnostics and treatments for cardiovascular disease."

DOWLING WINS DEAN'S DOCTORAL RESEARCH AWARD COMPETITION

Graduate student and Fischell Fellow **Matthew Dowling**, advised by Associate Professor **Srinivasa Raghavan (**Department of Chemical and Biomolecular Engineering), took first place in the 2010 Dean's Doctoral Research Award Competition for his dissertation, "Blueprinting Self-Assembled Soft Matter: An 'Easy' Approach to Advanced Biomaterial Synthesis in Drug Delivery and Tissue Engineering."

To give top Clark School doctoral student researchers special recognition that will be valuable in launching their careers, and to show all students the importance of high quality engineering research, Clark School Dean and Farvardin Professor **Darryll Pines** created the Dean's Doctoral Research Award in 2009. Students submit their work through competitions at the department level, with winners from each advancing to the Dean's finals.

While Dowling is perhaps best known for his work on the haemostatic (blood clotting) products he and his colleagues are developing for their startup company, **Remedium Technologies** *(see story, p. 17),* his dissertation research focused on soft matter, materials that are deformable solids or highly viscoelastic liquids (Jello and Silly Putty are two simple examples). Dowling drew inspiration from biology by designing biomaterials that self assemble and are similar in structure to cells and their organelles.

Dowling's dissertation describes four soft matter systems: a triggered-release hydrogel created by embedding pH-sensitive vesicles in a gelatin matrix; hybrid biopolymer capsules containing drug-loaded vesicles (hollow spheres made out of lipids) by means of a one-step self-assembly process; therapeutically functionalized biopolymer films; and a biopolymer that transforms a suspension of whole blood or soft tissue cells into a gel. These materials have various biomedical engineering applications, including controlled drug release, targeted drug delivery, wound healing, blood clotting, and tissue engineering.

"Matt is richly deserving of this prestigious honor," says Raghavan. "He is a unique individual and the model for a new breed of engineers, with a combination of superb scientific skills as well as the business and entrepreneurial skills needed to be the CEO of a promising startup company. As one of the first Fischell Fellows, he was challenged to bring biomedical discoveries from the lab to the market, and he has done just that."

VIRGILE NAMED 2010 FISCHELL FELLOW

The Fischell Department of Bioengineering is pleased to welcome the newest recipient of the Fischell Fellowship in Biomedical Engineering, incoming graduate student **Sean Virgile**.

The Fischell Fellowship is a unique opportunity for talented and innovative graduate students interested in applied research and product design in the biomedical industry. It features a $35,000 12-month stipend, full tuition waiver and full health benefits, and is renewable for up to five years.

Virgile earned his B.S. in biomedical engineering form the University of Rochester, where his undergraduate research focused on ocular drug delivery using contact lens material. He also participated in summer Research Experience for Undergraduates (REU) programs at The Johns Hopkins University and the University of Pennsylvania. His current research interests include microfluidics, early cancer detection, and bringing new technologies from the lab to the market.

"I chose Maryland," he says, "because of the close-knit community [of] students and professors, the support for turning research ideas into start-up companies, and the large number of opportunities to perform research both on campus and at government facilities such as the FDA and NIH."

recent DISSERTATIONS & THESES

DECEMBER 2009

M.S.

Qian Li: "Automated Quantification and Classification of Human Kidney Microstructures Obtained by Optical Coherence Tomography" Advisor: Yu Chen

MAY 2010

Ph.D.

Trent Bradberry: "Noninvasive Neural Decoding of Overt and Covert Hand Movement." Advisor: Jose Contreras-Vidal (Kinesiology)

Matthew Dowling: "Blueprinting Self-Assembled Soft Matter: An 'Easy' Approach to Advanced Biomaterial Synthesis in Drug Delivery and Tissue Engineering" Advisor: Srinivasa Raghavan (ChBE)

Jennifer Hong: "Liposome-Hydrogel Nanoparticles: Synthesis Methods and Characterization." Advisor: Srinivasa Raghavan (ChBE)

Leann Norman: "A Biophysical Evaluation of Cell-Substrate Interactions During Spreading, Migration and Neuron Differentiation." Advisor: Helim Aranda-Espinoza

The 2010 Fischell Festival

A CELEBRATION OF BIOENGINEERING'S POTENTIAL TO IMPROVE LIFE FOR MILLIONS OF PEOPLE

In April 2010, the Fischell Department of Bioengineering held its fourth Fischell Festival, featuring a variety of activities including guest speakers, entrepreneurial insights, live video of open heart surgery, the best of this year's senior design projects *(for details, see p. 11)*, a poster session, a career fair and information expo, and seminars. The event concluded with a Whiting-Turner Business and Entrepreneurial lecture presented by department namesake and benefactor Dr. **Robert E. Fischell**.

Video of selected presentations can be found online at ***fischellfestival.umd.edu***.

KEYNOTE SPEAKER: W. JONATHAN LEDERER

This year, we welcomed Dr. **W. Jonathan Lederer**, M.D., Ph.D., Professor and Interim Director of the Center for Biomedical Engineering and Technology (BioMET) at the University of Maryland Baltimore, as our Keynote speaker. Lederer's presentation, "Nanobiology Investigations in Living Single Heart Cells: Stretch-Activated Ca2+ Sparks and Arrhythmias," described his research group's efforts to develop new instruments for measuring and visualizing electrical signals originating from heart cells, for the purposes of understanding what happens during arrhythmias. They studied localized calcium signaling in individual heart cells, called "sparks." Sparks build up throughout each heart cell, finally coalescing into a calcium "wave" that causes the cell to contract. If there are too many sparks or they are incorrectly distributed, abnormal contraction—an arrhythmia—occurs.

Lederer's group designed a patent-pending device that can hold and stretch a heart cell in different ways to measure the forces acting on it as the sparks are produced. They found that overstretched heart cells trigger "a huge spark reaction," which multiplied over thousands of cells fuse to form not just an electrical wave, but a "tsunami," causing the heart to contract erratically. This knowledge will help scientists and doctors identify the underlying problems that cause arrhythmias.

FISCHELL FELLOWS SHARE THEIR EXPERIENCES IN ENGINEERING ENTREPRENEURSHIP

In his talk, "Building a Company as a Graduate Engineering Student: How the University of Maryland Makes it Possible and Why it Makes More Sense than Ever," current Fischell Fellow **Matthew Dowling** shared his adventures in entrepreneurship with the audience, explaining why the Clark School in particular was the perfect place to take the plunge. His company, Remedium Technologies, is developing sprays, foams, and bandages designed to stop heavy bleeding and treat chronic wounds more effectively.

"Only the marriage of engineering and business creates real solutions," said Dowling, who believes that engineers "are ripe to become entrepreneurs" because they already possess many of the right qualities and skills: passion, innovation, persistence, leadership, and a desire to learn. What they're often missing are the business skills. At the Clark School, the Maryland Technology Enterprise Institute (Mtech) is available to give students and faculty an edge by providing them with mentorship, development, networking and venture capital programs. Dowling credits Mtech with playing a crucial role in his growth as an entrepreneur and with Remedium's continued success. The support and spirit of his Fischell Fellowship, he says, provided the inspiration.

Former Fischell Fellow and alumnus Dr. **Dan Janiak** (Ph.D. '09) picked up where Dowling left off with his lecture, "A Venture Adventure," in which he offered a primer on the relationship between engineering entrepreneurs and venture capital companies. Like Dowling, he stressed the importance of the Fischell Fellowship in enabling him to pursue his scientific passions and Mtech in preparing him to interact with the venture capital industry. Turning a biotechnology product into a company, he explained, is often very difficult because of government regulations and approvals, so getting an education and experience in business while a student—especially by taking advantage of programs like Mtech's—is essential: "Your interest in entrepreneurship should not start when you start looking for a job," he said. "Understand that it's not about technology looking for a market, but the other way around."

LIVE MITRAL VALVE REPAIR

The Kim Building's monitors and screens switched from slides to surgery as the audience was connected live to Dr. **James S. Gammie**, M.D., Associate Professor of Cardiac Surgery at University of Maryland Medical Center. That morning, Gammie was performing a mitral valve repair, an open heart surgery used to treat the narrowing or leaking of the inflow valve used to conduct blood from the left atrium to the left ventricle. If the mitral valve's flaps are weakened or damaged by age, a birth defect, or an infection, blood washes back into the lungs, forcing the heart to work harder and wear out sooner. In this case, Gammie repaired the valve by replacing its chordal apparatus, the elastic "heart strings" that support it, with GORE-TEX® sutures. To test the seal, a member of his team flowed saline solution through the valve, allowing Gammie to adjust the sutures as needed to obtain the perfect fit.

AFTERNOON SEMINARS

"Engineering the Public's Health: A Global Perspective"

Robert Gold, Professor and Dean
University of Maryland School of Public Health

While personalized medicine specially tailored for individual patients based on genetics, history, or other factors is a growing trend in the field of bioengineering, Professor and Dean

◀ CAREER/INFO FAIR ▲ DAN JANIAK

FEST PHOTOS: LUISA DiPIETRO & AL SANTOS

▲ MITRAL VALVE REPAIR

WOULD YOU LIKE TO PARTICIPATE IN THE NEXT FISCHELL FESTIVAL?
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of the School of Public Health Dr. **Robert Gold** urged engineers not to forget about the impact their work can have at the community, national, or global scale.

Gold asked engineers to consider the biomedical needs that will result from threats to public health: disparities in healthcare availability among varying populations, the "new epidemic" of childhood obesity, changes in quality adjusted years of life, evolving definitions of family, preventable diseases, and more people seeking treatment for mental illness. According to Gold, virtually all research and innovation will ultimately have some impact on public health.

"The Story of Amalga in the Straits of Messina: Navigating Innovation between Scylla (Bad Design) & Charybdis (Failed Implementation)"

Mark Smith, M.D.
Director, MedStar Institute for Innovation

How do you navigate a project through rough waters? Once the scientist has produced the product, how does he or she secure buy-in from the bio or medical community? Those were the questions Dr. **Mark Smith**, M.D., Director of the MedStar Institute for Innovation, hoped to answer in his talk.

Smith presented a case study about Amalga, an information system for hospitals and other healthcare providers. When he was recruited to make the Washington Hospital Center's ER work more efficiently, he believed that application of new information technology was the key to improving clinical care. He described the design strategies he and his team used to create Amalga, release it to the ER, and eventually get the rest of the hospital on board. These included never forcing end users to adopt a technology, avoiding overdesign, liberating data from proprietary systems, and having access to a discretionary budget, which provides leadership with the power to make unexpected changes. "Fail early, often, and cheaply," he advised the audience, and, he added, remember that less is more: "Great ideas can be reduced to a bumper sticker."

"Magnetic Drug Delivery: From Magnets that Can Push, to Simulations, to Precision Control"

Benjamin Shapiro
Associate Professor, Fischell Department of Bioengineering and Institute for Systems Research

Associate Professor **Benjamin Shapiro**, director of the Control of Micro and Nano-Scale Systems Laboratory, described his research group's efforts to design better ways to magnetically manipulate nanoparticles introduced into the body to achieve clinical goals. Using advanced numerical simulations to accurately predict *in-vivo* behavior of magnetic nanoparticles, they have improved the design of magnetic drug delivery systems. Shapiro presented the results of an experiment in which a combination of magnets created push forces that delivered nanoparticles to the inner ear, enabling the targeting of disease sites that cannot otherwise be reached due to the blood/brain barrier. He also discussed the future of the emerging technology in the treatment of cancer, stressing the need for engineers, clinicians, and other specialists to work together to create optimal solutions.

BIOTECHNOLOGY CAREER FAIR AND INFORMATION EXPO

Eleven companies and organizations were on hand to demonstrate products and discuss careers in bioengineering, biomedical engineering, and biotechnology with interested students, faculty and guests:

- AdvaMed
- AERAS Global TB Vaccine Foundation
- American Association for the Advancement of Science
- Chesapeake PERL
- Henry M. Jackson Foundation for the Advancement of Military Medicine
- Igene Biotechnology
- Kelly Scientific Resources
- MASTRI Center, University of Maryland Medical Center
- Perinatronics Medical Systems
- RNL Biostar
- U.S. Food and Drug Administration

The Fischell Department of Bioengineering would like to thank the Clark School's office of Engineering Co-op and Career Services for organizing the career fair and information expo, as well as all of the companies and organizations that participated.

BIOMEDICAL ENGINEERING FOR IMPROVED HEALTH CARE, REDUCED COSTS AND MORE U.S. JOBS

In his Whiting-Turner Business and Entrepreneurial lecture, Dr. **Robert E. Fischell**, chairman and president of Fischell Biomedical, LLC, discussed how biomedical engineers can create new medical devices that can decrease the cost for patient care while improving the care that those patients receive, and how their manufacture can both create jobs and offset medical costs, which are now rising faster than inflation.

Fischell gave some of his own inventions (currently in development and clinical trials) as examples: an implantable medical device that has the capability to essentially eliminate congestive heart failure, the single greatest medical expense category in the United States; a device to treat migraine headaches without the need for expensive drugs; and a more effective, longer-lasting arterial stent that cuts down on surgery time, post-operative complications, and the need to repeat procedures.

THANK YOU!

The Fischell Department of Bioengineering would like to thank the Fischell family, all of the Fischell Festival's speakers, participants, presenters and guests; and University of Maryland students, faculty and staff, for a wonderful and informative event. We hope to see you all next year!

▲ DR. FISCHELL CHATS WITH STUDENTS

26TH SBEC

2010 SOUTHERN BIOMEDICAL ENGINEERING CONFERENCE HELD AT THE CLARK SCHOOL

The Fischell Department of Bioengineering was proud to host the **26th Southern Biomedical Engineering Conference** (SBEC 26) April 30—May 2, 2010. The event invited representatives from academia, industry, government research laboratories and clinical settings to learn about the latest developments in the theory and application of biomedical engineering.

Sessions covered a broad range of topics, including traumatic brain injury, auditory science, bioengineering and biomedical engineering education, nanotechnology, biomaterials, sickle cell research, cancer, imaging, biomechanics, drug delivery, kinematics, modeling, tissue and cellular engineering, and neural systems. The National Cancer Institute sponsored a special session on "Technologies For Cancer Diagnostics." Conference guests were able to choose from almost 170 presentations and interact with students at a poster exhibition.

SBEC 26's keynote speakers were:

- **John W. Karanian**, Ph.D., United States Food and Drug Administration, Center for Devices and Radiological Health, who spoke on "Medical Imaging and Analytical Tools in Bioengineering Research;"
- **Stefanie Jeffrey**, MD, Stanford University School of Medicine, who spoke on "Circulating Tumor Cells (CTC): Emerging Technologies for cancer Detection, Diagnosis & Prognosis;" and
- **John Jessup**, Ph.D., National Cancer Institute, National Institutes of Health, who spoke on "The Need for Fresh Bioengineering Approaches to Cancer Diagnostics."

SBEC 26 was co-chaired by BioE Professor and Chair **William Bentley**, Associate Professor **Keith Herold**, and Adjunct Professor **Jafar Vossoughi**, the original founder of the event. It was sponsored by the **International Federation for Medical and Biological Engineering (IFMBE)**, the **Biomedical Engineering Society (BMES)**, the **National Cancer Institute**, the **National Science Foundation (NSF)**, and **Springer**.

GOLDBERG, THOMAS WIN SBEC PAPER AWARDS

Fischell Fellow and Clark School alumna **Deborah Sweet Goldberg** (B.S. '06, chemical engineering) and fellow BioE graduate student **Peter Thomas** received Best Paper awards in the Ph.D. Student category for research they presented at the 26th Southern Biomedical Engineering Conference (SBEC 2010).

Goldberg, advised by BioE affiliate professors **Hamid Ghandehari** (University of Utah) and **Peter Swaan** (University of Maryland School of Pharmacy), was recognized for her presentation "Mechanisms of Poly(amido amine) Dendrimer Transepithelial Transport and Tight Junction Modulation in Caco-2 Cells." In it, she discussed her work with poly (amidoamine) dendrimers—nanoscale, branched polymers that show great potential as oral drug delivery carriers. She described her investigation of the mechanisms by which dendrimers cross the intestinal barrier, showing that dendrimer cellular internalization is mediated by several different types of endocytosis, including clathrin and caveolin pathways. Her research also demonstrated that cellular internalization of dendrimers enhances tight junction opening, allowing dendrimers to pass between the intestinal cells. Understanding the pathways of dendrimer transport across the intestinal barrier will allow for the design of orally delivered chemotherapy as an alternative to traditional intravenous chemotherapy, which could greatly improve the quality of life and treatment options for cancer patients.

Thomas, advised by Associate Professor **Srinivasa Raghavan** (Department of Chemical and Biomolecular Engineering), was recognized for his presentation "Monitoring and Controlling Oxygen Levels in Microfluidic Devices," which described research conducted in conjunction with Dr. **Samuel Forry** in the Multiplexed Biomolecular Science Group at the National Institute of Standards and Technology (NIST). Since oxygen level has been shown to greatly impact cell behavior such proliferation and differentiation, its precise control during cell culture is critical to maintaining proper cell behavior. Thomas' research is focused on developing a microfluidic cell culture device capable of generating a unique oxygen environment for cell base studies. Microfluidic systems allow fast and precise regulation of oxygen composition that current cell culture systems do not provide.

"I am very excited to receive this award from SBEC," says Thomas. "The work that I presented at this conference, a collaborative effort between UMD and NIST, has greatly shaped my graduate studies and has been a wonderful learning experience."

For more about Peter Thomas' work, see "Remedium Wins ORNL Global Venture Challenge," next page.

◀ SBEC CHAIR PROFESSOR KEITH HEROLD

PARALLEL SESSIONS ▼

ABOVE: AERAMATICS
BELOW: CLOUDSOLAR ▶

BIOE STUDENTS, ALUMNI WIN PRIZES AT UM $75K BUSINESS PLAN COMPETITION

Two startup companies whose members include past and present students from the Fischell Department of Bioengineering won prizes and honors at the Maryland Technology Enterprise Institute's 2010 $75K Business Plan Competition. The companies, **Aeramatics** and **CloudSolar**, represented two of the three finalists selected for the competition's biotechnology category.

Aeramatics, whose members include **Himali Fernando** (B.S. '09), won the biotechnology category and $15,000 to further the development of their product, InSpiro, a spirometer (a device used to measure the volume of air patients are able to inhale and exhale). InSpiro improves over current equipment—which in some cases is up to 30 years old—thanks to its easier-to-handle size and abilities to remind patients to use it, track prescribed usage, and set targets. Increased patient compliance will reduce post-operative complications, longer hospital stays, and the need for additional respiratory therapists. Aeramatics has a provisional patent on the technology and has built a prototype.

CloudSolar, whose members include bioengineering graduate student **Michael Armani** (advised by Associate Professor **Benjamin Shapiro**), received a Warren Citrin Social Impact Award and $5000 for their design of a rooftop solar energy system that can be used to heat swimming pools 62% more efficiently than similar, currently available products. The CloudSolar system uses a patent-pending biofluid to capture more heat. With over three million heated pools in the United States, the product can help extend the swimming season while substantially reducing heating costs. The team estimates that over a ten-year lifespan, each CloudSolar installation could save over 625,000 acres of trees or 315 million gallons of fuel.

The annual $75K Business Plan Competition promotes the commercialization of innovative ideas and University-created technologies by offering faculty, students, and alumni prizes for the best new venture plans. The competition emphasizes learning by offering one-on-one coaching for finalists, as well as the experience of presenting ideas to an experienced panel of judges. Companies active in the competition have generated millions in revenues, grants and awards.

REMEDIUM WINS ORNL GLOBAL VENTURE CHALLENGE

Kytoclot, a sprayable, blood-clotting foam developed by **Remedium Technologies, Inc.**, a startup company based in the A. James Clark School of Engineering, won first prize and $25K in the Community Resilience and Homeland Security division of the Oak Ridge National Laboratory's (ORNL) 2010 Global Venture Challenge. Remedium was represented by its CEO, graduate student and Fischell Fellow **Matthew Dowling** and company co-founders, fellow graduate student **Peter Thomas**, and postdoctoral research associate and alumna **Oluwatosin Ogunsola** (Ph.D. '05, chemical and biomolecular engineering).

In the ORNL Global Venture Challenge, students developing new technologies that address urgent energy and security needs compete for cash prizes and network with venture investors from across the country.

Kytoclot, Remedium's newest product based on their haemostatic technology, is designed to treat non-compressible injuries—those for which direct pressure or bandages cannot be used to control bleeding in large or irregular wounds in the body cavity. Typically, these injuries are very difficult or impossible to treat outside of an operating room and are a leading cause of hemorrhaging-related deaths. Kytoclot is a pressurized foam which, when sprayed into a wound, expands to fill the space and quickly stops the bleeding, giving first responders more time to transport the patient to a hospital.

"It's a lot like a can of shaving cream," says Dowling. "It doesn't require any special training to use so it can be distributed to soldiers, paramedics, or civilians for emergency or mass casualty situations."

The Global Venture Challenge award is only the latest in a string of competition wins for Remedium over the past two years. The young company has been aided in its development by the Maryland Technology Institute's Technology Advancement Program (TAP). Based in the Clark School, Mtech's TAP program helps faculty, student, and regional entrepreneurs launch successful companies and network with venture capital firms.

Clark School dean **Darryll Pines** is proud of Remedium's success. "Our TAP companies keep winning awards," he says. "This indeed is a testament to the nurturing and guidance they receive while in residency here."

All of Remedium's past and current members have been advised by or worked for its scientific co-founder and advisory board member, Department of Chemical and Biomolecular Engineering Associate Professor **Srinivasa Raghavan**. Raghavan is the director of the Complex Fluids and Nanomaterials Group laboratory, where much of the research behind Remedium's products is carried out.

◀ REMEDIUM, LEFT TO RIGHT: THOMAS, OGUNSOLA, AND DOWLING.

BIOE HOSTS RESEARCH EXPERIENCES FOR TEACHERS

The Fischell Department of Bioengineering is wrapping up its first Research Experiences for Teachers (RET) program. The National Science Foundation (NSF) sponsored three-year summer workshop, originally designed to provide K-12 educators with bioengineering laboratory experiences they could bring back to the classroom, has evolved into an effort to both better prepare students for the engineering and math courses they will encounter in college, and create new high school courses that will allow students to earn college credit. The program is a joint effort between the University of Maryland's A. James Clark School of Engineering and the University of Virginia (UVA), with support from UMD's College of Education.

BioE affiliate professor and Clark School Director of STEM (Science, Technology, Engineering and Math) Education Dr. **Leigh Abts** (College of Education), who has been involved with the NSF's RET program since its inception nine years ago, leads the BioE effort and coordinates activities with **James Groves**, the UVA School of Engineering and Applied Science's Assistant Dean for Research and Outreach. The teachers, who are recruited from Maryland, Virginia and the District of Columbia, select the specific project and campus on which to work.

"BioE was a natural choice for hosting the RET because it is so interdisciplinary," says Abts.

This summer, the teachers worked on two projects: the development of an engineering-oriented math course high school students can take for college credit, and an introduction to engineering course inspired by the Clark School's own ENES 100, the freshman engineering design course.

The math course project has been organized by Assistant Professor **Ian White**, and is hosted by his lab. There, teachers **Tera Carter** (Gretna High School), **Marcia Dalton** (Danville High School), **Andrea Robertson** (Wheaton High School), and **Prem-Raj Ruffin** (Friendship Public Charter Schools), part of the group assigned to the project, are rehearsing an experiment designed to teach students about differential equations and how they are used to solve problems in fluid dynamics. It uses a two-liter soda bottle, straw and catch pan to create a leak, and the bottle is marked at regular intervals to note the falling water level. Students will use software to process the data they collect and justify the formula that can be applied to the situation. The ultimate emphasis is on application: once the students learn the math, they'll take part in design-oriented projects the teachers will create based on the lessons learned.

HIGH SCHOOL EDUCATORS **PREM-RAJ RUFFIN** (FRIENDSHIP PUBLIC CHARTER SCHOOLS, LEFT), **ANDREA ROBERTSON** (WHEATON HIGH SCHOOL, CENTER), AND **MARCIA DALTON** (DANVILLE HIGH SCHOOL, RIGHT) REHEARSE A MATH EXPERIMENT IN ASSISTANT PROFESSOR **IAN WHITE'S** LAB.

"[The RET program] is giving me practical applications I can pull in while the students are learning a concept, so they can understand why they're learning it," says Dalton. Robertson agrees, noting that this particular experiment could be used in a discussion about the oil that flowed out of the damaged well in the Gulf of Mexico.

Robertson, an engineer herself, hopes the program will ultimately influence the creation of Advanced Placement (AP) engineering courses. "Right now engineering is not specifically taught," she explains. "People know what it takes to be a doctor but not an engineer. Engineering is about the whole design process, and it's harder to assess. That's why the design projects are so important."

The math course, BIOE 100, will have its inaugural class at the Friendship Collegiate Academy Public Charter School in Washington, D.C. this fall. Students will be concurrently enrolled at UMD, and their tuition will be covered by a grant from the NSF. Alumna **Jennifer Wolk** (Ph.D. '10, materials science and engineering), who works for the Naval Surface Warfare Center, will co-teach the course. White and the K-12 educators are also studying how to implement the curriculum in Prince George's and Montgomery County high schools.

"This has been a great opportunity for these high school teachers to develop a 'hands-on' curriculum with an engineering context to supplement typical mathematics education," says White. "Their work will have a tremendous impact on the students who take this course and then pursue a college degree in engineering or other quantitative sciences."

BIOE EXPANDS REU PROGRAM WITH FDA PARTNERSHIP

The Fischell Department of Bioengineering now offers students in its Research Experiences for Undergraduates (REU) program the opportunity to work under the guidance of mentors at federal labs, thanks to a new partnership with the U.S. Food and Drug Administration (FDA). The National Science Foundation-sponsored program recently completed its first year in which students were able to participate in projects underway at either the Clark School or on the FDA campus in Silver Spring, Md.

The NSF's REU program promotes and supports the involvement of undergraduate students in labs where they can play an active role in new or ongoing research. Student participants are typically rising seniors who live and work for the summer at schools other than those they attend, and receive a stipend for their living expenses.

BioE's 10 REU program participants recently joined other students working at the FDA at its Salute to Science Summer Intern Poster Session, where they presented the results of their research.

REU student **Ellen Tworkowski** (Carnegie Mellon University) spent her summer at the FDA, where she worked with her mentor, Dr. **Kenneth Phillips**, on a project that seeks to improve the efficacy of contact lens cleaning solutions by preventing the buildup of potentially toxic biomolecules. It was the first time she had been involved in designing an investigation process. "This was a

NEWSWEEK: BIOE A "SAFE BET" NEWSWEEK.COM RANKS BIOMEDICAL ENGINEERING #2 IN ITS LIST OF "12 SECURE JOBS FOR THE NEXT DECADE: A DOZEN SAFE BETS IN THE VOLATILE U.S. LABOR MARKET." THE U.S. BUREAU OF LABOR STATISTICS SAYS "BIOMEDICAL ENGINEERS ARE PROJECTED TO BE THE FASTEST GROWING OCCUPATION IN THE ECONOMY."

good project for me because it was just starting up when I got here," she says. "[Previously] a lot of what I'd done was gathering data."

Dr. **Charles Warr**, associate director for laboratories at the FDA's Office of Science and Engineering Laboratories, says the REU partnership provides the FDA with some unique benefits as well. "Undergraduates are all excitement," he explains. "They're all about letting us see the work that we've looked at for too long through another set of eyes. They're asking us all sorts of questions we hadn't thought of. Some of those questions are very leading and help us think about things we thought we'd already dealt with."

Dr. **Victor Krauthamer**, director of the FDA's Division of Physics, who worked with REU participant **Kelli Carter**, agrees. "[The undergraduates] know no bounds," he says. "They don't know the limitations [of the science] so sometimes there are things you think can't be done that they can do because of their energy and enthusiasm."

He has also enjoyed working with the faculty advisors from the Clark School. "Intellectually, we can get isolated here... having some professors involved in our research has been a real benefit to us," he says. "Because we're involved in device regulation, the more we communicate our problems to the academic world, the more it focuses their research in ways that help us and ultimately help the public."

Students who chose projects on the College Park campus found the experience no less rewarding. "I definitely learned a lot about research, about working in the lab, and about working with other people," says **Justin Rosch** (Clarkson University), who studied single biomolecule samples with Assistant Professor **Joonil Seog**, using an optical mini tweezers system—a piece of equipment to which very few people have access.

Alexander O'Connell (Cornell University) found his time in Assistant Professor **Ganesh Sriram**'s lab (Chemical and Biomolecular Engineering), where he mapped the carbon traffic though plants, invaluable. "I would definitely encourage anyone who thinks they have any kind of interest in going into research to [participate in] one of these programs because it was a great experience," he says. "We got right into the labs, full time."

To learn more about BioE's Molecular and Cellular Bioengineering REU program, please visit **www.bioe.umd.edu/reu**, or contact Associate Professor **John Fisher**, the director of BioE's REU program, at **jpfisher@umd.edu.**

NEW ONLINE MASTERS PROGRAM

Beginning Fall 2010, the Fischell Department of Bioengineering will offer a new online Master of Engineering (M.Eng.) degree program to better meet the needs of working bioengineers in the Washington, D.C. metro area, across the U.S. and around the world.

"Even before recent news articles listed bioengineers among the most in-demand professionals for the next decade, we saw the signs and began the process to create this new program to meet the national need for exceptionally skilled engineering and technology professionals," says Professor and Chair **William Bentley**. "Being located inside the Capital Beltway and so close to major biotechnology research institutions gives us a unique opportunity to understand their needs and to service the large number of professionals who want to further their education and add more specialization to their backgrounds."

Industries and institutions served by the new program include those in the fields of chemicals, materials, healthcare, biotechnology, electronics and devices, and defense and security, as well as major federal agencies such as the Department of Defense, NIST, NIH, FDA, USDA, and the U.S. Patent and Trademark Office.

The new program takes advantage of the A. James Clark School of Engineering's key strengths: its research and its experimental facilities. Students enrolled in the Graduate Program in Bioengineering will gain the knowledge base and skill sets to quantitatively measure and rationally manipulate cells, tissues, and integrated systems.

The curriculum will consist of seven core courses—Rate Processes in Biological Systems, Cellular and Tissue Biomechanics, Quantitative Cell Physiology, Transport Phenomena in Bioengineering Systems, Physiological Evaluation of Bioengineering Designs, Modern Methods of Drug Delivery, Biomedical Optics, Biosensor Techniques, and Tissue Engineering—and three elective courses students will select to customize their education to meet their career needs. No thesis or research work is required for the Master of Engineering program.

"The Master of Engineering degree is applicable to engineering professionals as well as post-baccalaureate students who are preparing to apply to medical schools, and others who can benefit from a highly-focused graduate degree," explains graduate program director Professor **Peter Kofinas**. "The flexibility to choose courses and delivery methods sets us apart with professionals who are working full-time or may not be close to campus."

Utilizing the Clark School's Distance Education Technology & Services unit, the program is able to offer working engineers and technical professionals access to coursework and faculty at the forefront of biotechnology.

"The online Master of Engineering degree offers the same high level of education and training experienced by full-time, on-campus students," says Dr. **George Syrmos**, executive director of the Clark School's Office of Advanced Engineering Education (OAEE), which will administer the program. "Delivering a truly interactive, virtual-classroom experience allows for communication with faculty and other students and facilitates the formation of project groups. The coursework is structured so that what students learn can be immediately beneficial in the workplace."

ELLEN TWORKOWSKI

To learn more about the Fischell Department of Bioengineering's online Master of Engineering program, as well as its new graduate certificate option, visit the OAEE web site at **www.oaee.umd.edu/grad/bioe**.

A. JAMES CLARK
SCHOOL OF ENGINEERING

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ABOUT THE COVER IMAGE

A BRIGHT FIELD IMAGE OF THE GROWTH OF A 20-30MM COLONY OF ENTRAPPED *E. COLI* CELLS 7 HOURS AFTER BEING CO-DEPOSITED WITH A CALCIUM ALGINATE HYDROGEL FORMED BY ELECTROADDRESSING. THE IMAGE COMES FROM THE LABORATORY OF PROFESSOR GREGORY PAYNE, ONE OF FIVE NEW FACULTY MEMBERS WHO JOINED THE FISCHELL DEPARTMENT OF BIOENGINEERING IN 2010. SEE OUR COVER STORY FOR MORE INFORMATION.

BIOFEEDBACK is published for alumni and friends of The Fischell Department of Bioengineering at the A. James Clark School of Engineering, University of Maryland.

Alumni news and comments are welcome! Please contact us at:
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Department Chair: Dr. William Bentley
Editor: Faye Levine

chair's MESSAGE

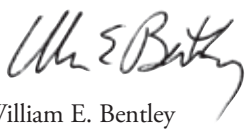
HUSKAMP SCHOLARSHIP, from page 2

and learning. Jeff personally experienced the life saving application of bioengineering. This scholarship fund will enable his legacy to help the next generation of scientists and doctors succeed, so that what seems impossible now will become the reality they create."

We are pleased to announce the first recipient of the scholarship, rising senior **Jessica Stewart**. Jessica is a once-in-a-decade individual who embodies the effusive energy, sincerity, tireless work ethic, pride and dedication that are Huskamp hallmarks—and this, in our view, made her the perfect fit for our newest award. She is one of the most energetic and visible students in our department, a top-notch lacrosse player, active in research, the leader of the Clark School's Student Ambassadors, and a member of QUEST, a community-based honors program that focuses on innovation, business acumen, quality systems management, and teamwork.

To contribute to the Jeffrey C. and Sandra W. Huskamp Endowed Bioengineering Scholarship, visit **www.greatexpectations.umd.edu**. Click on Make a Gift, then click Online Giving Form. Choose to make a new gift, and in Step 3 of the process, type "Huskamp" in the Search For A Fund field. The bioengineering scholarship will appear in a popup menu. Giving online is fast and secure.

With Best Regards,



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