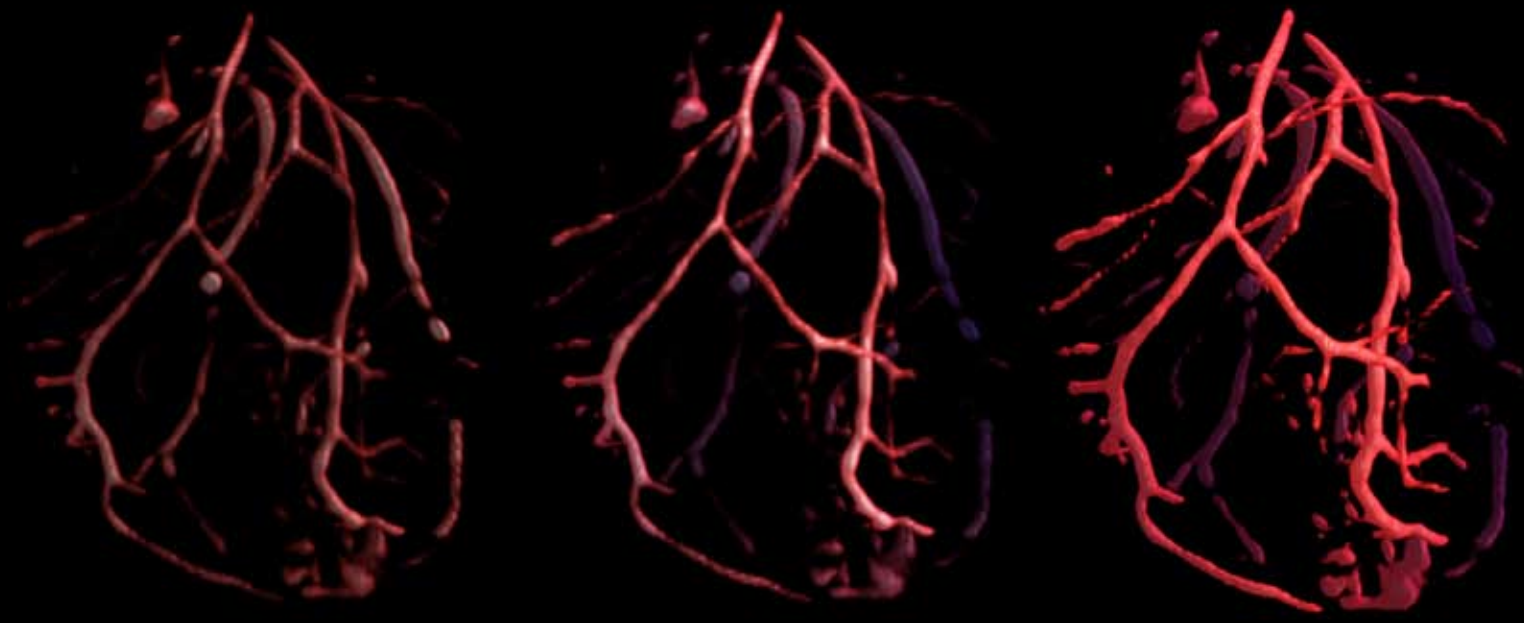
YALE BME NEWS

Department of Biomedical Engineering

WWW.ENG.YALE.EDU/BME Vol. 1 / No. 2 / Spring and Summer 2008



Yale's IMAGING Wizards

Also in this issue:
Vascular Biology and Therapeutics
BME Travels in China

Dr. Mark Saltzman, Chair of Yale Biomedical Engineering (credit: Terry Dagradi)

Yale BME

Letter

From The Chair

It is a great pleasure for me to present you with the second issue of our Yale Biomedical Engineering (BME) newsletter. Many things have happened since our last issue, as you will learn as you read the pages that follow. But the spirit of inquiry, adventure, and growth that I described to you in the last newsletter remain. I hope that you will read the full issue, but I want to highlight some of the most significant items.

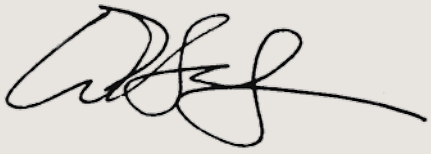
Our cover story describes the Yale Magnetic Resonance Research Center (MRRC), which is the research home to a large number of our BME faculty members and students. The Center has a long and distinguished history, specializing in creation of new methods for non-invasive imaging and spectroscopy and the application of these techniques to better understand human physiology. Much of the work in the Center involves the study of the brain, which was augmented by a recent award from NIH that created the Core Center for Quantitative Neuroscience with Magnetic Resonance. I am impressed with the high quality and broad significance of the work that my colleagues in the MRRC generate, and I hope that you will enjoy learning more about their work.

Also in this issue, we introduce you to the Vascular Biology and Therapeutics (VBT) Program, which just moved into a new research building on Amistad Street at the medical school campus (hence, called the new Amistad Building). The connections between VBT and BME are substantial. BME faculty members, postdoctoral associates, and students work, as part of VBT, on projects that range from tissue engineering of coronary vessels, imaging of vessel structure and remodeling in skin, targeting of drugs to vessels, and tissue engineering of microvascular networks.

The faculty in BME continues to grow in number and accomplishment. This issue introduces Professor Erik Shapiro, who adds a new dimension to our bioimaging program. I am proud of each of our BME faculty members, who continue to do excellent work in research, teaching, and service. I am not the only one who recognizes the value of their work, as the group continues to win major awards. Rich Carson received three major honors: a research award in PET imaging, a teaching award, and election as Fellow in the American Institute of Medical and Biological Engineering (AIMBE). Erin Lavik received a 2008 Women of Innovation Award from the Connecticut Technology Council and Tarek Fahmy received an NSF CAREER Award. Our students and postdoctoral associates also won awards this past year: this issue highlights the achievements of graduate student Michael Look and postdoc Kim Woodrow.

Since the last issue, we welcomed a new Dean of Engineering, Kyle Vanderlick, whose research work in membrane science intersects substantially with BME. I am delighted to report that, under Kyle's leadership, there are great things ahead for Engineering at Yale. In her first months at Yale, Kyle has impressed all of us with her energy, her enthusiasm, and her vision for the future of Yale Engineering. In recognition of that bright future, Yale re-established the School of Engineering & Applied Science this year. I will have more to say about the positive impact of that change on the Yale BME community in future issues.

I am delighted to be part of this vibrant, expanding community. I invite you to learn more about us: through this newsletter, through our website, or by visiting us in New Haven.



W. Mark Saltzman, Ph.D.
Goizueta Foundation Professor of Chemical and Biomedical Engineering
Professor of Cellular & Molecular Physiology
Chair, Biomedical Engineering

Yale BME Acquires New Funding

NSF Awards Grant to Develop Low-Current Patch-clamp Recording Instruments

Dr. Fred Sigworth, Professor of Biomedical Engineering and Physiology, in collaboration with Dr. Eugenio Culurciello received a National Science Foundation grant for their project titled "IDBR: High-Performance Integrated Patch Clamp Amplifiers". The project will develop instruments capable of high-speed, high-throughput recording of ion channel currents that are too low to record with clarity. The technology utilizes silicon-on-sapphire integrated circuits, which will increase the density of recording sites and miniaturize the recording equipment. Patch clamping is currently one of the most predictive analytical methods in cell and drug research. The new technology may make it possible to characterize the function of products from approximately 400 ion channel genes. The three-year award amount is $547,974.

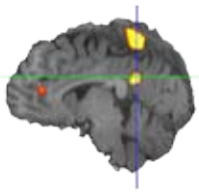
NIH Provides Funding to Model The Formation of Collagenous Tissues

Dr. Laura Niklason, Associate Professor of Biomedical Engineering and Anesthesiology, and collaborator Dr. Jay Humphrey were awarded a four-year National Institutes of Health RO1 grant for their project entitled, "Enabling Strategies for Growing Collagenous Tissues." Dr. Niklason and her laboratory hope to create new tools that will help scientists to understand extracellular matrix formation, including the deposition of extracellular matrix proteins, such as elastin and collagen. Using different materials, such as hydrogels and tubular mesh scaffolds, the group will model tissue development in a controlled in vitro environment using mathematical models, bioreactors, and non-invasive imaging systems. In developing these tools, the group hopes to grow connective tissues that can be used in regenerative medicine applications such as skin, ligaments and blood vessels.

Carson Awarded $1.3M to Analyze the Human Brain

Dr. Richard Carson, Professor of Biomedical Engineering and Diagnostic Radiology, was awarded a four-year RO1 grant from the National Institutes of Health for his work entitled, "Quantitative High Resolution Human Brain PET Imaging". This project aims to develop and validate new algorithms for Positron Emission Tomography (PET) image quantification, motion correction, input function measurement and parametric image creation, and to demonstrate the practical effect of these improvements on human PET data. The ultimate goal of this work is to facilitate widespread use and success of quantitative brain PET methods.

In This Issue



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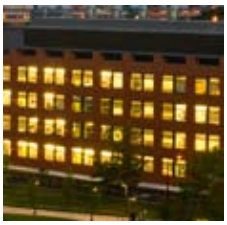

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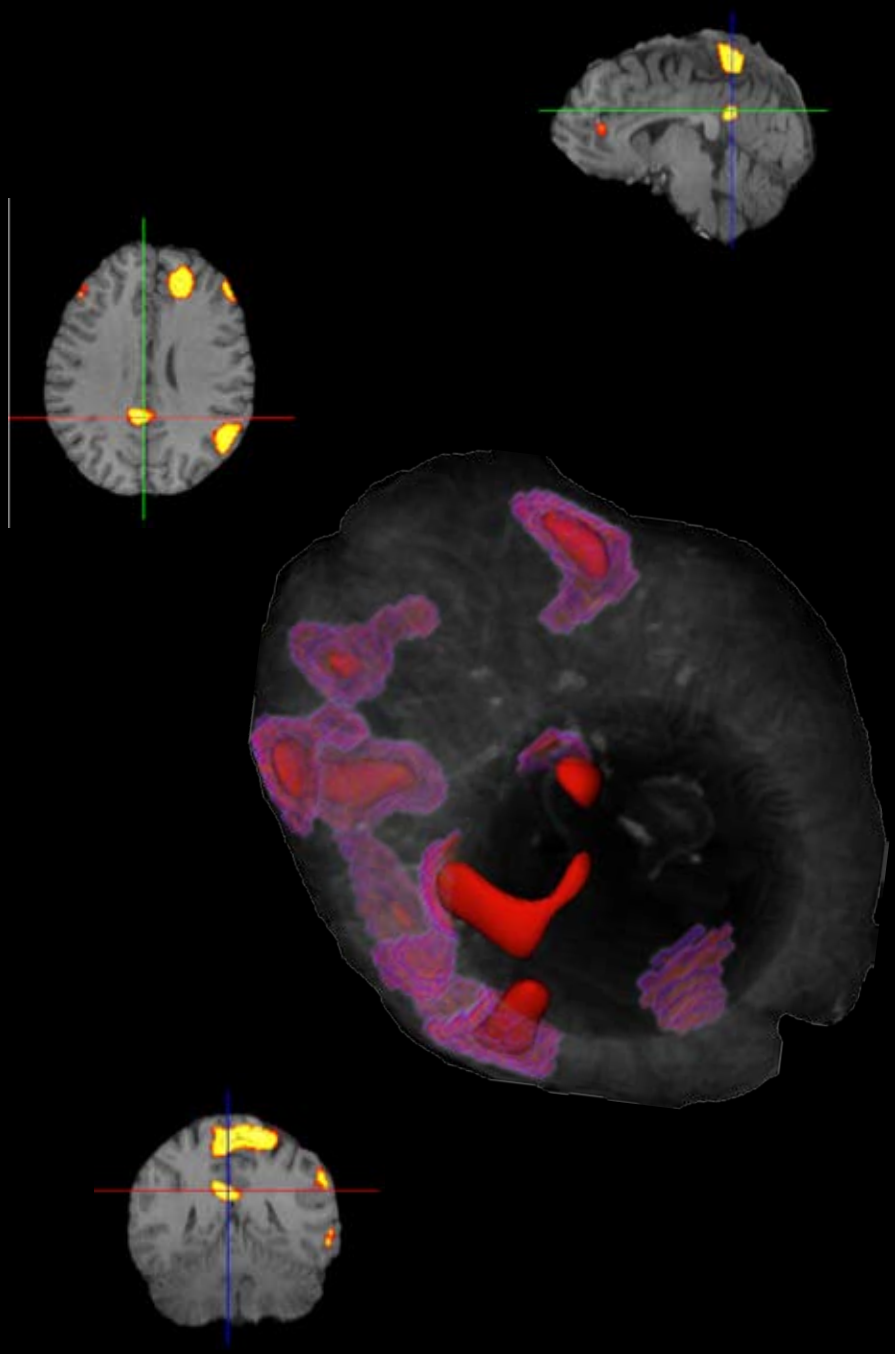
On the Cover: Image enhancement technique used by Yale's Magnetic Resonance Team to better visualize the vasculature of the heart. © 2008 IEEE

Image reprinted with permission from Joshi, A. and Qian, X. and Dione, D and Bulsara, KR and Breuer, CK and Sinusas, AJ, Papademetris, X. Effective visualization of complex vascular structures using a non-parametric vessel detection method. IEEE Transactions on Visualization and Computer Graphics, accepted for publication.

Magnetic Resonance

How Yale scientists are working to enhance the future of medical imaging



In 1986, a group of Yale scientists established a research center that has since been on the forefront of unlocking the mysteries hidden inside the human body. The Yale Magnetic Resonance Research Center (MRRC) was founded after these scientists recognized the enormous potential possible in biomedical research with the emergence of Nuclear Magnetic Resonance (NMR). Over the years the MRRC has become an interdepartmental, interdisciplinary research laboratory that provides state-of-the-art Magnetic Resonance (MR) equipment, infrastructure and expertise for the development and application of MR Imaging (MRI) and MR Spectroscopy (MRS) in biomedical research. Located in the Anlyan Center on the medical school campus, the MR research facilities occupy 33,000 square feet of dedicated laboratory and imaging space. The research in the MRRC focuses on the study of intact biological systems by developing methods for obtaining structural, functional, physiological and biochemical information. Applications for MR techniques in the biomedical sciences are growing rapidly, and Yale scientists are contributing to the cutting edge of these technologies. Some of the current areas of research include applications of functional MR imaging (fMRI) for neurosurgery and neuroscience, and MR spectroscopy for brain, muscle and liver energy metabolism, diabetes, and adult and juvenile epilepsy and psychiatric disorders.

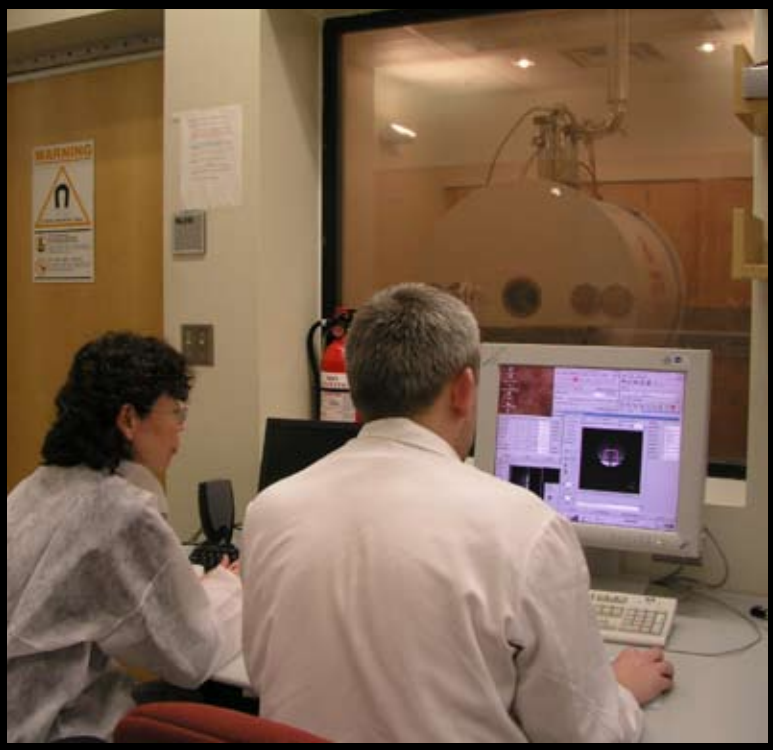
A group of faculty members from Yale's BME department are leading the field in their research to better understand the human body. These professors, including Fahmeed Hyder, Xenophon Papademetris and Todd Constable, are developing technologies that they hope will revolutionize the future of medicine.

The strength of the Yale MRRC is, and has been, its potential for in vivo work. Active interplay between various magnetic resonance methods have rapidly advanced the imaging abilities possible in vertebrates. Recently, Yale acquired funding to develop the Core Center for Quantitative Neuroscience with Magnetic Resonance at the MRRC, with a $3.8 million grant from the National Institute of Neurological Disorders and Stroke. The Center is a manifestation of the types of multi-modal research being conducted in different laboratories around campus, and the funding supports shared resources and facilities used by many NIH-funded professors at Yale. With the availability of this shared equipment, the facility generates the ability for greater productivity than would be possible via efforts by individual researchers. In addition, the funding also encourages researchers that have no experience with MR to take advantage of the facility for their individual projects.

The new Center consists of three research Cores, each dedicated to improving the effectiveness of ongoing research based upon multi-modal Magnetic Resonance Imaging (MRI), heteronuclear Magnetic Resonance Spectroscopy (MRS), and neurophysiology. In addition, the center boasts one service Core, where a cluster of high-performance workstations provide the equipment needed for rapid data analysis and information sharing. Each "Core" is directed by a faculty member, with a junior scientist who plays a key role in assisting the scientists and running the equipment.

Dr. Fahmeed Hyder, Associate Professor of Biomedical Engineering and Diagnostic Radiology, has been appointed the new director of the Center. Hyder is excited about the project and hopes it will provide new possibilities for his department and others around campus, "It is expected that the Center will promote a more cooperative and interactive research environment for neuroscientists who are utilizing Magnetic Resonance technology at Yale, and will nurture new cross-disciplinary approaches in medicine and physiology, as well as neuroscience."

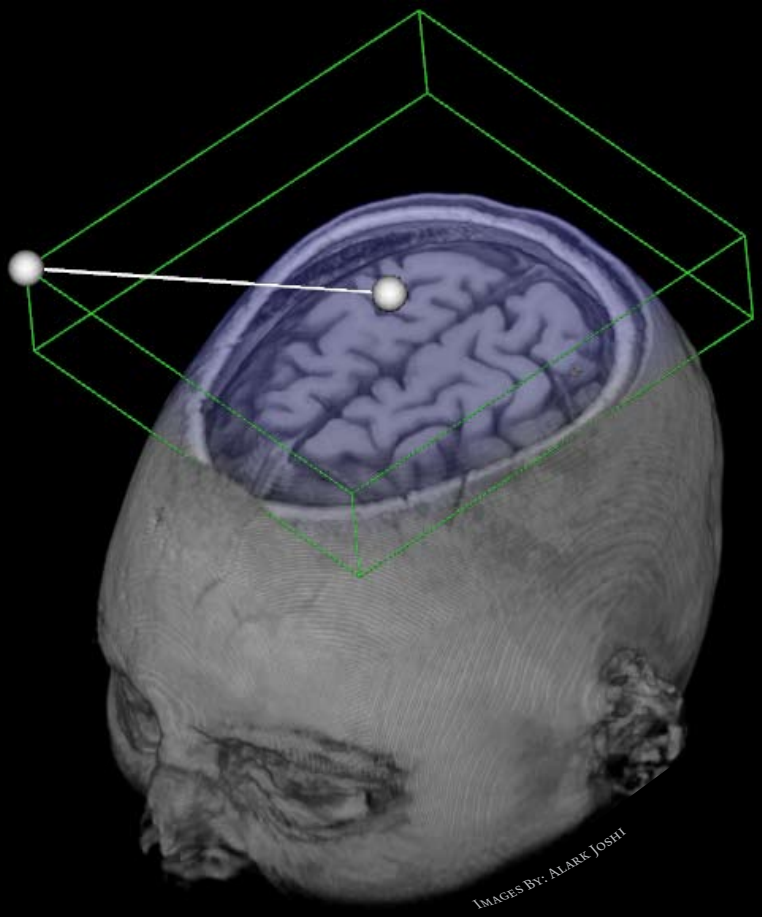
Dr. Xenophon Papademetris, Assistant Professor of Biomedical Engineering and Diagnostic Radiology, is the faculty member that runs Core 4 of the Center, the service Core. Recently, Dr. Papademetris and Dr. Michael Levene, Assistant Professor of Biomedical Engineering, were awarded a 3-year R21 grant to develop deep brain image-guided microscopy. This exciting project involves the design of a needle-like optical microscope system in Dr. Levene's laboratory that can be inserted into the brain to visualize cells and tissue. Dr. Papademetris will be working in coordination with the Levene lab to develop an image-guided methodology to compensate for the deformation of the brain that occurs during the insertion of the microscope lens, to better locate target areas. The project was awarded funding based on a request for applications from the National Institute of BioImaging and Bioengineering to develop "disruptive" technologies for image-guided interventions. In total, only ten such awards were made. Other investigators on this project include Dr. Lawrence Staib, Associate Professor of Biomedical Engineering and Diagnostic Radiology, Dr. Kenneth Vives of Neurosurgery and Dr. Michelle Johnson of Diagnostic Radiology.



During brainstorming sessions with neurosurgeons Dr. Dennis Spencer and Dr. Vives about potential new research directions in image-guided neurosurgery, Dr. Papademetris said that Dr. Levene's name came up repeatedly. It was clear to the neurosurgeons that optical imaging is a key technology needed in the field, and if the minimally invasive microscopy work could be translated into human use, it would impact many neurosurgical procedures. The scope would have the ability to give surgeons a high-resolution view of tissue below the brain surface. This insight led to the formulation of the current project and collaboration.

"It is expected that the Center will promote a more cooperative and interactive research environment for neuroscientists who are utilizing Magnetic Resonance technology at Yale, and will nurture new cross-disciplinary approaches in medicine and physiology, as well as neuroscience." - Hyder

The development of deep brain microscopy has the potential to revolutionize neurosurgical interventions such as biopsy and electrode placement, making them more accurate and efficient with the goal of improving treatments for



Images By: Alark Joshi

diseases such as cancer, Parkinson's disease, and epilepsy. This development will address key limitations of current conventional tomographic imaging techniques (e.g. MRI/CT) such as the lack of resolution or specificity to distinguish normal tissue from cancerous tissue, or to precisely determine the location of different cell layers, as needed in electrode implantation for Parkinson's disease.

Another significant contributor to the MR Center is Dr. Todd Constable, the Director of Yale's Diagnostic Radiology Magnetic Resonance Imaging Research Center. Dr. Constable is a Professor of Biomedical Engineering, Diagnostic Radiology, and Neurology. His laboratory was recently awarded a $1.7 million five-year RO1 grant from the National Institutes of Health that will be used to investigate the "Influence of baseline brain state on functional Magnetic Resonance Imaging". In his recent research, Dr. Constable notes that despite the widespread clinical use of anesthetics and the volume of research focused on brain function, few studies have used neuroimaging techniques to better understand the mechanisms of these agents and how they interact with the brain.

Functional MRI has rapidly become a valuable tool for neuroscientists and has the potential to provide insight into the neurophysiological impact of anesthetic agents. Yet the relationship between brain signal changes and neuronal activity is not well understood, particularly in the presence of an agent that might alter the normal coupling between blood-oxygen-level-dependent (BOLD) signal changes and the underlying neuronal activity. Changes in baseline brain activity, metabolism or flow may influence the amplitude of the BOLD signal measured in an activation experiment since there are almost no calibrated human studies of these effects. Calibration of the fMRI experiment allows pure physiological changes, such as changes in baseline cerebral blood flow, to be dissociated from changes in neuronal activity normally reflected in the BOLD signal measured.

Core Center for Quantitative Neuroscience with Magnetic Resonance Faculty and Staff: From left: Fahmeed Hyder (Program Director, Core 1 director), Xenios Papademitris (Core 4 director), Dustin Scheinost (Core 4 scientist), Douglas Rothman (Core 2 director), Peter Herman (Program Coordinator, Core 4 scientist), Daniel Coman (Core 2 scientist), Halima Chahboune (Core 1 scientist), Basavaraju Sanganahalli Ganganna (Core 3 scientist). Not pictured: Hal Blumenfeld (Core 3 director)).

These studies are particularly challenging when they are performed in humans because it is difficult to design informative but passive tasks that are amenable to the MR setting. This work will focus on a series of hierarchical but passive tasks involving either sensory/motor stimuli or auditory stimuli, applied to humans in the awake and anesthetized state. These experiments will provide insight into the brain's response to stimuli under anesthetic conditions and reveal the impact of anesthetics on specific cortical regions of the brain, as well as larger networks. Constable anticipates that these experiments will lay the groundwork for future studies investigating higher order cognitive function such as those associated with attention and memory.

Professor Todd Constable.

In addition to Hyder, Papademetris, and Constable, the Yale Biomedical Engineering imaging faculty boasts a large group of distinguished scientists including Professors Richard Carson, Robin de Graaf, James Duncan, Douglas Rothman, Erik Shapiro, Lawrence Staib and Hemant Tagare. Imaging research stands as one of the central themes in Yale's commitment to biomedical engineering. Through collaborations with the Yale Medical School and hospital, Yale faculty work on projects aimed at better analyzing the human body through image analysis techniques that are revolutionizing and upgrading equipment, procedures, and techniques that are currently used in the medical community. Yale biomedical engineering faculty hope that their research will assist in advancing the future of medical imaging to provide for better detection and treatment of various ailments and diseases.

Pages 3 and 4 imaging credits: Alark Joshi

Faculty Spotlight

Our faculty are making great contributions to the world of biomedical engineering. Here are a few highlights.

Michael Levene

A recent publication from the Levene lab (see page 8) details a new image processing method to evaluate metabolic dysfunctions in epileptic brain tissue. The technology was developed in collaboration with Anne Williamson and Dennis Spencer from Yale's Department of Neurosurgery. This new method clearly reveals how NADH, a natural fluorophore and metabolic co-enzyme, is distributed differently in epileptic brain tissue than in normal tissue. Using a technique known as fluorescence lifetime imaging, they have shown exciting preliminary data on differences in cellular metabolism between control and epileptic brain tissue. Future work will extend this technique to identifying specific cellular defects in human epileptic brain tissue. The full-article can found for free on the Optics Express website.

Themis Kyriakides

The Kyriakides laboratory is investigating the tissue reaction to biomaterials. Specifically, they seek to determine how biomaterials elicit the generation of cellular signals that regulate the processes of inflammation, blood vessel formation, and tissue repair. They are utilizing in vitro and in vivo assays of blood vessel formation and inflammation to probe the function of specific biomaterial-induced molecules. In addition, they have developed projects that are aimed at translating their basic science findings into the generation of biomaterials with biological intelligence. These include non-thrombogenic synthetic vascular grafts, scaffolds for tissue engineering applications, and non-fouling electrodes and sensors.

Tarek Fahmy

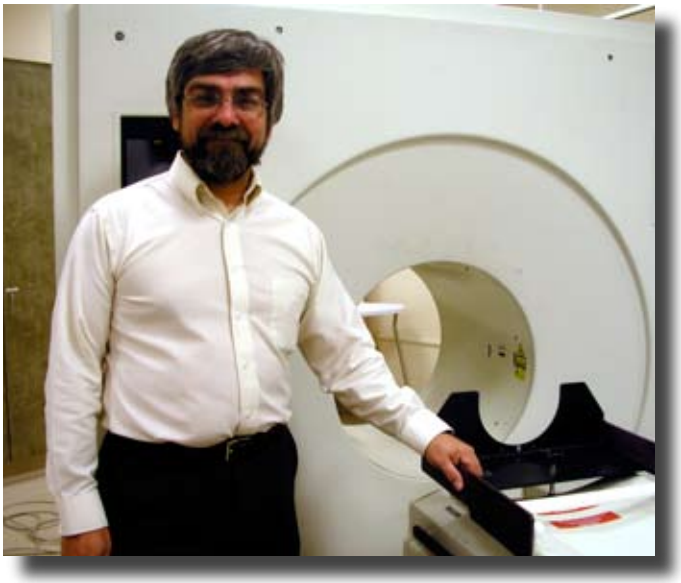
The laboratory of Dr. Tarek Fahmy specializes in the development of drug and antigen delivery strategies to the immune system using specialized biomaterials. One of Fahmy's current immunotherapy projects, recently published in *Molecular Therapy,* focuses on the delivery of artificial cell-like particles that are able to enhance T cell activation by 45 times the normal level. This work, completed by lead author and graduate student Erin Steenblock, has the potential to provide a patient's body with the ability to better fight both cancer and infectious diseases. These artificial "cells" are microparticles that are made of poly(lactide-co-glycolide), a biodegradable polymer that is FDA-approved and currently used in medical materials such as biodegradable sutures. To increase the population of antigen-specific T cells, particles are surface-modified with T cell-specific markers. The particles themselves are also fabricated to release cytokines that have the ability to stimulate the proliferation of T cells. Fahmy hopes that in the future these particles will provide an easy and effective method to combat cancer and disease.

W. Mark Saltzman

The diverse, highly collaborative work of the Saltzman lab is woven together by the common thread of bio-compatible polymeric materials used in drug delivery and tissue engineering. One cluster of projects is centered on developing vaccines that can bypass the mucosal barrier in mucus membranes. One of the most exciting developments in this area is the use of small interfering RNAs (siRNAs) in nanoparticles to achieve knockdown of gene expression in the female reproductive tract. In addition, a newly-formed team is investigating the delivery of chemotherapeutic agents to brain tumors through convection-enhanced delivery. This group is using nanoparticles to deliver these agents, while analyzing their penetration and distribution in the brain. Their aim is to enhance the abiltiy of the particles to deliver drugs, recognize cancer cells, and move through the brain. Other current projects include treatments for diabetes through pancreatic cell preservation, investigating behavioral changes induced by chronic delivery of anti-depressants to the brain, and an investigation of blood vessel stimulation and growth.

Laura Niklason

The Niklason laboratory utilizes fundamental knowledge of cell biology combined with engineering principles to answer questions pertaining to vascular disease and regeneration. One major focus of the lab is utilizing differentiated vascular cells, or vascular precursor cells, for arterial regeneration in vitro. Using bioreactors that deliver biomimetic pulsatile forces to developing tissues, they are exploring the impact of physical stimuli, soluble factors, and substrate molecules on the development of engineered arteries. In these efforts, they work with differentiated vascular smooth muscle and endothelial cells derived from large animals or from human biopsy specimens. In addition, they are elucidating the cues that drive vascular differentiation from adult circulating stem cells or marrow-derived stem cells, so that these cells may be used for vascular regeneration. As an extension of the vascular engineering work, the lab is also developing strategies to culture vascularized cardiac muscle and lung tissue, using co-culture paradigms and biocompatible scaffolding materials. In the cardiac and lung work, the application of biomimetic conditions and specialized bioreactors is also central for driving tissue development.



Richard Carson

The Carson lab is currently researching the development of a 4D Positron Emission Tomography (PET) reconstruction algorithm. This approach will take the raw PET data and produce images of physiological parameters such as blood flow or receptor binding potential. This project utilizes a huge computational program that simultaneously handles approximately 50 billion measurements and solves for 20 million unknowns. This approach has the advantage of optimal statistical handling of the PET data to provide images with low noise and no bias. It is implemented with a computer cluster of 138 processors. Current work includes testing with simulated and actual PET data, assessment of all the corrections for PET physical effects and subject motion and comparison to standard methods.

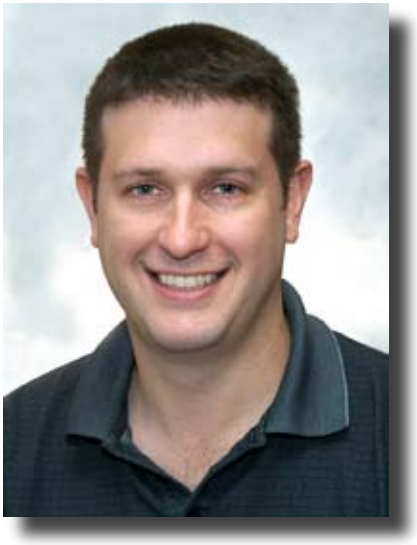
Robin de Graaf

Professor Robin de Graaf recently published the second edition of a text that he wrote entitled "in vivo NMR Spectroscopy: Principles and Techniques". This is an update to the original text published in 1999. The book, published by Wiley, John & Sons, Inc., covers both the technical and the biophysical aspects of NMR technology. It incorporates many of the new advances that are on the forefront of NMR research and technology.

For more information about these and other BME faculty, visit our website at www.eng.yale.edu/bme

A New Face in Yale BME

The BME Department Welcomes a New Faculty Member



Erik Shapiro is the newest faculty member to join the ranks of Yale's biomedical engineering faculty. After obtaining his doctorate in Chemistry from the University of Pennsylvania, he completed a post-doctoral experience at the National Institutes of Health (NIH) in Molecular Imaging. In 2006, Dr. Shapiro joined the Department of Diagnostic Radiology at Yale as an Assistant Professor, and was given a joint appointment in the Department of Biomedical Engineering this past fall. Shapiro was also recently awarded a Stem Cell Research Program Grant from the State of Connecticut.

Dr. Shapiro's lab has a general focus on using magnetic resonance imaging (MRI) for molecular and cellular imaging applications. Molecular and cellular imaging allows scientists and doctors to move past simple anatomic imaging, enabling the non-invasive observation and measurement of metabolic, physiological and functional processes in living subjects.

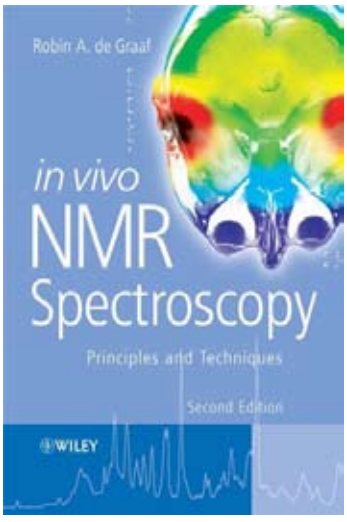
Working at the intersection of chemistry, physics, and biology, the laboratory focuses on three main cores. The first core involves the development of novel MRI contrast agents with the synthesis and construction of high relaxivity superparamagnetic nano- and micro-particles, whose MRI properties can be made sensitive to various stimuli, such as gene expression.

The second core is the use of magnetic resonance imaging for monitoring cell migration. Cells can be loaded with MRI contrast agents and observed using tailored experimental conditions. Current models under investigation in the laboratory are migration of native and non-native immune cells, homing of transplanted stem cells and migration of endogenous neuronal progenitor cells.

The third focus of the laboratory is using targeted contrast agents to detect specific molecular epitopes to selectively target these MRI agents to precise tissues or cells of interest by way of antibody- or receptor-mediated affinity. This application could be particularly useful in detecting cancer and in identifying unique cellular populations.

Recent Publications from Yale BME

A sampling of the latest works by our faculty and students



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BME Faculty Receive Numerous Awards

Carson Honored With Multiple Awards

Professor **Richard Carson** was honored with multiple distinctions for his work in biomedical engineering. Carson, a Professor of Biomedical Engineering and Diagnostic Radiology, and co-director of the Yale PET Center, received the Kuhl-Lasson Lecture Award for Research in Brain Imaging. This award is given out each year by SNM, an international scientific and professional organization dedicated to promoting the science, technology and practical application of nuclear medicine. The SNM Brain Imaging Council, "honors a scientist who has made significant contributions to the field of functional brain imaging using single photon emission computer tomography (SPECT) and PET."

In addition, Dr. Carson was elected to the College of Fellows of the American Institute for Medical and Biological Engineering (AIMBE). This distinction placed Carson in the top 2% of the medical and biological engineers that make up AIMBE. AIMBE was founded in 1991, "to establish a clear and comprehensive identity for the field of medical and biological engineering." Carson accepted his award in February, at the AIMBE Annual Event: "The Global Impact of Medical and Biological Engineering."

This spring, Carson was also recognized by the Yale University College of Engineering as the 2008 Sheffield Distinguished Teaching Award recipient, honoring his commitment to excellence in teaching Yale biomedical engineering students.

Fahmy Awarded National Science Foundation Early Career Award

Tarek Fahmy, Assistant Professor of Biomedical Engineering, was awarded a Faculty Early Career Development (CAREER) Program award from the National Science Foundation (NSF). Fahmy's project proposal, titled "Engineering Therapeutic Immune Responses with Artificial Antigen-Presenting Cells," describes his proposed future research. In his laboratory, Fahmy has found that these artificial cells, made of the FDA approved material, PLGA, have the ability to significantly enhance the response of the immune system to fight disease. The goal of his work is to provide an "off the shelf" therapy that could have a significant relevance to the public interest in areas such as disease and cancer therapy.

The NSF CAREER AWARD honors young faculty who "exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research." It is one of the highest honors for young faculty members, and aims to support the early career activities of teachers who are most likely to become the academic leaders of the future. The awards are funded in the amount of $400,000 over five years.

Lavik Honored By Connecticut Technology Council

Erin Lavik, Associate Professor of Biomedical Engineering, was chosen by the Connecticut Technology Council to receive one of the 2008 Women of Innovation awards. Lavik was awarded the "Academic Innovation and Leadership" award. In choosing a winner, the Council sets out to find, "...a woman in an academic setting who has created and fostered programs in curriculum development, student research, and teacher-student collaborations. A woman who has worked to inspire and encourage other women to pursue careers in technology, science, or engineering." The Council honored Lavik on January 30th at the fourth annual Women of Innovation awards dinner in Southington, CT. "Each year, we are in awe of award winners' outstanding accomplishments," said Matthew Nemerson, the Council's president and CEO. "Connecticut has an extraordinary pool of technology companies. We are proud to offer an awards program that honors exceptional innovators and leaders and provides them with a professional network of other women who strive for excellence."

The Connecticut Technology Council is the state's industry association of over 2,000 technology oriented companies and institutions, providing leadership in areas of policy advocacy, community building and assistance for growing companies.

Photo Credit: Connecticut Technology Council

The Staff of BME

What Keeps the Machine Running

In the BME Department, we are grateful for three terrific people that work behind the scenes to keep things running on a daily basis.

Senior Administrative Assistant, **Elna Godburn**, is a seasoned veteran of the Yale Engineering staff. Having earned a degree in business administration, her primary responsibilities are to conduct the business activities of the department, advising both faculty and staff in policies and procedures. The span of this work, too wide to detail in full, includes faculty and research appointments, the student internship program, faculty leaves, compensation, and special reports. "I love our department – the interaction with faculty, students, and staff," she writes. "We are fortunate to work with these dynamic people, and to enjoy this new building as well."

Deanna Lomax is our departmental Administrative Assistant to the chair. From managing vendors, special events, assembling material for grants, purchasing supplies, to generally being a help to all of us, the daily workings of the department are facilitated with her assistance. She is delighted to work here, she says. "I could not have asked for better co-workers. All in all, I have finally found my happiness working at Yale in the BME Department."

Carolyn Meloling, a Senior Administrative Assistant, operates a tight ship over at the Brady Memorial Laboratory, where her office is located. For the past 20 years, her many responsibilities have not only included work for our department but also for the Image Processing and Analysis Group in Diagnostic Radiology. She also functions as an Editorial Assistant for Medical Image Analysis, an international journal.

Deanna Lomax and Elna Godburn

Carolyn Meloling
Photo credit: Henry Douglas, Dept. of Diagnostic Radiology

Gonzalez joins the Yale BME Team

Anjelica Gonzalez grew up in Las Vegas, Nevada with a myriad of interests that included journalism, softball, and orchestral violin. Yet among passions, she found math to be especially enjoyable. Over the years, Anjelica developed an interest in engineering that was spurred on by her grandfather, who ran the irrigation systems for Moapa Valley, a farming community outside of Las Vegas. During summers spent on the farm, he would use the irrigation systems to introduce the ideas of fluid dynamics to her in a rudimentary way.

After graduating from high school, Anjelica attended Utah State University to study irrigation engineering, in hopes of following in her grandfather's footsteps by returning to his farm to introduce computer automated irrigation planning. However, her plans took an unexpected turn when she was introduced to bioengineering, and discovered that engineering principles of mechanics, fluid dynamics, and thermodynamics could be applied to any system, including the human body. This was the spark that launched her towards a career in biomedical engineering.

Anjelica earned a PhD in Structural and Computational Biology at Baylor College of Medicine. Her main research focus was to develop an automated 3-D cell tracking system for fast moving cells such as cancer cells and leukocytes. She went on to use whole protein, and eventually, an artificial extracellular matrix to determine the contribution of individual adhesion molecules to functional migratory activity. She continued her education with post doctoral work at Texas Children's Hospital in Leukocyte Biology in pediatric intensive care.

Gonzalez is currently a Associate Research Scientist in the Department of Biomedical Engineering. She works to develop biomaterials for use in investigational tools, particularly for studying immunological responses to inflammatory signals from various sources. More specifically, this work utilizes an artificial extracellular matrix to investigate neutrophil and macrophage signaling that results in cellular activity resembling that of physiological states, including sepsis, arthritis, diabetes, atherosclerosis and wound closure.

After completing this research experience, Gonzalez plans to pursue a faculty position to further her career in biomedical engineering.

Photo credit: Terry Dagradi.

Yale VBT

Three BME faculty members are players in one of Yale's latest investments to bring biomedical research from the bench to the bedside. Professors Mark Saltzman, Laura Niklason and Themis Kyriakides, now have lab space at the School of Medicine's new $88.6 million research facility at 10 Amistad Street. These BME professors, who share the VBT space with investigators in surgery, immunology, cardiology, pathology, and pharmacology, are members of the Interdepartmental Program in Vascular Biology and Therapeutics (VBT), one of the three translational research programs housed in the new building. Other faculty members with close associations to Yale BME are Dr. Christopher Breuer, a pediatric surgeon, and Dr. Jordan Pober, immunobiology professor and vice-chair.

Translational medicine is the bridge that connects lab research to the patient; its aim is to take discoveries in the basic sciences and turn them into effective clinical treatments. Founded in 2000, VBT was the first translational research program established at Yale. The program seeks to use insights gained from vascular biology to improve treatments for heart disease, peripheral heart diseases, cancer and stroke, and to find ways of achieving better outcomes for organ-transplant patients. The success of the program helped catalyze the establishment of the two other translational research programs now also housed at Amistad: The Human and Translational Immunology (HTI) program and the Yale Stem Cell Center (YSCC). The two floors in the building dedicated to VBT have provided space where 12 faculty members currently reside, while the program it-

Clay Quint (top) of the Niklason lab and Weiming Tian (bottom) of the Kyriakides lab hard at work.

New home, new bridges

self is composed of approximately 40 faculty from around campus.

Interdisciplinary teamwork is critical in translational research. Strategically, the VBT program brings together researchers from a wide spectrum of basic science and clinical fields. "We have cell biologists and immunologists and surgeons and pathologists and bioengineers all working together in an ideal environment for interdisciplinary work," says Saltzman. "I think that's a very rare happening among universities." In addition to these faculty, the building houses other VBT collaborators from pharmacology, cardiothoracic surgery, vascular surgery, and other departments.

The opening of the new building in October of 2007 has literally made room for these collaborations to take place, with space for over 250 scientists throughout the facility. Kyriakides says, "We are thrilled to share space with Drs. Niklason, Saltzman, and Breuer, with whom we have joined projects. Most notably, we have access to their unique expertise, and they provide us with novel testbeds for the evaluation of our experimental approaches." Kyriakides also heads VBT's Tissue Engineering group, a constellation of VBT tissue engineering researchers who gather every two weeks to present and discuss their projects.

The building houses state of the art microscopy, imaging equipment, and cell sorting facilities. There are also many new pieces of shared equipment purchased specifically for the program, all of which are readily available to the researchers. In addition, all laboratories can share equipment contributed by individual professors, allowing for better and more convenient use of specialized instruments.

The layout of the building was calculated to facilitate teamwork, featuring continuous, open spaces between labs, faculty offices grouped together by common research goals, and conference rooms situated next to the offices. The location, just two blocks from Yale-New Haven Hospital, serves to network biomedical researchers and clinicians. Moving her lab to these facilities has paid off for Niklason who says, "The move to Amistad has put our group in close proximity with colleagues in surgery, pathology and the Stem Cell Center. This increased proximity has led to several new collaborations, and has helped to make our own work in several areas go faster."

In addition to providing a place for research, the building stands as Yale's most recent commitment to a greener campus. Its design features environmentally-friendly elements such as high-efficiency lighting, ultra-low flow water fixtures, use of reflective ceilings and large windows to optimize available light, a rainwater collection and purification system for use in toilet tanks, and bike racks and showers to encourage biking to and from work.

Yale BME 2008 Doctoral Graduates

Catherine Lo

The delivery of drugs to the brain for the treatment of diseases such as cancer has proven to be difficult. Many neural devices currently in use can cause inflammation and irritation after they are inserted. Catherine Lo, of Fullerton, California, spent her graduate work developing a system that would help enhance the delivery of drugs to treat these diseases, under the direction of Dr. Mark Saltzman. In her thesis work entitled, " Poly(lactide-co-glycolide) nanoparticle assembly as controlled delivery coatings for microfabricated neural prosthetics," Lo focuses on a method of surface coating using nanoparticles, tiny spheres made of polymer materials. These modifications provide drug delivery from the surface of neural devices to improve the typical biological responses that occur around an implant site, such as inflammation. Her research results demonstrated that nanoparticle assembly is effective in providing therapeutic doses of the desired drugs for treatment. In addition, she also found that these coatings can be used to deliver DNA for gene therapy. Lo has been awarded a National Research Council Postdoc Fellowship to work at the National Institute of Standards and Technology (NIST) in Gaithersburg, MD.

Millicent Rauch

Laura Sacolick

Laura Sacolick, of Fort Lee, New Jersey, spent her PhD research at Yale working on a way to better observe the body through image analysis. Under the direction of her advisor, Dr. Robin de Graaf, and professors Dr. Douglas Rothman and Dr. Fahmeed Hyder, Socolick performed research on several method development projects for in-vivo human magnetic resonance imaging and spectroscopy. These projects included developing pulse sequences, MRI scanner hardware and software programming, spatial localization methods, and image reconstruction. The majority of her work was done for human research on a 4 Tesla scanner. Sacolick concluded her results in a thesis entitled, "Method Development in in vivo Magnetic Resonance Spectroscopy and Spectroscopic Imaging." She is currently spending a few months traveling the world and intends to take a position working as a Magnetic Resonance scientist.

Amy Scouten

Yale BME Stars in Hollywood

Lights, camera, action! Yale graduate students and faculty traveled to Hollywood, California this past September to take part in the Biomedical Engineering Society (BMES) annual conference. The conference was held at the Renaissance Hollywood Hotel located at the Hollywood and Highland Center, adjacent to the famed Kodak Theatre, home of the Academy Awards® ceremonies. The theme of the conference, "Engineering the Future of Biology and Medicine," drew many biomedical engineering researchers from around the country. The graduate students in attendance each completed formal presentations or poster sessions to share their research (see titles below, presenters in gold).

During their free time, students toured the homes of celebrities in The Hollywood Hills, shopped on Hollywood Boulevard, explored the Santa Monica Pier, and experienced European art at the J. Paul Getty Museum in Los Angeles.

Treatment of Glaucoma Through Delivery of Poly(lactic-co-glycolic acid) Microspheres To The Eye
J. Bertram, S. Saluja, M. Voss Kyhn, E. Scherfig, K. Warfvinge, M. Kuehn, Y.H. Kwon and E.B. Lavik

VEGF Delivery Combined With Endothelial Cell Transplantation For Therapeutic Revascularization
S. Jay, B. Shepard, J.S. Pober, and W.M. Saltzman

Primary Neural Progenitor And Endothelial Cells In Macroporous Gel Promote Stable Vascular Networks
M.F. Rauch, M. Michaud, H. Xu, J.A. Madri, and E.B. Lavik

Real-Time Analysis Of Neural Progenitor Cells On Poly(ethylene glycol)/Poly(L-lysine) Hydrogels
R. Robinson, S.R. Hynes, M.F. Rauch, K.B. Buck, P. Forscher and E.B. Lavik

Nanoparticle Surface Properties Affect Distribution After Convection-Enhanced Delivery
A. J. Sawyer and W. M. Saltzman

Rebecca Robinson (lt.) and Cicely Williams fill the hands of Susan Sarandon at Grauman's Chinese Theatre on Hollywood Boulevard.

Millicent Ford Rauch, from Chatham, New Jersey, recently completed her graduate work with a thesis entitled, "Engineering microvascular networks for the treatment of spinal cord injury: Co-culture of neural progenitor cells and endothelial cells". Under the direction of advisor Dr. Erin Lavik, her research focused on finding a novel treatment for spinal cord injury. Rauch sought to achieve this by tissue engineering microvascular networks of vessels that could restore blood flow to the ischemic, or blood deprived, environment of the injured spinal cord. Using a coculture of neural progenitor cells and endothelial cells seeded within a macroporous hydrogel, she was able to promote the formation of stable vascular networks in an in vivo subcutaneous model. When these microvessels were implanted in a spinal cord injury model, an improvement in the number of functional vessels at the injury site was observed. Furthermore, the construct that they developed led to a reduction in gliosis and inflammation and an increase in neural expression. Millicent is currently working with Carigent Therapeutics.

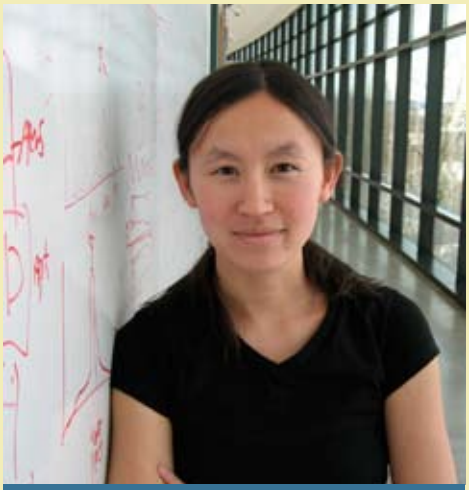
Amy Scouten, of Smiths Falls, Ontario, recently graduated after defending her thesis entitled, "Optimization and Application of Whole-Brain Cerebral Blood Volume Functional MRI." Working with her advisor, Dr. Todd Constable, Scouten focused on the design, simulation and application of magnetic resonance imaging (MRI), and pulse sequences for improved functional brain imaging, with a focus on characterizing the hemodynamic response associated with functional activation. She developed a correction procedure for the recently proposed Vascular Space Occupancy (VASO) imaging technique that takes into account the significant contribution of cerebrospinal fluid changes to the functional MR signal. After defending her thesis, Amy worked as an MR physicist for six months at the Medical Research Council Cognition and Brain Sciences Unit in Cambridge, England. She now holds a postdoctoral fellowship in the Department of Medical Biophysics at the University of Toronto, under the supervision of Dr. Bojana Stefanovic.

Woodrow (3rd from left) poses with the other fellowship recipients and notable persons including (from left) Ralph Cicerone, President of the National Academy of Sciences, Beatrice Dautresme, Vice President of L'Oreal, Laurent Attal, President and CEO of L'Oreal USA (on right), and astronaut Sally Ride (4th from right).

Woodrow Awarded the L'Oréal Fellowship for Women in Science

Since arriving at Yale, Dr. Kim Woodrow has made great contributions to the field of biomedical engineering, and was recently honored for her efforts and commitment. Woodrow, a postdoctoral fellow in the laboratory of Dr. Mark Saltzman, was selected as one of five recipients of the L'Oréal USA Fellowships for Women in Science for 2007. The highly competitive award is given out yearly to support young female scientists in advancing their careers.

Dr. Woodrow's research aims to investigate whether modifications made to the surfaces of nanospheres will improve their uptake by cells for use in drug delivery applications for infectious diseases and cancer. Agents including DNA, RNA, proteins, peptides and small molecule drugs are encapsulated in biodegradable polymers that can be modified to target specific areas of the body using less invasive technologies than currently available. In particular, one of Woodrow's current research goals is the targeting of small blood vessels that innervate tumors and support their growth and development. By targeting these structures with anti-angiogenic factors, she hopes to slow and eventually stop the growth of tumors through the use of these engineered multi-functional controlled delivery structures. Woodrow currently has collaborations with Yale's Department of Pharmacology and the Yale Cancer Center, where she is focusing on the delivery of siRNA with various peptides.



Kim Woodrow

"Medication only helps a patient if it goes to the right place. Our goal is to make sure it happens as often and as effectively as possible." -Woodrow

L'Oréal created the Women in Science program in 2003 to honor scientists who raise awareness of the contributions that women have provided to the sciences and to identify and reward exceptional female researchers in the U.S. to serve as role models for younger generations. Candidates are judged by a panel of scientific leaders and former L'Oréal Women in Science North American Laureates in areas including intellectual merit and academic record, ability to plan and conduct research, evidence of initiative, originality and productivity, and potential for career enhancement. The fellowship awards $40,000 to each recipient to be used in their postdoctoral research.

"It is vital that we encourage emerging scientists who hold the key to future discoveries," said Ralph J. Cicerone, president of the National Academy of Sciences, who presided over the selection jury. "L'Oréal USA's visionary fellowship program cultivates women scientists and provides essential support as they embark on their careers."

Woodrow completed her undergraduate degree in molecular biology and went on to obtain a doctorate degree in chemical engineering from Stanford in 2006.

Biomedical Engineering Undergraduates *In Motion*

Highlights from the 2007-2008 Academic Session

Dr. Anjelica Gonzalez, rt., talks with undergraduate student Andrew Wiedemann about biomedical engineering.

Organizers of the event and BMES officers (from lt. to rt.) Salvador Nunez, Atu Agawu, and Amy Chiu introduce the speakers to students and faculty.

Course Profile

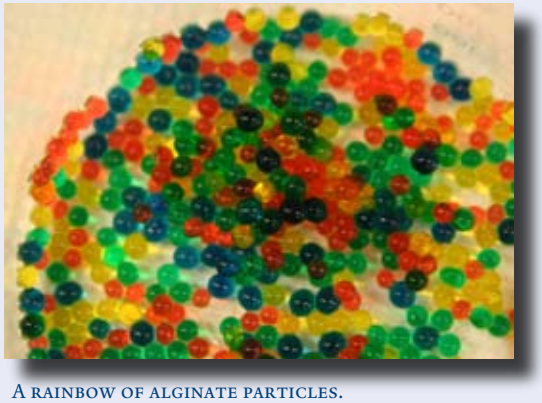
BENG 100: Frontiers of Biomedical Engineering

Frontiers of Biomedical Engineering, an introductory Biomedical Engineering course in Yale's undergraduate curriculum, attracts students from many different backgrounds looking to find out what the field has to offer. Designed for both science and non-science majors, BENG 100 focuses on the basic concepts of biomedical engineering and the connection that they have with human function and anatomy. The course covers topics such as drug delivery, tissue engineering, product development, patent protection and FDA approval.

Students in BENG100 make red alginate particles to mimic how controlled drug delivery therapies function.

During a visit to a course session, we found the students making particles, or tiny spheres that can encapsulate various therapeutic drugs. Using food coloring to mimic a potential drug, the students encapsulated the "drug" in particles of alginate, a component of seaweed that is currently used in drug delivery. They then observed the release of the "drug" by analyzing the amount of food coloring entering into the liquid phase from the particles.

Serge Kobsa, an MD/PhD student and Teaching Fellow for the course, is excited about the opportunities the course provides, "The course offers a wide but detailed overview of the current reaches of our knowledge in the fields of biological and medical engineering. The themes explored in 'Frontiers of Biomedical Engineering' are, as they should be, of interest to future scientists, and non-science majors alike. It is a course about the scientific advances that are defining our lives in the twenty-first century."



A rainbow of alginate particles.

Yale undergraduate Jocelyn Traina works with graduate student mentor Yen Cu.

Yale undergraduates listen to presentations by various faculty members.

BMES Introduction to Research

BME faculty introduce their research to prospective undergraduate researchers

As an undergraduate, trying to imagine all the possible opportunities available to you can be daunting. To help their fellow students navigate these waters, a group of seniors from the Yale undergraduate chapter of the Biomedical Engineering Society (BMES) organized an event that opened a window to areas of work available during their time as Yalies and beyond. Atu Agawu, vice president of BMES, explains, "We thought that most undergraduates, especially freshman and sophomores, had no real knowledge of the research that was going on around campus, especially in the BME department." Agawu and his fellow BMES officers stepped in to bridge the gap.

The BMES-sponsored event featured diverse aspects of biomedical engineering and offered students a chance to talk with faculty in a relaxed atmosphere. Professors James Duncan, Laura Niklason, Themis Kyriakides, Mark Saltzman, Stephen Zucker, Richard Carson and Research Associate Anjelica Gonzalez, presented highlights of the work taking place in their laboratories. An eager audience listened as the speakers touched on areas of research ranging from tissue engineering to MRI imaging and mathematical analysis. The talks and conversations showcased the possibilities for assisting in major projects currently taking place on campus.

Caleb Rhoads, a sophomore in Yale College, was one of the students drawn to the event by hopes of gaining research experience. "I was already interested in working in a lab and so when I heard about this event I thought it would be a good idea to attend just to see the different kinds of research that various professors were working on," he says. "I thought it was very interesting. It really helped me to decide which lab I wanted to work in based on my interests in tissue engineering."

Agawu was also pleased with the outcome. "All the students I talked to said they really enjoyed the event, and that it was good to see the variety of research that professors here on campus are doing. We hope to hold similar events in the future."

The Undergraduate Internship: Learning Science Through Hands-on Research

Last summer, seven Yale undergraduates participated in the Department of Biomedical Engineering's 2007 Undergraduate Research Internships. Students completed research in diverse areas including tissue engineering and medical imaging. This is the fourth year of the program.

Stephen Chan (Advisor: Dr. Laura Niklason)
Decellularized Umbilical Arteries as Pediatric Vascular Grafts

Kathleen Koch (Advisor: Dr. Themis Kyriakides)
Altered biomechanical properties in bones of MMP9-null mice

Rosh Sethi (Advisor: Dr. Erin Lavik)
Co-culture of Olfactory Ensheathing Cells and Neural Progenitor Cells

Roshan Sethi (Advisor Dr. Erin Lavik)
Bioengineering Treatment for Spinal Cord Injury

Jocelyn Traina (Advisor: Dr. Mark Saltzman)
Mucolytics and Drug Delivery Systems

Lauren Grosberg (Advisor: Dr. Michael Levene)
Confocal Differential Interference Contrast Microscopy

Yale undergraduates Roshan and Rosh Sethi work on their spinal cord research in the laboratory.

(Left to right) BME grads Katie Johnson, Katie Allen, Karen Chen, Kristen Andersen, Andrew Banooni, Allison Polland

2007 Graduates: One year down the road

Twenty-three undergraduates received degrees in Biomedical Engineering last May. We caught up with a few of them to find out where they are now.

Karen Chen and Professor Tarek Fahmy

Kelly Karns is at Cambridge University studying for a master's degree in bioscience enterprise on a Gates Scholarship. The program combines scientific classes in the major therapeutic areas with business classes in order to provide an interdisciplinary curriculum that teaches the skills required to take science from the bench to the bedside. She also won a business competition at Cambridge and is seeking further funding for a start-up company to create an improved tuberculosis diagnostic test.

Bruce Pohlot is a Motion Analysis Lab Coordinator at Shriners Hospital for Children in Philadelphia. He performs gait analyses on children with orthopaedic abnormalities. In the analysis, reflective markers are put on anatomical points of interest and viewed through numerous cameras to produce a model of the child. The data is used to create kinetic and kinematic graphs, which help staff and doctors to design the most effective way of helping the child.

Professor Michael Levene and Aigerim Djamanakova

Drausin Wulsin is teaching high school biology and chemistry at the Landon School, a private school near Washington, D.C. He writes, "I love my job because I have the opportunity to expose my students to interesting and applicable aspects of science they've never seen before. They also really like blowing things up. High schoolers have a unique position in that they are old enough to understand in-depth scientific concepts and to perform sophisticated experiments, but young enough that they have had relatively little contact with the really fascinating parts of science."

After receiving acceptance into Harvard Business School, Gilbert Addo decided to defer and work for Xerox in their Investor Relations group. He writes, "It's been a great experience thus far and the job has kept me quite busy." He will begin at Harvard in the fall of 2009.

Michaela Panter

Aigerim Djamanakova has been pursuing a PhD in Biomedical Engineering at the Johns Hopkins School of Medicine, with a research focus in medical imaging.

Katie Allen is an Investment Associate at Bridgewater Associates in Westport, Connecticut. After a year-long intensive training program for new hires, she spent the first 8 months in the trading department trading foreign currency and working on transaction cost projects, and recently rotated into the client facing department.

2007 Commencement Exercises on Old Campus

Karen Chen just completed her first year at Vanderbilt School of Medicine. Over the summer, she conducted research for Vanderbilt's Institute for Medicine and Public Health.

Vadim Tsipenyuk is working at Goldman, Sachs & Co. in the Technology Media and Telecommunications group of the Investment Banking Division. He enjoys the challenge of making financial models and working with companies on a variety of transactions.

Karlo Perica is enrolled in the MD/PhD program at Johns Hopkins Medical School. His research interests are in tumor immunology and T cell receptor membrane organization. In his free time, he enjoys playing basketball and exploring Baltimore.

Sandeep Saluja and Gilbert Addo (ends) with friends

Sandeep Saluja is a full-time Research Assistant in Dr. Erin Lavik's lab in the Biomedical Engineering Department at Yale. His research focuses on developing new therapeutic approaches for the treatment of retinal degeneration caused by glaucoma.

Michaela Panter completed her first year as a graduate student in Engineering and Applied Science at Yale. Under the guidance of Dr. Tarek Fahmy, she is characterizing the immunological synapse between T cells and different types of antigen-presenting cells.

Allison Polland is in medical school at Columbia University's College of Physicians and Surgeons. She is also doing research in the lab of Professor Jonathan Barasch studying NGAL, a novel biomarker of kidney injury.

Kristin Knox relocated to Los Angeles, CA to enter the field of market research. She works with key companies in the entertainment and video game industries, helping them assess the market potential of their products. "I use the logical and analytical skills I learned in my biomedical engineering courses to sift through raw data and draw meaningful conclusions," she writes.

Katherine Johnson spent the year at the National Cancer Institute in Bethesda, MD on an intramural research training award. The aim of her project was to understand how HPV infection occurs, both in vitro and in vivo, for different types of HPV. She used an in vivo model of HPV, which her lab developed and published in the July 2007 issue of Nature Medicine. She is matriculating at Harvard Medical School this fall.

Kristen Andersen is in medical school at Columbia University College of Physicians and Surgeons. Having seen phase 1 clinical trials for convection-enhanced delivery of chemotherapeutic agents into brain tumors she writes, "It was extremely interesting for me to see this new technology in the clinic after having learned the basic science while working in Professor Saltzman's lab at Yale." Over the summer, she conducted neurosurgery research in a cerebrovascular lab.

Casey Harness is a Project Manager for Cole Hargrave Snodgrass & Associates, a national polling and survey research firm based in Oklahoma City. The focus of their work is mainly political, but they are also becoming heavily involved in market and university research throughout the nation and the world.

BME Class of '07

Gilbert Cameron Addo
Katie Ann Allen
Kristen Nicole Andersen
Andrew Boby Banooni
Jamie Franklin Capo
Karen Chen
Aigerim Omirkoulovna Djamanakova
Casey Christopher Harness
Katherine M Johnson
Kelly Melia Karns
Kristin Elizabeth Knox
Javier I Lapeira
Won-Hoon Lee
Michaela Shulamit Panter
Karlo Perica
Bruce G Pohlot
Allison Rachel Polland
Sandeep Singh Saluja
Jordan Spence
Vadim Gregory Tsipenyuk
Drausin F Wulsin
Li Cai

SCALING WALLS, CROSSING CULTURES

BME AMONG THE "YALE 100"

Police-escorted motorcades, paparazzi and reporters, lavish banquets with heads of state, 5-star hotels – just an ordinary day in China for **Professor Erin Lavik**, doctoral student, **Stacey Demento**, and college senior, **Tanya Klinkhachorn** as part of the "Yale 100" last May. The one hundred Yale students, faculty and staff were selected to participate in a ten-day trip to China as honored guests of Chinese President Hu Jintao, who extended his invitation to Yale during his April 2006 address at the University. The trip included tours of cultural and historical sites, visits to top universities, and meetings with government officials, students and scholars.

Yale holds a distinctive place of prestige in China's corporate imagination. In 1854, Yung Wing of Guangdong Province graduated from Yale, becoming the first person in China's history to earn a degree from an American college or university. "In China, Yale is seen as the top school," said Demento. "The President told us, 'You will run the U.S. someday, and the students at our top schools will be running China someday.'" Hu's aim for the trip was to catalyze relationships that would lead the delegates to include China in their future plans.

Indeed, although the trip was, in Klinkhachorn's words, "a whirlwind ten days," it was not without a personal face. Each of the delegates spoke of extraordinary gestures of hospitality by individuals who invited them into their homes and lives. In the city of Xian, the delegates were personally hosted by local families who went beyond their means to entertain their guests. "It was a very humbling experience," Klinkhachorn says.

Demento was also floored by the self-sacrifice of her host family. One of the many privileges they arranged for her was a personal tour by a renowned Chinese calligrapher at a museum where his works are exhibited.

Lavik says, "I was struck by how kind people were. I am not the most coordinated person, and I tripped and fell flat on my face in one of the crowded markets in Beijing. Everyone - the shoppers, and the salespeople - stopped what they were doing and made sure I was ok."

Seeing the architectural accomplishments of China was a special highlight of the trip for Lavik. While in Shanghai, Lavik and two other faculty delegates ran into Yale Electrical Engineering professor, Edmund Yeh. A native of Shanghai, Yeh offered them an insider's architectural tour of the city that spanned a range of styles, from an Elizabethan-styled banquet hall to an Art Deco lobby. While climbing the Great Wall, Lavik was inspired by its scale and the challenges of the landscape on which it was built. She says, "The Wall demonstrates that the impossible is intensely possible with enough time and resources."

The austerity of the Chinese education system also left an impression on the delegates. Chinese students are placed in their areas of specialty before they enter college, have little freedom to choose their area of study, spend many more hours in classes than American students and, with few exceptions, do not have the luxury of electives or extracurricular activities. "The students look exhausted," says Dementó. Both delegates strongly respect the students' diligence but noted sparks of interest in a system that allows for greater independance and creativity. Klinkhachorn says, "I was glad to see some of the students questioning the system."

Perhaps the most deeply-felt effects of the trip were the

Tanya Klinkhachorn at Tiananmen Square

Stacey Demento with President and Mrs. Levin at the Great Wall

bonds it created among the Yale delegates. "Some of my best friends now are people I met on the trip," says Klinkachorn. For Lavik, a number of collaborations grew during discussions over shared meals or while touring. Demento says, "It was like a retreat that brought people from every department together and gave me a greater connection to Yale."

In fact, Demento did more than enjoy her new sense of connectedness. As a result of a conversation in Beijing with Professor Erol Fikrig, chief of the Infectious Diseases Section at the School of Medicine, Demento, her advisor, Professor Tarek Fahmy, and Fikrig launched a collaboration to develop a vaccination strategy for the West Nile Virus. Her research focuses on developing a vaccine delivery system in which she creates biodegradable nanoparticles that mimic bacteria in order to stimulate an immune response. Working with Dr. Harald Foellmer, an associate research scientist in Fikrig's lab, she loaded a protein from the West Nile Virus into her nanoparticles, subcutaneously administered the formulations to mice, and observed survival by injecting the mice with West Nile Virus. The experiment worked. On the first run, 100% of the mice that were vaccinated survived infection. In follow-up experiments, she is seeing 70% survival rates for nasal administration of the vaccine. She is working to optimize the antigen and route of administration, in order to create a globally effective vaccine.

Demento's vaccine may well impact the world in future years, but for now, she and her two fellow travelers speak with simple gratitude and humility of the privilege of touring China with the Yale 100. It was, says Lavik, "an extraordinary gift."

Professor Erin Lavik (middle, wearing blue baseball cap) with other faculty at the newly-built 2008 Summer Olympics "Bird's Nest" Stadium

Around Campus

Training Engineers and Scientists of the Future

A New Collaboration Helps New Haven Public School Teachers Bring Real Science And Engineering Into the Classroom

Teachers become students in the Yale-New Haven Teachers Institute course "Health and the Human Machine." (Photo Credit: Michael Marsland)

Since 1978, Yale and the New Haven Public Schools have maintained a partnership to help develop new and relevant course materials for the classroom. James R. Vivian, founding director of the Yale-New Haven Teachers Institute, acknowledges the program was designed to, "...strengthen teaching and improve learning of the humanities and the sciences in our community's schools." Participating teachers from area elementary, middle and high schools are designated as "Institute Fellows" and are in charge of preparing a curriculum unit for the program. After designating an interest in a particular area, Fellows are matched with a faculty member with interest and experience who then serves as a lecturer for the course. Last summer, Dr. Mark Saltzman was asked to conduct a course for the institute entitled, "Health and the Human Machine". The course covered topics including human physiology, nutrition, infectious diseases, and biomechanics. The motivation for the class originated with a group of Fellows from a New Haven middle school looking to bring valuable health information into their classrooms. The Fellows themselves came from very diverse disciplines - from languages, to visual arts and biology - but were all looking for a way to engage their students in classroom discussions about topics in nutrition, physiology and medicine. In collaboration with Dr. Saltzman, the Fellows created physiology curriculum units that can be used to teach various subjects, both in the classroom and online. They designed the curricula in a broad enough fashion that different aspects can be implemented in classrooms from elementary to high school levels. This year, Dr. Saltzman conducted the class for a second summer, this time covering concepts of nutrition, diabetes and metabolism.

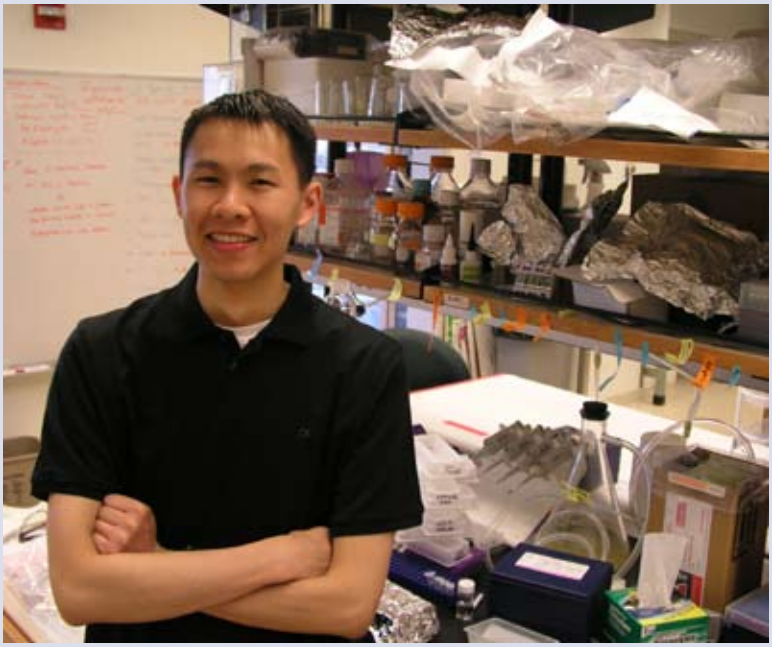
BME Celebrates Yale vs. Harvard in "The Game"

The grills were lit, the fans dressed for a cold New England day, and the spirits of Yale students, staff and alumni were running high. Last year's game, hosted by Yale, was the 124th match between two of the biggest rivals in history, with both teams heading into "The Game" unbeaten with high expectations of a perfect season. Enthusiastic departmental members arrived at the home of Dr. Mark Saltzman ready to prepare for what would promise to be a spectacular display of tradition and athleticism in the 2007 match-up between Yale and Harvard in the fall football season. Before the big game, students and faculty were found playing touch football in the backyard while others enjoyed a feast of traditional tailgating foods and company. With full bellies and Yale attire, the group progressed down the street to the Yale Bowl to share in a piece of history. Despite the anticipation, preparation, chatter and cheer, Yale came up short for a victory, but the members of the department left having had a day of fun and camaraderie.

First year graduate students Rachael Fields and Yu-Ting Liu take part in the festivities at last fall's Yale-Harvard Game.

Graduate students Rachael Sirianni and Tom Chia spend time with Liberty Summer, Greg Sirianni, and Professor Mark Saltzman at the BME Tailgate prior to "The Game".

Yale BME Graduate Student Receives Two Prestigious Fellowships



Michael Look, a second year biomedical engineering doctoral student in the laboratory of Dr. Tarek Fahmy, was recently selected as the recipient of fellowships from the National Science Foundation Graduate Research Fellowship Program (NSF GRFP), and the National Defense Science and Engineering Graduate (NDSEG) Fellowship funded by the U.S. Department of Defense. These highly selective funding opportunities highlight the best and brightest graduate students around the United States. Although it is an honor to receive one, it is very rare for a student to be awarded both of these highly competitive fellowships.

The two fellowships are awarded by the various institutions to support young scientists in their educational careers. The NSF awards fellowships to students in the fields of science, technology, mathematics and engineering, "...to ensure the vitality of the human resource base of science and engineering in the United States and to reinforce its diversity." The Department of Defense looks to support students performing research in areas relevant to the national defense needs.

Michael's current research focuses on the study and development of nanoparticle systems for immune system applications. His first project is aimed at finding a treatment for lupus, an autoimmune disease, by developing nanoparticles that selectively target and kill the specific immune cells that cause disease. In addition, he is also investigating an orally delivered nanoparticle vaccine system where he attempts to induce allergic responses, in order to enhance immunization efficacy.

Yale BME Participates in World Sport Stacking Day

On November 8, Yale Biomedical Engineering graduate students, undergraduates, and a few adventurous faculty members, gathered to participate in the 2007 World Sport Stacking Association Guinness World Record day. A media release from the World Sport Stacking Association claims the 2007 event as the second Guinness World Record's "World's Largest Sport Stacking Event".

The cup stacking game used for the event, Speed Stacks from Play Along, incorporates the use of 12 cups, a board, and a timer. Designed to test hand-eye coordination and speed, the game has been used in many school systems and can be found around the world. The premise of the game is to assemble and disassemble specially designed plastic cups in predetermined formations as quickly as possible. A typical stack meet incorporates both individual and team events. Event coordinators and captains, Rebecca Robinson and Cicely Williams were thrilled with the turnout, "Yesterday's event was better than we could have hoped. We had many people in the department come and 'stack it up'—novices and experts alike. We feel this will really put Yale BME on the map!" The pair hope that these kinds of activities will promote teamwork and form bonds between departmental members inside and outside of the classroom and laboratory.

Tarek Fadel and Erin Steenblock, both graduate students, compete in the Guinness Book of World Records Sport Stacking Meet.

The Art of Engineering

"The Scientific Sky"
Rachael Sirianni

A recent competition held in the department put out a call for "Art By Engineers" to showcase the creative side of the students, faculty and staff. Many remarkable displays of talent were received, and a panel of judges selected three pieces that will hang in a permanent gallery in the Malone Engineering Center. The selected pieces included:

First Place: "The Scientific Sky" by Rachael Weiss Sirianni
Second Place: "Dinner with the Dwarves" by Jason Stockmann
Third Place: "Grow" by Yu-ting Liu

"Dinner with the Dwarves"
Jason Stockmann

"Grow"
Yu-Ting Liu

Editors and Design Layout: Audrey Lin and Jennifer Saucier-Sawyer
Photo and Image Credits: Yen Cu, Tanya Klinkhachorn, Audrey Lin, Yu-Ting Liu, Michael Marsland, Terry Degradi, Stacey Demento, Jennifer Saucier-Sawyer, Pavithra Venkat
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Questions or Comments?

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Yale BME NEWS is a bi-annual publication of the Yale Department of Biomedical Engineering.
Vol. 1, No. 2 highlights Yale Biomedical Engineering Department events through August of 2008.

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