



Biomedical ENGINEERING News

Spring 2008

New School Prepares Graduates for a Growing Field

Although biomedical engineering is a relatively new field, an increased aging population and focus on health care has created numerous employment opportunities for graduates. According to the Bureau of Labor Statistics (BLS), 14,000 people had jobs in biomedical engineering in 2006, with an anticipated 21% growth in the field over the next decade. The School of Biomedical Engineering (SBME) at Colorado State University is poised to prepare graduates for these increased employment opportunities. As the collaborative effort of four colleges at CSU, the interdisciplinary Ph.D. and Master of Science degrees offer a breadth of opportunities and depth of knowledge, producing high quality graduates. Additionally, the Master of Engineering degree offers an accessible professional development opportunity for engineers and scientists in the biomedical industry.

**Colorado
State
University**

Discovering the Link Between Vascular Control, Age, and Cardiovascular Disease

As the leading cause of death for both men and women, cardiovascular disease affects over 80 million people each year in the United States. **Dr. Frank Dinunno**, assistant professor in the School of Biomedical Engineering (SBME) and the Department of Health and Exercise Science, is studying the effects of aging on vascular regulation to gain a better understanding of cardiovascular disease. Many investigators have focused on either the effects of aging on sympathetic nervous system activity at rest and in response to various stressors, or the effects of aging and/or disease on endothelial dysfunction. Dinunno's research attempts to integrate how these two very powerful modulators of vascular tone interact to regulate blood flow and oxygen delivery to peripheral tissues (e.g. skeletal muscle). Working with a team of graduate students, Rick Carlson (research associate), and Dr. Wyatt Voyles, M.D. (Heart Center of the Rockies), Dinunno is seeking to understand the regulation of blood flow and oxygen delivery to skeletal muscle in humans. More specifically, the research is designed to understand how advancing age impacts the "normal" control mechanisms



observed in young subjects. Research has found that aging is associated with many changes in the integrative control of the circulation such that blood flow and oxygen delivery to peripheral tissues are compromised in older adults during various physiological stressors. Dinunno's research is funded through three NIH grants, two from the National Institute on Aging, and one from the National Heart, Lung, and Blood Institute.



State-of-the-art equipment allows for sophisticated and accurate measures of cardiovascular function.

"We believe it is important to understand how aging effects vascular regulation since older adults are characterized by a reduction in exercise capacity and are at greater risk of developing ischemic heart and cerebrovascular disease."
- Dr. Frank Dinunno

Alumni Spotlight: Maile Ceridon Traveling the World for Science

It is not every engineer that gets to study at both NASA and in Antarctica, but **Maile Ceridon** is no ordinary engineer. This Mayo Clinic graduate student has had opportunities of a lifetime, starting at CSU.

While an undergraduate at CSU, Maile worked with Dr. Susan James in the Rocky Mountain Materials Research Lab. She participated in research studying friction and wear between different components of hip and knee replacements. While a sophomore and junior at CSU, she helped build a device that simulated micro grav-

ity that later was tested on NASA's "vomit comet." Specifically, she completed mechanical testing on the different polymers modified to reduce friction. Maile continued her research career as a cooperative education student for NASA, where she studied constant force resistant exercise units.

Her favorite part of CSU was the atmosphere. "Even as an undergrad the professors listened to what I could contribute. If I was motivated enough, my professors were always there to guide me in specific directions," Maile said.

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Who's New?

After four years, the typical Doctorate of Veterinary Medicine (D.V.M.) student would be celebrating graduation. Instead, **Katrina Easton** will be taking the Ph.D. qualifying exam this May. Katrina will complete her Ph.D. and D.V.M. in May 2011. Although this degree combination requires a time commitment some students can't comprehend, Katrina sees it as an opportunity to combine her passions in research and clinical medicine. Earning both degrees will allow her to stay in academia, open a clinical practice, or take a position in industry.

Katrina's research with Dr. Chris Kawcak involves the fetlock, or metacarpo-phalangeal joint, the most commonly injured joint in race-horses. She is using *in-vivo* and *in-vitro* methods and finite element analysis to better understand the biomechanics of the joint and determine factors predisposing horses to catastrophic injuries. Katrina enjoys back-packing, running, and snowshoeing, and hopes to improve her climbing this summer.

Susan Yonemura came to CSU after a successful career in the technology industry.

She saw a Ph.D. as an opportunity to do research with practical implications, "where the value of her work would not be determined by profits alone." The interdisciplinary Ph.D. program appealed to Susan's desire to understand clinical problems and apply engineering knowledge, develop solutions and improve quality of life for patients.

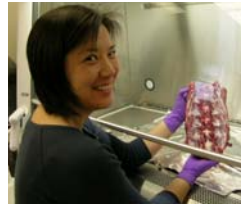
During her rotation with Dr. Matt Kipper, Susan focused on surface modification for implants. She gained a better appreciation for controlling tissue interfaces which she can apply in her dissertation research with Dr. Sue James, developing improved treatments for intervertebral disc disease. Susan plans to return to the industry setting and looks forward to having a direct impact on bringing new treatments to market. She also plans to spend more time training and entering competitions with her two standard poodles and reading a few good novels.

Through internship experiences in his bachelor's program, **Tim Ruckh** discovered his passion for in the biomedical industry.

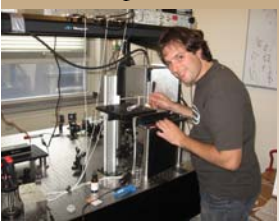
After completing his master's in mechanical engineering, Tim knew he wanted to continue to do research. Industry leaders advised him that obtaining his ideal research position would require him to earn his Ph.D.

Tim is completing rotations this semester with Drs. Matt Kipper and Ketul Popat, his Ph.D. co-advisors. "Lab rotations exposed me to areas of research that were completely different than my master's research and I have gained a more diverse skill set," explains Tim. The rotations create flexibility for him to propose projects and conduct research in his area of interest.

Tim's research focuses on electro-spinning of materials to create thin fibers similar to those in the extracellular matrix. He hopes to create a material that will stabilize growth factors. Tim currently plans to enter industry after earning his Ph.D. However, faculty have advised him that as he nears graduation, academia may become more appealing.



Dr. Diego Krapf is a new core faculty member in the School of Biomedical Engineering. Dr. Krapf's research experience includes infrared photodetectors, semiconductor quantum dots and quantum wells, porous silicon, nanoelectrodes for electrochemistry applications, and nanopores as DNA sensors. His current work lies at the interface between engineering, physics, and biology at the nanometer scale. At CSU, Krapf also teaches in the electrical and computer engineering department and is pursuing research using nanoscale devices to unravel the dynamic behavior of protein-DNA complexes crucial in understanding human diseases, including many types of cancers and neurological disorders. Prior to joining CSU,



Krapf worked as a postdoctoral fellow at Delft University of Technology in the Netherlands. He received a bachelor's degree in physics from the Hebrew University of Jerusalem in Israel and a master's degree and Ph.D. in applied physics, also from the Hebrew University. He and his wife, Susan, are the parents of Alessandro, who has recently started attending pre-school in Fort Collins. In his free time, Krapf enjoys scuba diving, ultimate frisbee, reading, and playing board games. He has also enjoyed improving his skiing skills this winter in the Rocky Mountains.

Dr. Ketul Popat joined CSU as an assistant professor in the School of Biomedical Engineering and the Department of Mechanical Engineering in January of 2008. Dr. Popat's research interests include bio-nanotechnology and its application in tissue engineering, drug eluting coatings for implantable devices, and biomaterial surface modification and characterization. Before coming to CSU, Dr. Popat completed postdoctoral research at Boston University and the University of California at San Francisco. His current research focuses on developing, refining, and extending select fabrication routes for producing materials with controlled nanoarchitecture and bioactivity, as well as developing nanostructured surfaces that elicit controlled biological response. Through gaining an understanding of how physical surface parameters influence cellular adhesion and differentiation, Dr. Popat hopes to design biomaterial surfaces for a variety of tissue engineering applications, controlling the size of nanoarchitecture to manipulate the release rates of drugs at physiological dosages and increase patient compliance. Dr. Popat earned his bachelor's degree in chemical engineering from M.S. University in India, a master's degree in chemical engineering from Illinois Institute of Technology, and Ph.D. in bioengineering from the University of Illinois at Chicago. He recently purchased a home in Fort Collins and has been entertaining visiting family and friends.



Alumni Spotlight

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even though she is currently a graduate student at the Mayo Clinic, Maile can count on her former CSU professors to be quick with a letter of recommendation or an idea for a reference on a particular topic.

Maile's advice for incoming undergrads includes: "Find something that you really enjoy and go after it. If something sparks your interest along the way, don't hesitate. Ask how to get involved and put yourself in a position to learn more and have a new experience. Ask questions and be aggressive about your education and your knowledge." She also mentioned that students should enjoy Fort Collins, the mountains, and the opportunity to play outside most days of the year.

Following her graduation from CSU, Maile accepted a fellowship to pursue a Ph.D. in the Department of Physiology and Biomedical Engineering at the Mayo Clinic in Rochester, Minnesota—an institution that only accepts 20-30 graduate students a year. Her research focus is on bronchial circulation and blood flow to the non-gas exchanging airways, specifically researching this circulation in heart failure patients versus healthy patients. Maile

is researching changes in pulmonary function as well as functional abnormalities, regulation of flow through the bronchial circulation, and the cost and work of breathing.

Her graduate research has allowed her the opportunity to travel to Antarctica with current mentor, Dr. Bruce Johnson. While in Antarctica, Maile was part of a team studying acute hypoxia, determining whether genetic or biochemical markers predetermined altitude sickness. For six weeks the team took blood samples and collected data on pulmo-



Maile prepares blood samples at McMurdo station in Antarctica.

photo courtesy of the Antarctic Sun newsletter

nary function, blood pressure, heart rate and other physiological functions, comparing samples across people and locations. The team is currently analyzing the data. Maile's favorite part of the project was "being able to study science while being in Antarctica."

Her advice for graduate students is to "stay involved in something outside of your work. Graduate school is hard and it is easy to get caught up in the culture of just science, but you need to maintain something of yourself and your identity. Get involved in something outside of your work, and keep your life balanced."

Maile believes the CSU faculty were key in getting her interested in biomedical engineering and that the program gave her a solid logical and scientific basis for solving problems in the Mayo Clinic.

As for the future, Maile intends to complete a post doctoral fellowship, after which she plans to remain in research and academia.

SBME Director Dr. Sue James Hails from New Zealand

Dr. Susan James, director of CSU's School of Biomedical Engineering, is spending a year at the University of Canterbury developing an international, collaborative research effort between UC's Centre for Bioengineering and the School of Biomedical Engineering at CSU. The team, including Professor James, Senior Lecturer Dr. Mark Staiger, from UC's Mechanical Engineering Department, and Dr. Tim Woodfield from the Biomaterials and Tissue Engineering (BioMATE) research group within UC's Centre for Bioengineering has just been awarded \$26,000 from the Brian Mason Scientific and Technical Trust to kick start the research.

The team is leading a project that will take the first steps towards replicating the structural and physiological properties of the human intervertebral disc. Dr. Staiger explained that in most developed countries, lower back pain is the leading cause of chronic disability in adults aged 18-45, and

absenteeism due to back pain is second only to the common cold. "The commercial market for solutions to lower back pain continues to grow and researchers are now trying to develop biomimetic intervertebral disc replacements that mimic the natural disc and can be used as a clinical alternative to spinal fusion," Dr. Staiger said. "The UC project aims to replicate the properties of the disc using novel biomaterials with the aim of producing a replacement for degenerated or damaged discs."

"... collaboration will be of great benefit to the Canterbury region by allowing access to the combined world-class expertise in place at both Colorado State University and the University of Canterbury, with the potential for student exchanges through a recent international memorandum of understanding signed by both universities."

- Dr. Staiger, University of Canterbury
"My sabbatical here at UC has introduced me to the potential of electrospinning for

the creation of nanofibres that mimic those found in the extracellular matrix of the human body. Building a collaboration with Dr. Staiger has led to this exciting project using his state-of-the-art electrospinning techniques and some of the novel biopolymers developed in my lab at Colorado State University. This is truly a great example of how international collaboration can lead to new research and eventually new healthcare technologies."

- Dr. Susan James



(Left to right) Jason Kerr, Dr. Susan James, Julian Phillips, and Dr. Mark Staiger.

SBME Forms Industry Advisory Board

The first meeting of the School of Biomedical Engineering (SBME) Advisory Board will be held on April 3rd. The Board was recently established to advise SBME on program and curriculum matters. The board also serves as a connection between the academic department and industry.

The Board is composed of SBME faculty

and industry leaders who have an invested interest in the future of the program and quality of our graduates. The board will provide feedback to the school regarding expanding educational opportunities, establishing an internship and co-op program, working to broaden curriculum

selection, and more. SBME will utilize this industry guidance to build competitive undergraduate certificate and graduate degree programs and to maintain a current curriculum as the industry evolves. The relationships built through this partnership will also help ensure the program continues to prepare students for successful careers.

Current Advisory Board Members Include:

Steve Simske, Ph.D., Hewlett Packard
Warren Mauter
Rick Jory, Sandhill Scientific
John Gauger, Zimmer
Paul Schmidt, Ph.D., PR Pharmaceuticals
J. Dennis Bruner, Ph.D., P.E.

Kirk Kindsfater, M.D.
Ivan Vesely, Ph.D., ValveXchange
Brett Beal, CSU Career Center
Ranil Wickramasinghe, Ph.D., SBME
Christian Puttlitz, Ph.D., SBME
Susan James, Director, Ph.D., SBME

If you would like more information or to inquire about joining the advisory board, please contact Rebecca Chase, SBME Coordinator, at (970) 491-7077 or [Rebecca.Chase@colostate.edu](mailto:rebecca.chase@colostate.edu).

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SBME Seminar Series Kicks Off

To further the interdisciplinary mission of the School of Biomedical Engineering (SBME), advanced degree seeking students are required to attend a weekly seminar series. Seminar speakers include industry leaders, professors from leading biomedical engineering academic programs, and our own excellent faculty. Students learn about recent trends in research and network with leaders in the field. The seminar series is open to the public.

This semester we have been honored to have the following industry and faculty members present seminars:

Dr. William Dernell, Department of Clinical Sciences, Colorado State University; *Pulmonary Delivery of Chemotherapeutics: Applications and Animal Modeling*

Dr. Diego Krapf, Department of Electrical and Computer Engineering, Colorado State University; *Nanopores as Single-Molecule Sensors*

Dr. Amy Pruden, Department of Civil and Environmental Engineering, Colorado State University; *Antibiotic Resistance Genes as Emerging Environmental Contaminants*

Dr. Paul Schmidt, Chief Scientific Officer, PR Pharmaceuticals; *Results for Sustained Release Drug Delivery to the Eye to Treat Retinal Disease*

Dr. Ivan Vesely, Founder and Chief Scientific Officer, ValveXchange Inc.; *Heart Valve Tissue Engineering*

Dr. Ravi Bellamkonda, Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech/Emory; *Using Nanoscale Contrast Agents to Probe the Vascular Leakiness of Tumors to Predict the Effects of Systemic Chemotherapy*

Dr. Steve Simske, Principal Scientist, Hewlett Packard; *Security Printing and Imaging at HP Labs*

Dr. Daniel Gustafson, Department of Clinical Pharmacology, Colorado State University; *Pharmacokinetic Modeling Approaches in Oncology: Pre-Clinical and Clinical Applications*

Upcoming Seminars:

March 27

Paul Hudnut, Director of Venture Development, and **Dr. Henry Nowak**, Director of the Center for Entrepreneurship, CSU College of Business; *Entrepreneurship in the Life Sciences Industry*

April 3

Dr. Raja Ghosh, Department of Chemical Engineering, McMaster University; Canada Research Chair in Bioseparations Engineering; *Hydrophobic Interaction Membrane Chromatography, An Effective Tool for Purification: Analysis and Detection of Antibodies*

April 10

Sean Hays, Summit Toxicology, TBA

April 17

Dr. Kenneth Solen, Department of Chemical Engineering, Brigham Young University; *Hemo-Incompatibility: A Multi-Variable Problem that Requires Multi-Variable Examination*

April 24

Dr. Ozan Akkus, Weldon School of Biomedical Engineering, Purdue University; *An Electrochemically Induced Collagen Assembly Process for Synthesis of Biomimetic Tendon-Like Materials*

May 1

Dr. Brian Tracy, Department of Health and Exercise Science, Colorado State University; *Variability of Neuromuscular Output in Human Aging*

May 8

Dr. Wei Tan, Department of Mechanical Engineering, University of Colorado at Boulder, TBA