**In the Spotlight:**  
**Dr. Cassandra Fraser**  
Winner Cavaliers’ Distinguished Teaching Professor Award  
By Shannon Melinda Smith

DR. CASSANDRA FRASER has been a faculty member in the Chemistry Department for nine years. Her academic journey to this position has been an unusual one, but her life experiences have helped her to become a respected educator and advisor.

**Divinity School**  
In her fourth year of undergraduate school, Dr. Fraser left three years of chemistry study and delved into the humanities, focusing on the history of thought, including political theory, theology, philosophy and women’s studies. For the next step in her career path, she applied to divinity school. With a one-year academic foundation in the humanities, she took a risk and decided to attend Harvard Divinity School. This was a very flexible program, and she took a variety of courses in religion, comparative culture, political theory, and psychology. However, she was not interested in becoming an ordained minister, but was on a quest for learning about people—what is important to them and why. In her last of four years at Harvard she returned to science, working in the Department of Cellular and Developmental Biology and the Laboratory of Toxicology at Harvard, while taking chemistry courses. Thereafter, Dr. Fraser began to look for graduate research opportunities elsewhere in chemistry.

**Environmental Concerns and Career Choices**  
"While much good comes from chemistry, of course some chemicals can be bad" she says, reflecting on an undergrad professor’s story of a toxic waste dump that led her to think more broadly and deeply about the environment and chemistry’s impact on the world. "What is safe to put in our bodies may also be safe to release into the environment," she considers as a possibility for synthetic design. She studied cancer and cell growth in two research labs at Harvard while finishing divinity school, experiences that influenced her decision to return to science. The "structures and processes of nature are incredible," After much thought, she decided to go back to chemistry with an interest in metals as catalysts, both enzymes occurring and working naturally in the body and synthetic systems. Her graduate research with Prof.
Brice Bosnich at the University of Chicago was inspired by enzymes that bind and activate dioxygen. Her postdoctoral research with Prof. Robert H. Grubbs at Caltech involved carbohydrate functionalized polymers that served as simple models of cell surfaces, and work in her group now, follows a similar bio-inspired vein. Dr. Fraser realizes that as a synthetic chemist, one need not be restricted to mimicking nature. One can be inspired by nature and design new things. She enjoys being creative.

On Finding a Home at UVA
After post-doctoral study, Dr. Fraser began to look for positions in academia. She was interested in finding a place with research focus, but scholastically diverse enough to satisfy her multifaceted interests. At UVA, she felt that education was very important, with a “big picture, liberal arts college flare,” but with all the advantages of a research university. She applied to liberal arts colleges and research universities, but found at UVA opportunities to explore a wide variety of her professional interests at an institution with important philosophical ideals, beautiful surroundings, a colorful history, and research on the cutting edge of the field.

On Women in Science
It is obvious to those of us in science that women are often a minority in the workplace. Dr. Fraser reflects, “In my graduate and post-graduate career, I realized that I was one of few, but I wasn’t really bothered by that.” She explains that, after becoming a faculty member, she began to sense a definite change in gender roles. With grants and awards offered exclusively for women and different treatment in certain situations, a difficulty lies in distinguishing what acknowledgements result from merit or from gender considerations, which was never an issue before. While this poses frustrations at times, Dr. Fraser seems to push aside any doubts and has found that the most effective strategy when faced with obstacles is to “be constructive, dream her way out of tough situations, and do what she loves to do.” She thinks that it is important to network broadly both to remain intellectually challenged and to share experiences and vision with a diverse group of students and colleagues.

On Teaching
There are three important issues in academia: research, teaching, and service.

“If anyone says to me that research is all that is important, I would have to say to them, ‘I’m sorry, but I disagree.'” Dr. Fraser says that there have been incredible opportunities in all three areas here at UVA, but feels that graduate education could be improved. That is why she sits on advisory committees for the Jefferson Scholarship Foundation, a group designed to envision new scholarships at the graduate level to find students not only exceptionally talented in science, but also with a sense of public responsibility and a passion for sharing their knowledge more broadly.

On Multidisciplinary Study
In conclusion, Dr. Fraser says, “There are so many important issues that require that we talk to each other (across disciplines). We can practice communicating in an academic environment and then take these skills out into the world.” That is what her new class Designing Matter is about. There, in the Common Course, students faculty and members of the UVA community and beyond, from a variety of different backgrounds come together to study matter—how it is perceived, represented, understood, how it is designed, shaped, used and discarded, and for whose benefit—from scientific, applied, ethical, aesthetic, and other vantage points. Participants are challenged to consider and share different perspectives on important issues of local, national, and global importance.

Application of Technology: UVA Medical School Replaces Canine Lab with Human Patient Simulator

By Rooshin Dalal

A Dark History
In late January 2004, the Charlottesville community learned of a controversial class offered at the UVA Medical School. The class, entitled "Life-Saving Techniques Lab", was offered as an optional elective to 140 third-year medical students each year. Students taking the class were able to practice inserting chest tubes, perform a cricothyroidotomy, and dissect tissue to insert IV needles into veins. All of these procedures were performed on anesthetized beagles which were euthanized at the end of the lab. Nearly 100 of these canines were purchased and killed every year at a cost of nearly $22,000 to the state taxpayers. What was most troubling, however, was the fact that over 80% of all medical schools (including all of the top 20 schools) had long since eliminated animal labs in favor of more accurate, economical, and humane alternatives such as computerized human simulators or human cadavers. Something had to be done to bring the curriculum at UVA up to date.

see PATIENT SIMULATOR, page 7
Externship Experience: Orchid Cellmark

By Katie Horsman

extermination at Orchid Cellmark in Germantown, MD. Orchid Cellmark is the largest private forensic DNA testing company in the world. Their work, typically on contract from law enforcement agencies, includes forensic casework, convicted offender DNA databasing, and post-conviction DNA testing, among others. Some of the high-profile cases for which they've completed DNA analysis include OJ Simpson, JonBenet Ramsey, the Unabomber, and the Green River murders.

I spent the summer at Cellmark developing a real-time PCR assay for the quantitation of total human genomic DNA and male DNA for use in forensic casework. The method for DNA quantitation used in the majority of forensic laboratories (including Orchid Cellmark) is a slot-blot method, which is time-consuming, labor-intensive, subjective in interpretation, and limited in the linear range of quantitation. In addition, the method does not provide a measure of the quantity of male (only) DNA in mixed samples. Therefore, a real-time PCR assay was developed to address the shortcomings of the slot-blot assay.

The method that I've developed provides both male and total human genomic DNA concentrations with a single duplex reaction. As opposed to two separate reactions, the amount of DNA required is reduced, which is essential in forensic casework where the DNA quantities are often extremely limited. In addition, because of the delineation of the male and female DNA in the sample, the analyst can best determine the downstream analysis methods to pursue, such as Y-chromosome DNA typing.

Following development of the assay, I completed validation experiments as well as wrote the standard operating procedure and quality control documentation for adoption of the assay into Cellmark's forensic casework. This work has been submitted for presentation at the American Academy of Forensic Sciences annual meeting and is being prepared, in manuscript form, for submission to the Journal of Forensic Sciences.

I thoroughly enjoyed Orchid Cellmark, the fast-paced atmosphere of industry, and, of course, weekends in Washington DC.

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Welcome To New Trainees

By Gordon Laurie

A WARM WELCOME and congratulations to Gary Davis, Brian Schmidt, Jacob Jordan and Vicky Kelley on their acceptance into the BTP. Gary is a PhD student in Milton Brown's lab (Chemistry) and is a 2002 graduate of Washington and Lee University (Chemistry BS). Jacob comes from Vanderbilt, our baseball nemesis, where he recently (2004) graduated with a BE in Chemical Engineering. Jacob is in the Fernandez lab. Brian hails from the University of Pittsburgh where he received his BS in Chemical Engineering with a concentration in Bioengineering in 2001. Brian is in the Michael Lawrence lab. Vicky brings an unusual resume to the BTP. A recent MD graduate from UVa, Vicky has an interest in applying biotech approaches to her long term interest in neurology. Vicky is a 2000 Chemistry graduate from the College of William and Mary.
Two Cultures and the Revolution in Biotechnology

By Harvey Lodish

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The two cultures of science are not those of C. P. Snow who forty years ago articulated the growing gulf between the humanists and ascendant scientists in the post-war period. They are the two groups of scientists—cell biologists in particular—who work in academe and in industry. Bridging the considerable gulf between these groups is important for the benefit of industry as well as for the support of university research.

One major problem is that basic science research faculty in general often undervalue the work done in industry and can make it difficult for their students and fellows to pursue careers there. As noted in last month’s President’s Column, I’ve asked groups of graduate students and postdocs at a wide range of universities and research institutes about where they see themselves in ten years. Their answers are remarkably similar. Only a handful see themselves directing their own research program in an academic laboratory, and well over half plan to work in a pharmaceutical or biotech company.

On one hand we do a fair job educating these students and postdocs about the various career opportunities available to them. Many institutions have career days where alumni or local colleagues describe their careers in industrial research, patent law, scientific editing, laboratory administration, and many others that require a strong background in science. The WICB Career Lunch at the ASCB Annual Meeting is an outstanding example of this type of mentoring.

However, a critical problem exists between students/postdocs and their PIs. When I ask students or postdocs if they would feel comfortable asking their PI for help or advice in seeking employment outside of academia, I receive a universal and emphatic “no.” Part of this negativism results from the strong if outmoded notion that we, the research faculty, are training people only for careers in academic research—in essence to become our successors. Another part may result from the historically strong but equally outmoded notion that the top students and postdocs go into academic careers and that only the less qualified individuals take industrial jobs.

But the negative attitude is largely attributed to the fact that only a handful of academics have even a basic knowledge of what goes on in a biotech or pharmaceutical company. Most have only vague notions of how research in a for-profit lab is organized and conducted and the kinds of career paths one can have there. It would be interesting to accumulate some “hard data” on this point.

To solve this problem, companies themselves need to take the lead by holding research days or open houses to specifically target the faculty, not the students and fellows they are trying to recruit. These events could include scientific talks focused on the company’s research. Tours of industrial labs are also very useful. Most academics would be startled at the lab equipment in routine use in for-profit research labs, much of which is simply unavailable even in top academic labs. These can open the way for mutually profitable collaborations, assuming both sides can overcome the other gulfs that separate them. Interactions like these could also make our faculty realize the many advantages of nonacademic careers for their own students.

I have found collaborating with industry very satisfying. One collaboration is now in its twelfth year, and I’ve been involved in two others of over four years. I stress the word “collaboration” as this is really the key to success. Interactions can result in significant research support for an academic laboratory, but can also result in true collaborative partnerships in which both sides derive the benefits from the beginning.

One example was a long-term partnership to study a family of membrane fatty acid transport proteins we had cloned. We helped the company generate lines of cultured mammalian cells overexpressing each of these proteins for their use in screening drug targets. In turn we worked together to generate several mouse knock-outs; the actual blastocyst injections and mouse husbandry was done by the company. Importantly, these mice have been given to many academic labs and have led to four papers in peer-reviewed journals.

A second example concerns a company that markets a particular protein, hormone and recently generated a version having a longer half-life. In discussions with the company, we realized that essentially nothing is known about the site or mechanism of turnover of this or similar hormones in the body. I developed a hypothesis for hormone degradation that led to company support of a postdoc in my lab; in turn, the company has paid us a number of mutant versions of the hormone that the company had made and purified in earlier studies. Those reagents greatly enhance the power and speed of our own research and the company gets to know why their new drug works better than the old one.

In these and other collaborations students and postdocs were actively involved and made regular visits to the partner industrial labs. In fact, they found these interactions a very stimulating aspect of their training.

see REVOLUTION, next page
Industrial collaborations with academe are most likely to succeed when both sides have a real interest in the results of the project, and when the contact is at a PI- to PI-level. (In companies, PIs are often called group leaders.) While the company may very much want to know the result, it may not have the in-house expertise to work on the project or more likely, may not want to hire extra people just for a specialized short-term project. Companies should learn to seek not-for-profit labs in their fields of interest and develop long-term relationships with the key leaders. Companies need to lighten up and understand the free and open culture of research universities. All too frequently they try to place unreasonable restrictions on intellectual property and publications that consequently prevent the important research from being conducted.

Academic leaders should realize that there are many potential advantages to industrial collaborations additional to research funding. Companies can provide reagents and equipment that are simply unavailable elsewhere. Also, the intellectual property conditions on a well-written contract do not generate significant restrictions and only create minimal delays in publishing the results. Finally, increases in these activities should help make it easier for fellows and students to learn more about industry, and to be less intimidated about approaching their PI for advice in non-academic careers.

2nd Biotechnology Training Program Symposium

by Qin Sun

ON MAY 6TH, THE Biotechnology Training Program hosted the second biennial spring symposium entitled "Real-world Systems Biology: Designing Better Drugs and Improving Tissue Function" at Jordan Conference Center of University of Virginia. The major goal of this symposium was to engage current trainees and faculty participants in linking cutting edge research in basic science to implications for manufacturing pharmaceuticals and their efficacy in treatment. The symposium was also designed to expose current trainees in the program to internship/employment opportunities with biotech companies in our geographic region and to promote the training program among the biotech corporate community. The symposium began with introductory comments from VP for Research and Graduate Studies, School of Medicine, Ariel Gomez, and Gordon Laurie, director of the BTP. Four sessions followed: Epigenetic Approaches to Tissue Engineering and Regenerative Medicine, Proteins by Design: Function-directed Protein Discovery and Engineering, Improving on Nature: Novel Synthetic and Molecular Assembly Pathways to Pharmaceutical Effectiveness, and RNAi: Understanding & Manipulating Cellular Messages. Academic speakers included Jennifer Elisseeff from Johns Hopkins, Steve Withers from University of British Columbia, Michael Betenbaugh from Johns Hopkins, and Tom Roberts from Harvard Medical School. Company speakers included Mohammad Heidarian of Wake Forest Institute, Brian Grinnell of Lilly, Jeffry Watkin of Applied Molecular Evolution and Ron Herzig of Upstate. The event, organized in significant part by training students, highlights what it was termed "Real World Systems Biology". The Industry-Student Network Session and the poster session were also greatly successful. Congratulations to the poster Winners: Katie Horsman, Tsutomu Sasaki, Scott Capitosti and also appreciations to the work of the poster session judges: Patrick Martin, Lakshmi Nair (Laurencin post-doc), and Bill McIntire (Garrison post-doc). Thanks to all the speakers for the many excellent talks and particular thanks to Roseanne Ford for leading the organizational effort, to Martin Schwartz and Zygmunt Derewenda for speaker ideas and invitations, to Joe Schmidt for fundraising, to Leslie Fox for logistical management, and to the student committee of Michelle Kofron (poster, meeting booklet), Jace Fogle (awards and publicity) and Shannon Smith (minority recruiting). Also sincere thanks for the important contributions of Elizabeth Britt (web) and Beth McQuaid.
New Corporate Advisor

David B. Patteson

MR. DAVID B. PATTESON served as President and CEO of Biotech, Inc. and as Executive Vice President of Biotech's biopharmaceutical parent, Dyax Corp, from 1998 to 2003. Following the October 2003 acquisition of Biotech, Inc. by genomics sequencing pioneer, Pyrosequencing AB (PYROA, SSA), the combined company was renamed Biotech AB (BIOT, SSA). Mr. Patteson was appointed President of Biotech's Discovery Chemistry Group including Biotech, based in Charlottesville, VA, and the former Personal Chemistry AB of Uppsala, Sweden. Mr. Patteson currently serves on the Executive Committee, is an officer of Biotech AB and is President and Chief Operating Officer of Biotech, LLC, the US holding company for North American group activities.

From 1994 until 1998, Mr. Patteson served as Corporate Vice President and General Manager for Siebe plc's Field Measurement and Controls Division. During this period, Mr. Patteson also served as Managing Director and member of the Board of Directors of wholly-owned and majority-owned subsidiaries of Siebe plc – Precision Light Measurement Systems Limited (Plymouth, UK) and Foxboro NMR Ltd. (Haifa, Israel), respectively. Mr. Patteson was responsible for over $250M of business revenues, managed 1,200 employees and oversaw global production facilities. Prior to Siebe plc, Mr. Patteson was President of Perstorp Analytical, Inc., a laboratory and process analytical instrument company. Mr. Patteson graduated from the University of Richmond and Virginia Polytechnic Institute and State University. He also completed a two-year multinational course program in International Management and Marketing conducted by the Institute of Management Development (" IMD") in Lausanne, Switzerland 1992. Mr. Patteson currently serves on the Board of Scientific Advisors for The University of Richmond, is a member of the Board of Directors of Contravac, Inc., and most recently joined the Board of Corporate Advisors for our Biotechnology Training Program.

Mr. Patteson was born in Richmond, VA, grew up in Chapel Hill, NC (Dad was at Duke, Mom worked at UNC) until he was 14, and then moved back to VA. He has lots of personal interests such as golf, tennis, hiking/climbing, downhill skiing, spending time with his wife and two boys (14 and 12 years old).

Alan Simpson

MR. ALAN SIMPSON is a Vice President of Operations for a Global Contract Research Organization (CRO), PRA International. PRA has 23 locations worldwide and employs about 2,500 people. Mr. Simpson manages the drug development company located twelve miles north of Charlottesville in the University of Virginia North Fork Research Park, near the Charlottesville/Albemarle regional airport. The Charlottesville office employs around 450 people all involved either operationally or supporting clinical research programs around the world.

Mr. Simpson is originally from the UK having moved to Charlottesville three years ago to take over the management of the office. He has been with PRA for nearly six years. Prior to PRA, he worked in a variety of positions both in operations and sales within the industry with other CROs and pharmaceutical companies. He is a pharmacist by profession. He has two grown up children who live in the UK completing their education. His interests are golf, painting, bike riding and socializing.

Mr. Simpson recently joined the Board of Corporate Advisors of our Biotechnology Training Program.

Robert L. McKown, Ph.D.

DR. ROBERT L. MCKOWN is a Professor of Biotechnology in the Department of Integrated Science and Technology at James Madison University. He received his PhD in Molecular Biology and Biochemistry from the University of California at Irvine and completed a Postdoctoral Fellowship in Molecular Genetics at the University of California, San Francisco. As a Senior Research Scientist for DNA Plant Technology in Oakland, California, he worked on the development of genetically engineered bacteria, yeast, and plants expressing foreign genes. In 1994, he took a faculty position in the Department of Biological Sciences at California State University, Hayward and became a consultant to the Biotechnology Industry. In 1996, he accepted a faculty position at James Madison University to develop a biotechnology program for the new College of Integrated Science and Technology. He is currently a member of the Board of Directors for the Virginia Biotechnology Association, faculty advisor to the JMU Student Chapter of the International Society for Pharmaceutical Engineering, and '03 winner of Virginia Bio's Educator of the Year award. His research interests involve the cloning, expression, purification, and analysis of recombinant proteins for the development of human therapeutic and diagnostic products.
HUMAN SIMULATOR, from page 7

Call to Action
Although many medical students and physicians were concerned that such a course existed at UVA, only a few committed individuals were initially willing to do something about it. These motivated medical students, physicians, and community members formed an organization known as Citizens for Humane Medicine. Its goal was to eliminate the unnecessary dog lab by educating the public and providing information on humane alternatives.

News of this "life-taking" course soon spread across the state after various newspapers, television newscasts, and radio stations covered the story for week after week. Hundreds of supportive emails and phone calls poured into CHM, the medical school administration, and local animal rights groups. Nearly 2500 signatures were submitted to the medical school administration on a petition to end the outdated animal labs. Many physicians came forward to explain that this type of lab was unnecessary and unethical. The Charlottesville community was coming together on an issue which was tarnishing the reputation of the University.

Change for the Better
Within one week, the dean of the medical school, Dr. Arthur Garson, placed a moratorium on the lab and set up a special committee to investigate the situation. The committee met over the next few weeks and presented their report in late February. On Feb 26, 2004, Dr. Garson announced the findings of the committee. They discovered that "many skills previously taught with animals can now be learned with simulation models." Based on this and additional information, the committee concluded that "the use of dogs for medical education and training is not necessary" and recommended that "the [class] be discontinued." Furthermore, they asked the medical school to develop programs without using dogs that meet the educational needs of medical students for emergency care skills and for surgical skills. The goals, objectives, and outcome measures need to be carefully defined and wherever possible simulation models used.

Looking Ahead
This came as great news to everyone, especially the men and women of CHM who had volunteered many hours towards this campaign. Although this marks a turning point for medical education, the University and the Charlottesville community must continue to strive for the highest ethical standards and encourage the use of humane, cruelty-free alternatives whenever possible. Thanks to the efforts of many dedicated individuals, nearly 100 dogs will no longer die each year at UVA in the name of medical education. Instead, superior non-animal based methods, such as human patient simulators and human cadavers, will be used to teach medical students how to perform important procedures on humans. Beginning this school year, medical students at UVA will not only learn using the most sophisticated and effective methods available, they will also learn that compassion and respect for all forms of life are integral to the practice of medicine.

2004 Teaching Awards
CONGRATULATIONS TO DR. CASSANDRA FRASER (Cavaliers' Distinguished Teaching Professorship), Dr. Mike Worthington (All University Teaching Award), and Dr. Bill Guilford (All University Teaching Award)

Promotions
CONGRATULATIONS TO DR. ROSEANNE FORD who was recently appointed Associate Vice President for Research and Graduate Studies.

Michael Smith Goes Swiss
By Michael L. Smith

Hiking Kara on Mount Pilatus
I recently joined the Institute for Biologically Oriented Materials (Inst.f.Biol.-Orient.Materialwiss.) at the Swiss Federal Institute of Technology Zurich (ETH) as a postdoc. My project will attempt to determine the function of strain in the extracellular matrix on fibroblast function. Specifically, we study how strain alters the function of the extracellular matrix protein fibronectin through availability of cryptic binding sites. This project uses fluorescence resonance energy transfer (FRET) visualized using confocal microscopy to quantify the degree of unfolding in two- or three-dimensional in vitro fibroblast cultures. This project may have important implications in the field of cellular mechanotransduction.
The Faculty & Their Research

Gary Balian—(C&BMG) Biochemistry of connective tissue macromolecules.

Travis Blalock—(EE) CMOS digital and analog signal processor design.

David Brautigan—(M) Protein phosphates and cell signaling circuits.


Giorgio Carta—(CE) Adsorption and ion exchange, chromatography, biocatalysis.

Zygmunt Derewenda—(MPBP) Protein structures and function, macromolecular crystallography, mechanisms of signaling by GTPases, protein-protein interactions.

Douglas DeSimone—(CB) Cell adhesion molecules in development.

Brian Duling—(MPBP&BME) Cell-cell communication in the vessel wall, including chemical, electrical, and mechanical processes that lead to coordination function of endothelial and smooth-muscle cells.

Victor Engelhard—(M) Structure and synthesis of antigens recognized by T lymphocytes; tumor immunology.

Erik Fernandez—(CE) Purification of biological molecules, protein structure, magnetic resonance imaging and spectroscopy.

Roseanne Ford—(CE) Environmental remediation, microbial transport in porous media.

Cassandra Fraser—(C) Polymeric metal complexes: synthesis, properties and uses.

Jay Fox—(M) Basal membrane structure and metalloproteinases.

H. Mario Geyson—(C) Combinatorial Chemistry.

Stephanie Guerlain—(SE) Information system development in the human genome era.

Bill Guilford—(BME) Vascular and molecular engineering.

Brian Heimke—(BME) Endothelial mechanotransduction, cellular biomechanics, nanotechnology tools for cellular bioengineering, cell-cell interactions in microcirculatory blood flow.


Andrew Hillier—(CB) Interfacial engineering, materials chemistry, electrochemistry, scanning probe microscopy.

Rick Horwitz—(CB) Cell adhesion in development and pathobiology.

Donald Hunt—(C&P) Protein sequencing by mass spectrometry.

Isa Hussain—(P&NS) Functional roles of low density lipoprotein receptor-related protein (LRP) and protein kinase C in astrocytic tumor invasive growth.

Donald Kirwan—(CE) Mass transfer and separation, crystalization, biochemical engineering.

James Landers—(C&P) Biological, bioanalytical and clinical chemistry.

Gordon Laurie*—(CB) Molecular control of epithelial differentiation.

Cato Laurencin—(O, BME, and CE) Biomaterials, tissue engineering, drug delivery and nanotechnology.

Michael Lawrence—(BME) Biochemical, cellular, and mechanical factors regulating leukocyte adhesion.

Klaus Ley—(BME&MPBP) Molecular mechanisms of leukocyte adhesion and genetic engineering targeting atherosclerosis.

Timothy MacDonald—(C) Biorganic and synthetic organic chemistry.

Pamela Norris—(MANS) Areal technology.

J. Thomas Parsons—(M) Protein kinases in cell adhesion.

William Pearson—(BME) Protein evolution; transcription.

Ian Sarembock—(InMD) Role of inflammation in vascular injury and repair.

Thomas Skalak—(BME) Cardiovascular mechanics, microcirculation.

Ann Sutherland—(CB) Cell matrix interactions in mouse development.

Ronald Taylor—(BME) Clearance of pathogens.

Martin Schwartz—(M) Integrin signaling and its relevance to mechanotransduction, cancer and vascular disease.

Judith White—(B&M) Molecular mechanisms of viral and cellular adhesion/fusion proteins; molecular mechanisms of sperm-egg binding and fusion: ADAMS in fertilization and development.

Michael Wormalt—(B) Post-transcriptional regulation of gene expression; Development of RNA-based therapeutics.

*Program Director

Training Departments

B Biology

BME Biomedical Engineering

BMSS Biochemistry, Molecular Biology & Genetics

C Chemistry

CE Chemical Engineering

CB Cell Biology

EE Electrical Engineering

EM Internal Medicine

MI Microbiology, Immunology & Infectious Disease

MANS Mechanical Aerospace & Nuclear Engineering

MMSB Molecular Medicine & Systems Biology

MPBP Molecular Physiology & Biological Physics

NS Neuroscience

O Orthopaedics

P Pathology

SE Systems Engineering