UNIVERSITY OF PENNSYLVANIA Issue 5 • Fall 2001

News from the IME

Institute for Medicine and Engineering

From the Director's Desk

Dr. Peter F. Davies

A COMING OF AGE: This issue of the newsletter coincides with the completion of the Institute's fifth year, a time traditionally regarded as a reference point for evaluating our accomplishments and a platform for planning the activities of the next several years. This year has seen the flowering and fruition of several initiatives. IME-centric activities include completion of the first year of pre and postdoctoral research for IME Training Grant appointees (pictured below), the award of a large NIH Bioengineering Research Partnership Program grant to the IME ($6.7m), and emerging IME thrusts in genomics, proteomics, and NASA-related work that dovetail with wider university initiatives (see inside). Joint efforts with the Department of Bioengineering culminated in the award of a Whitaker Leadership-Development Award to the department, which should ensure the future vitality of biomedical engineering at Penn. At Children's Hospital of Philadelphia, IME Member Dr. Robert Levy is leading the development of a Clinical Tissue Engineering Institute. His first recruit and new IME member, Dr. Prasad Shastri, arrives from MIT in the late summer (more in the next newsletter). These developments occur against a background of very successful grant activities by the IME core Faculty, an important measure of Institute vitality, visibility and impact. This year has seen the senior faculty reach near-saturation of their available research effort for grant support along with excellent growth in grants awarded to the more junior faculty. In addition to grants, the "currency" of academic success includes papers in the best biomedical, clinical, and engineering journals, excellent teaching reports, successful mentorships, visibility at national and international meetings, service on scientific committees and study sections, and the maintenance of cohesive multidisciplinary interactions through the Institute. The success of IME investigators and their trainees in these demanding pursuits is reflected in the honors and awards featured elsewhere in this newsletter.

The IME functions as a hub from which many spokes reach to Penn's basic science and clinical departments and Centers, as well as to national and international collaborations. Looking ahead, several new initiatives are currently underway within the IME umbrella. They include the development of 2 "niche" areas within which quantitative studies are underrepresented at Penn: - (i) the highly interdisciplinary field of Drug Delivery, an initiative led by IME Member Vladimir Muzykantov (Pharmacology) together with IME Faculty Scott Diamond (Chemical Engineering), and (ii) integrative aspects of Cancer Metastasis, led by IME Faculty Valerie Weaver and Warren Pear (both Pathology). Throughout the year, approximately monthly seminars on these topics will be featured within the IME Seminar Series.

Another area of development is genomics. The IME has been involved in genomics research for over three years through an alliance with AstraZeneca Pharmaceuticals. In the wake of the human genome project, sequencing of the genomes of several other species is well under way in both the public and private sectors. The recent availability of reasonably priced robots and microarray printers has provided standard tools for studies of multi-gene expression. We are setting up a genomics facility in the IME for custom printing of subsets of genes that will be available to IME investigators by late summer. Closely behind genomics is proteomics, the analyses of protein expression by cells and tissues. A state-of-the-art approach to the simultaneous analyses of many proteins is Fourier transform time-of-flight mass spectrometry. New IME member Dr. Ian Blair, Director of the Cancer Pharmacology

Felice Macera

IME Director Peter F. Davies, with IME training grant trainees (from Left) Michael Boretti, Mukul Goel, Helim Aranda-Espinoza, and Tessa Sundaram. Inset: Peter Photos.

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Educational Initiatives

Penn Bioengineering Receives $14 Million Grant from the Whitaker Foundation

In June the Whitaker Foundation announced a $14 million Leadership Development Award to Penn's Department of Bioengineering; the funds will be matched by university support of $42.5 million. The funds, phased in over the next several years, will provide a new building with modern research and educational facilities for the department, the recruitment of 7 new faculty members and additional resources for graduate student support. "This is an extraordinary time for biomedical engineering in the U.S., and Penn, with its strengths in engineering and medicine are well poised to take advantage of new medical discoveries in the advancement of human health", said IME Faculty Daniel A. Hammer, Professor and Chair of Bioengineering and PI of the Whitaker Leadership Development initiative.

Among its peers, Penn Bioengineering is recognized for the quality of its teaching, particularly at the undergraduate level. The formation of the interdisciplinary IME in 1996 by the Schools of Medicine and Engineering created new research and educational opportunities for Bioengineering and facilitated direct links to basic biomedical research and clinical medicine in Penn's highly-ranked School of Medicine. Through IME activities, Bioengineering students enjoy hands-on training in state-of-the-art laboratories, and gain direct knowledge of physician's work through clinical preceptorships.

The Whitaker Foundation administers a series of competitive grant proposals supporting research and education in biomedical engineering at academic institutions in the U.S. and Canada.

Pathology and Laboratory Medicine Clinical Case Conference

IME faculty Warren S. Pear, M.D., Ph.D., introduced a new case-oriented format into the Department of Pathology and Lab Medicine Grand Rounds. Once per month, the Department holds a Clinical Case Conference in which clinical and basic science presentations that relate to the case are combined. The past year's topics included chronic myelogenous leukemia, spinal muscular atrophy, histoplasmosis, and thyroid cancer. This year's conferences will be held at noon in Austrian Auditorium on the following dates: 9/24, 10/15, 11/19, 12/17, 1/21/02, 3/18, 4/15, 5/20, and 6/17. Two different cases are presented during the hour.

CONTINUED FROM COVER....

From the Director's Desk

Center at Penn and an expert in mass spectrometry, leads a joint Pharmacology-IME-Pathology proteomics initiative.

Beyond genomics and proteomics, the ultimate challenge in biomedical research is Systems Biology, an understanding of the structural, spatial, and dynamic aspects of cells, tissues and organisms in all their complexity. To review this area, we invited Seattle's Professor Leroy Hood, a champion of integrative systems biology, to present the plenary lecture at the IME Symposium 2001 in December. In addition to the full-day IME symposium, a Biophysics Workshop will be held on October 9th led by IME Faculty Paul Janmey to coincide with the seminar and visit of Professor Lipowsky, Director of the Max Planck Institute in Potsdam, Germany (more on these meetings on the last page).

We live in heady times for medical and engineering research. New ideas and techniques must be integrated without losing the rigor of good experimental design. With so many new tools coming online, ranging from nanotechnology to whole proteome analysis, it is worth remembering that these are merely means to an end; what matters most is the quality of the questions asked, the hypotheses being tested, and the designs being formulated – the central features of academic research excellence.

Current IME Training Grant Trainees

Helim Aranda-Espinoza, Ph.D., post -doctoral trainee with Dennis Discher (MEAM) and Paul Janmey (Physiology) at the IME. Research project title: "Mechanical and Dynamical Properties of Neurofilaments"

Michael I. Boretti, Bioengineering graduate student in Keith Gooch's lab. Thesis research: "Pre-vascularization of Islets using Microvascular Networks"

Mukul S. Goel, Chemical engineering graduate student in Scott Diamond's lab. Thesis research: "Neutrophil Enhancement of Fibrin Formation under Flow"

Peter Photos, Chemical Engineering graduate student in Dennis Discher's Lab. Thesis research: "Polymersomes: Characterizations towards Biophysical Applications"

Tessa A. Sundaram, M.D./Ph.D. student in Leon Axel's lab (Radiology). Thesis research: "Development of a Canonical Human Heart Model Using MR Imaging and Multidimensional Analysis"

Wujing Xian, Ph.D., post-doctoral trainee with Paul Janmey (Physiology). Research project title: "Structure-Function Analysis of Gelsolin" (July 1, 2001)

IME Awarded $6.7 Million NIH Bioengineering Research Partnership (BRP) Program Grant

The highest score in the spring 2001 competitive BRP cycle of the National Heart Lung and Blood Institute of the NIH went to a large five-year interdisciplinary research grant awarded to IME investigators led by director Peter F. Davies. The grant focuses on the biomechanics of cardiovascular cells, membranes, and molecules with emphasis on how these properties determine and control cardiovascular tissue function. The partnership is composed of two interactive components: first, fundamental cell and molecular investigations of cardiovascular mechanotransduction, and second, preclinical studies of engineered arteries, heart valve calcification, and microcoil treatment of intracranial aneurysms. Complementary experimental approaches that are both design-driven and hypothesis-driven include geometric constraints, spatial analyses, protein conformational changes, deformation properties of molecules and membranes, and mass transport characteristics that regulate vascular cell structure, gene expression, function, and maladaptation to blood flow forces leading to pathological change.

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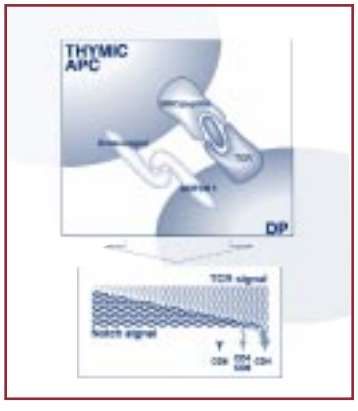
The integrative group of IME investigators is Drs. P.F. Davies (Project Director), S.L. Diamond, D.E. Discher, K.J. Gooch, D.A. Hammer, P.A. Janmey, I. Levitan, V.M. Weaver and Dr. R. J. Levy of the Children's Hospital of Philadelphia.

Notch1 Regulates Maturation of $CD4^+$ and $CD8^+$ Thymocytes by Modulating TCR Signal Strength

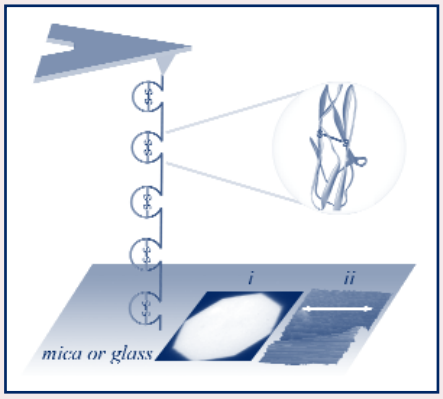
David J. Izon. Jenni A. Punt, Lanwei Xu, Fredrick G. Karnell, David Allman, Peggy Myung, Nancy Boerth, John C. Pui, Gary A. Koretzky, and Warren S. Pear

Notch signaling is involved in cell fate decisions and is critical for T cell development. Warren S. Pear and colleagues at Penn, Haverford College, and Harvard University showed that Notch signaling regulates later stages of T cell development in a dose-dependent fashion *(Immunity, 14, 253-64, 2001)*. Using *in vivo* and organ culture models, they showed that active Notch signaling blocked developmental maturation of immature thymocytes. The developmental block was dependent on the strength of the Notch signal and was associated with impaired T cell receptor signaling. These results suggest that the decrease in Notch signaling that normally occurs during early stages of T cell maturation is required for further development, and that failure to down-regulate Notch signaling at this stage of development prevents further maturation and predisposes the cells to leukemic transformation. Pear and colleagues also found that Notch signaling represses transactivation of an AP1/NFAT reporter in Jurkat cells. They propose that Notch signaling modulates positive selection by titrating the T cell receptor signal strength, which is known to be potentiated by MAPK-dependent signals. One possible mechanism for an effect of Notch signaling on MAPK has recently been identified in C. elegans, where proper fate specification during C. elegans vulval development required Notch-dependent up-regulation of the MAPK phosphatase, LIP-1.



Forced Unfolding Modulated by Disulfide Bonds in the Immunoglobulin Domains of a Cell Adhesion Molecule

Philippe Carl, Carol Kwok, Gavin Manderson, David W. Speicher, and Dennis E. Discher



Many proteins experience tensile forces as an intrinsic aspect of their function. The IgCAM superfamily of Immunoglobulin Cell Adhesion Molecules are typical in this although they have a diverse number of independently folded Ig domains, overall lengths and 'adhesive reach'. Almost every IgCAM domain, however, contains an intra-domain disulfide bond (or two) that stabilizes the folded state.

We have employed single molecule atomic force microscopy (AFM) to assess extensibility and folding forces of IgCAMs as well as the effect of the disulfide bond in several multi-domain Ig-CAMs. In recent studies (Proceedings of the National Academy of Science – USA 98: 1565-1570, 2001), we exploited the disulfide bond of the protein MelCAMas a conformational 'switch'. In the absence of reducing agent, a sawtooth pattern of unfolding peaks appeared with average period and total length appropriate to known primary sequences. With reducing agent present, the average period increases, as does the total unfolded length. Similar, unpublished results have now been found for VCAM-1. Such results not only demonstrate that covalent chemistry can be performed on protein molecules one bond at a time but also show that the oxidation-reduction micro-environment of a protein can be an important determinant of a protein's micromechanical function, e.g. adhesive reach.

Bioengineering Research Partnership Grant for Studies of Epilepsy

A 5-year, $6.5 million NIH Bioengineering Research Partnership grant was awarded to Penn researchers for development of an implantable device to predict and prevent epileptic seizures. The program builds on findings from the lab of IME member Brian Litt, M.D. (Neurology and Bioengineering), that identified a cascade of events that lead to temporal lobe seizures beginning hours before their electrical and clinical onset *(Neuron, April 2001)*. The researchers will vertically integrate their work from the single cell and molecular level, to large-scale networks spanning the cerebral cortex and subcortical integrating regions. Findings will be applied to sophisticated computational models of the hippocampus, thalamus and cerebral cortex, and lead to the development of experimental paradigms to deliver electrical stimulation and local pharmacologic therapy to disrupt seizures as their precursors develop. Animal experiments will supplement continuous data recorded from adults and children implanted with intracranial electrodes during evaluation for epilepsy surgery. The team, led by Professor Marc Dichter, Director of Penn's Institute for Neurological Sciences, consists of IME members Brian Litt (Neurology) and Leif Finkel (Bioengineering); Drs. D. Contreras, P. Crino, G. Baltuch (U. Penn Departments of Neuroscience, Neurology, and Neurosurgery, respectively); Drs. D. Coulter and D. DeLugos from CHOP, and Dr. G. Vachtsevanos from Georgia Tech.

Ex vivo Remodeling of Arteries Technology Optioned to Nascent Enterprises

In February this year, Nascent Enterprises optioned the technology for *ex vivo* remodeling of excised blood vessels for vascular grafts developed by IME faculty Keith J. Gooch (Assistant Professor of Bioengineering), with his post-doc Valerie Clerin and bioengineering graduate student Rebecca Gusic. The core of the technology is a fundamentally different approach for creating tissue-engineered blood vessels. Dr. Gooch and coworkers have shown that by manipulating the mechanical environment, intact vessels can be directed to grow and remodel outside of the body. Ultimately, it may be possible that small vessels could be harvested from a patient, remodeled outside of the body, and then used for a bypass graft.

The University of Pennsylvania Health System Joins NASA's National Space Biomedical Research Institute (NSBRI)

Following a competition against 14 other medical schools, the University of Pennsylvania Health System was invited to join the NSBRI, a NASA consortium of research institutions established with the goal of reducing health concerns related to exploration missions. Now that the International Space Station is operational, and a manned Mars mission planned before 2020, the NSBRI seeks to devise countermeasures for potentially incapacitating effects of extended periods of space travel, when crews are far out of reach of earth-based help. IME Director Peter F. Davies joined a team of senior Penn scientists led by Dr. David Dinges and School of Medicine Vice-Dean Glen Gaulton who presented to the NSBRI advisory board in Houston. The successful effort resulted in six NSBRI grants to Penn's Medical School in 2001, including a $1M grant to IME to perform genomic analyses of the cardiovascular system as a function of gravitational transitions (Davies), part of the NSBRI Smart Medical Systems Team.

$3 Million MURI Award to Develop Biologically-based Artificial Vision Systems

A multi-university team led by IME member Leif Finkel, M.D., Ph.D. (Professor of Bioengineering) won a five-year, $3 Million award via the Multi-University Research Initiative (MURI) at the Office of Naval Research. Unlike a person, a state-of-the-art artificial neural network that has "seen" hundreds of similar images often encounters difficulties identifying a new similar image as part of the same category. The project aims toward development of artificial-vision technologies that might detect patterns as robustly as the human brain, beyond the current limitations of computer simulations of the brain's visual cortex.

Dr. Finkel's Penn collaborators are IME faculty Kwabena Boahen, Ph.D. (Bioengineering), who will develop novel hardware for the project, and Diego Contreras, Ph.D (neuroscience) who will provide key data for building these models through his recordings from the visual cortex. At Columbia University, Dr. Paul Sajda will develop the fundamental mathematical underpinnings and bridge the probabilistic analysis to medical and other image applications. Dr. Edward Adelson from MIT will help detect patterns in real-time systems subject to movement. The project also involves interactions with several government laboratories and private corporations.

At Penn, the award will support four graduate students and one post-doctoral researcher annually.

What Goes Up...

Humans tolerate the transition from earth's gravity to outer space quite well, and the body rapidly adapts to zero gravity. The heart becomes smaller and the large arteries that supply blood to the body correspondingly change their structure over a period of weeks to months. Problems with the cardiovascular system, however, are much greater when astronauts return to earth. The weaker heart has trouble pumping blood to the head, and blood pools in the lower extremities because of the altered blood vessel structures. Weakness, dizziness, and fainting occur frequently. On earth, plenty of help is available during the long recovery from space flight; but what happens upon arrival at Mars following 9-10 months of space travel? Sustaining forces up to 3G upon entry to Mars' atmosphere, and subjected to the Martian 0.3G gravity, will the astronauts be incapacitated? Drs. Peter Davies and Denise Polacek of the IME, together with Dr. Chris Stoeckert of Penn's Center for Bioinformatics are profiling changes in thousands of heart and artery genes in response to simulated gravitational changes in an animal model through a 3 year NSBRI grant. Some of the work will be conducted at the NASA/ Ames facility in California.

Genomics and Proteomics: A High Throughput Multifunctional Array Facility in IME

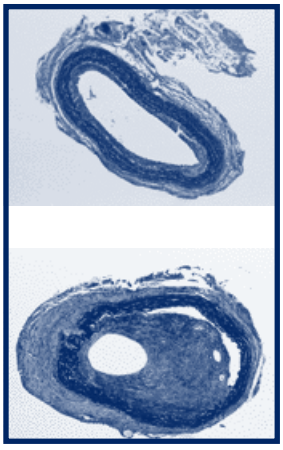
During the past three years, quantitative parallel measurements of gene expression on cDNA microarrays have been performed in the IME Director's lab in collaboration with a pharmaceutical partner. This year, the IME is expanding its genomics and arraying capabilities. Dr. Denise Polacek (Senior Research Investigator, IME) will head the facility, which will be located in the Vagelos Research Labs. The facility will include an automated workstation for liquid handling and sample preparation, a microarraying robot for "printing" onto glass slides and other surfaces and a confocal fluorescence array scanner for detection and analysis of hybridized signals, together with necessary computers and software. Initial research activities are focused on vascular biology in relation to the focal origin of atherosclerosis and the role of hemodynamic forces in this process, enzyme microarrays for functional blood phenotyping in coagulation and fibronolytic research, neurological injury resulting from acute and chronic CNS trauma, metastatic breast cancer mechanisms driven by the interaction of integrins with the extracellular matrix, and the transcriptional regulation of Notch proteins in hematopoiesis and leukemia. The instruments will also be used to array enzymes for simultaneous measurements of reaction kinetics in biological fluids and cells, a technique developed by the Diamond lab.

In a new initiative, the IME has expanded its alliance with the Center for Cancer Pharmacology (Director, Dr Ian Blair) to develop an inter-Institute proteomics facility centered on existing programmatic collaborations, including NIH Program Project Grant, Specialized Center (SCOR) grant, newly awarded program grants (e.g., BRP), and submitted IME and Cancer Pharmacology initiatives. The latter also includes a joint major instrumentation proposal to the NIH.

Delivery of Human Vascular Endothelial Growth Factor with Platinum Coils Helps Stabilize Cerebral Aneurysms in a Rat Model

John M. Abrahams, Mark S. Forman, Sean Grady, Scott L. Diamond

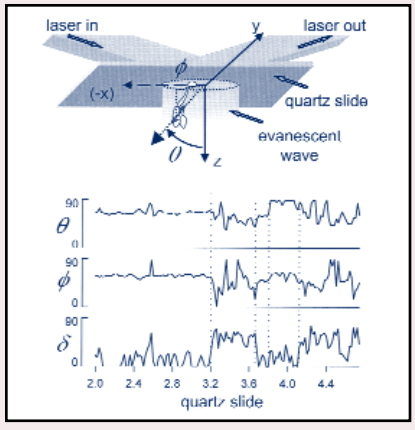
Cerebral aneurysms, a dangerous ballooning of a thinned artery wall, can be surgically corrected. However, many are deep within the brain beyond the reach of the surgeon. A therapy used for the last decade is to pack the aneurysm with small platinum coils via catheter delivery. This creates a blood clot in the aneurysm, to help stabilize it and prevent enlargement or rupture. However, the coil-treated aneurysm is often necrotic and lacks proper tissue organization. Drs. John Abrahams (Neurosurgery) and Scott Diamond (Chemical Engineering) at the IME have demonstrated that linkage of recombinant human vascular endothelial growth factor (rhVEGF) to the platinum surface of the coil causes significant thickening of the weakened vessel wall and significant integration of the vessel around the implanted coil, greatly strengthening the weakened region *(American Journal of Neuroradiology, in press)*. Using this new approach, they demonstrated release of appropriate growth factors that direct the biodegradable clot scaffold toward the desired tissue-engineering goal – aneurysm stabilization. Efforts are now underway to validate catheter delivery of biodegradable coils (Abrahams et al., *Neurosurgery, October 2001)*, and coils that are coated with linked adenovirus. For this work, Dr. Abrahams will receive the prestigious Galbraith Award for best research by a cerebrovascular surgery resident at the 2001 Congress of Cerebrovascular Surgeons, as well as the Best Abstract Award in Neurosurgical Technology and Instrument Invention from the World Federation of Neurological Surgeons.



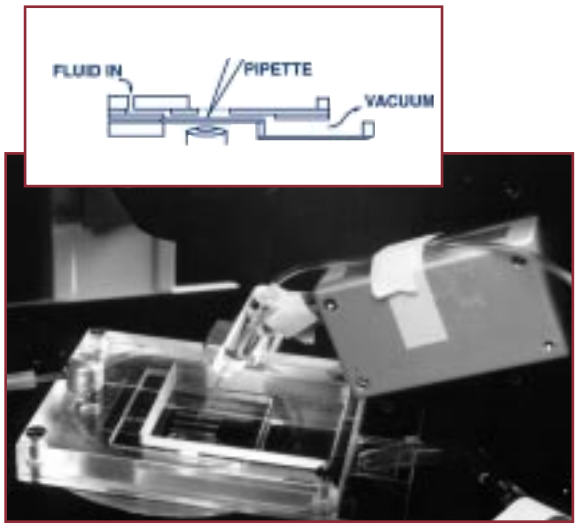
Cross-section of artery implanted with platinum coil (top) or platinum coil with rhVEGF (bottom) after two weeks (coil removed).

Protein Structural Dynamics by Single-Molecule Fluorescence Polarization

Joseph N. Forkey, Margot E. Quinlan, and Yale E. Goldman



During the last two decades, structural biology, molecular biology and biophysical techniques have greatly enhanced our understanding of the structure and biochemistry of proteins. However, elucidation of the quantitative relationships between structural changes in the proteins, enzymatic activity, signaling, energy conversion and macromolecular interactions will require further development of novel methods. In this paper, published in *Progress in Biophysics and Molecular Biology, 74(1-2): 1-35 (2000)*, PMI Director Dr. Yale Goldman, with his post-doc Dr. Joseph Forkey and graduate student Margot Quinlan describe a new technique, Single Molecule Fluorescence Polarization (SMFP), that has the potential to fill a void in conventional methods for determining the structural basis of protein activity. Using state-of-the-art optical microscopes and novel fluorescent probes attached to specific protein domains, SMFP makes it possible to quantify rotational motions that mediate function in individual protein molecules. The paper reviews examples of biophysical systems in which orientation changes are essential to their mechanism, the advantages of detecting such rotations with individual molecules, the development of SMFP, special fluorescent probes, the optical apparatus, data analysis and some recent experiments. The figure schematically shows the optical arrangement in a total internal reflection fluorescence polarization microscope and changes in orientation (θ, ϕ) and extent of mobility (δ) of a subdomain of the myosin molecule.



MIF device on a microscope stage with an electrophysiological micropipette lowered into the recording chamber.

A Chamber to permit Invasive Manipulation of Adherent Cells in Laminar Flow with Minimal Disturbance of the Flow Field

Irena Levitan, Brian P. Helmke, and Peter F. Davies

An obstacle to real-time *in vitro* measurements of endothelial cell responses to hemodynamic forces is the inaccessibility of the cells to instruments of measurement and manipulation. At the IME, Dr. Irena Levitan, in collaboration with Drs. Peter F. Davies and Brian Helmke, has designed a parallel-plate chamber, the Minimally Invasive Flow Device (MIF) to resolve this difficulty. The chamber allows direct access to adherent cells through slits in the upper surface whilst they are subjected to a defined flow field. Surface tension forces at openings in the upper plate counter the hydrostatic pressure across the chamber and prevent fluid leakage over a range of flow velocities. The study *(Annals of Biomedical Engineering, 28:1184-1193, 2000)* shows that 1mm longitudinal slits are sufficiently narrow to sustain chamber shear stresses of up to 15 dyn/cm2, while being wide enough to allow a micropipette to reach cells at the bottom of the chamber. The investigators also demonstrated minimal disturbance of flow fields near the cells when microinstrumentation (e.g., an electrophysiological pipette) is inserted. Using this device, stable electrophysiological recordings of both whole cell currents and single channels were obtained in a selection of cells exposed to flow in the device.

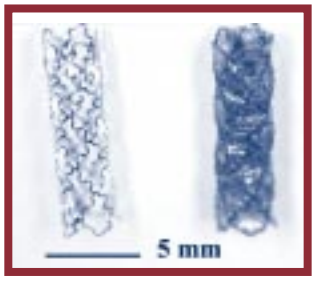
Recent Honors and Awards to IME Members:

Kwabena A. Boahen, Ph.D. won a NSF CAREER award for his research on "Neuromorphic Computation in Silico" ◆ **Irena Levitan, Ph.D.** received a Scientist Development Award from the National Center of the American Heart Association for her research on "Mechanisms of Regulation of Volume-Sensitive Anion Channels in Vascular Endothelial Cells by Actin Cytoskeleton" ◆ **John Abrahams, M.D.** (Neurosurgery resident in Scott Diamond's lab) won the prestigious Galbraith Award for best research by a cerebrovascular surgery resident at the 2001 Congress of Cerebrovascular Surgeons, as well as the best abstract award in Neurosurgical Technology and Instrument Invention from the World Federation of Neurological Surgeons for his research on biomodified coils for cerebral aneurysm ◆ **David F. Meaney, Ph.D.** is the 2001 recipient of the Y. C. Fung Young Investigator Award from the Bioengineering Division of the American Society of Mechanical Engineers. This is one of the field's top honors, given annually to a bioengineering researcher under 36 ◆ **Peter F. Davies, Ph.D.** received a Special Recognition Award from the Arteriosclerosis, Thrombosis and Vascular Biology Council of the American Heart Association, in recognition of his "longstanding investigations into hemodynamics and mechanotransduction mechanisms in vascular cells" ◆ **Valerie M. Weaver, Ph.D.,** received a DOD BCRP Career Development Award and an Alberta Heritage Foundation Educational Award ◆ **Philip Nelson, Ph.D.** received the Ira Abrams Award, the highest distinguished teaching honor of Penn's School of Arts and Sciences. Dr. Nelson was cited for the creation of Physics 280 - Biological Physics ◆ **Brian Litt, M.D.** (with David Callans, M.D.) was awarded a Dana Foundation Grant under the Clinical Hypotheses Program in Brain-Cardiovascular System Interactions ◆ **Chris Stoeckert, Ph.D.,** and colleagues from CBIL won the first CAMDA award for best presentation. PlasmoDB, CBIL's malarial parasite web site built with Biology Professor David Roos and his group, was featured in Science's NetWatch ◆ **Arjun Yodh, Ph.D.,** was named the James M. Skinner Professor of Science (Endowed Chair). Dr. Yodh was named Sigma Xi National Lecturer (2000-2001) ◆ **Randall D. Kamien, Ph.D.** was named the William Smith Term Professor in the School of Arts & Sciences ◆ **Robert J. Levy, M.D.** was elected Member at Large of the Executive Board of the Society for Biomaterials ◆ **Quanyi Li, Ph.D.** from Dr. Levy's group, and **Kenneth Ryan, Ph.D.** won fellowships from the Florence Murray Faculty Fellowships. **Dr. Ryan** is also a recipient of a Foerderer Foundation Grant ◆ **David M. Eckmann, Ph.D., M.D.** was elected to the Association of University Anesthesiologists ◆ **Louis J. Soslowsky, Ph.D.** was appointed Conference Chair for the 2003 Summer Bioengineering Conference

Gene Delivery from a DNA-Controlled Release Stent in Porcine Coronary Arteries

Bruce D. Klugherz, Peter L. Jones, Xiumin Cui, Weiliam Chen, Nicholas F. Meneveau, Suzanne DeFelice, Jeanne Connolly, Robert L. Wilensky, Robert J. Levy

IME members Drs. Robert J. Levy and Peter L. Jones (now at U. of Colorado), with colleagues at the Children's Hospital of Philadelphia and the University of Pennsylvania Health System have addressed the problem of how to achieve localized and sustained delivery of therapeutic DNA to sites of angioplasty *(Nature Biotechnology 18:1181-1184, 2000)*, using 'site specific therapy'. The team developed a polymer impregnated with plasmid DNA that, when coated onto a stent (a metallic tube that expands to open blocked coronary arteries) releases DNA without causing inflammation or interfering with stent mechanics. When implanted into pig coronary arteries, a stent coated with the polymer released the GFP gene to transfect ~1% of arterial cells, as shown by immunofluorescence. Although only a small fraction of cells were transfected, the specific localization of effect represents a proof of principle for this approach. Such sustained-release localized delivery methods will be developed to improve treatment for a variety of vascular disorders. A potential application is the inhibition of restenosis, a common occurrence following angioplasty and one which requires repeat treatments or alternative therapy such as arterial bypass grafting.



Balloon-expanded arterial stents, comparing noncoated (left) to DNA-polymeric (PLGA) coating.

Updated Rankings of Penn's School of Medicine:

Fourth among research-oriented medical schools in the nation, behind Harvard (1st), Johns Hopkins (2nd) and Duke (3rd), by *US News & World Report* (April 9, 2001)

Second in total funding from the NIH for fiscal year 2000, for the second year in a row. Departments ranked first nationally: Pathology & Laboratory Medicine, Dermatology, and Radiology; Ten additional departments in the top five

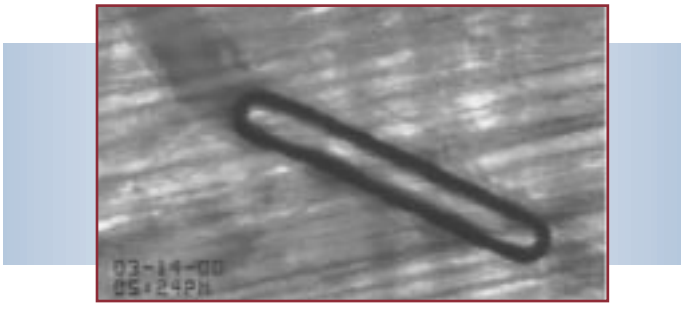
The Hospital of the University of Pennsylvania was named to the Honor Roll of the best hospitals in the nation by *US News & World Report* (July 20, 2001)

Wetting Characteristics of Aqueous Surfactant-Laden Drops: Potential Therapy for Bubble Obstruction of Blood Flow

David M. Eckmann, Daniel P. Cavanagh, and Annette B. Branger.

No easily obtainable effective clinical therapy exists to prevent or treat cerebral microvascular gas embolism, a very common occurrence in cardiac surgery. Modification of wetting and interfacial tension by exogenous surfactants to alter the contact dynamics is one potential therapeutic approach.

A recent study by IME member David M. Eckmann, M.D. (Anesthesia) and his graduate students *(Journal of Colloid and Interfacial Science, in press)* describes wetting experiments performed to determine how contact angles and contact angle hysteresis change with varying soluble surfactant concentration in the bulk liquid. Contact angles of aqueous solutions of two



*Intravital microscopy view of arteriolar gas embolism bubble obstructing microvascular blood flow **in vivo** in the rat cremaster muscle.*

surfactants were measured over a range of concentrations on three substrates. Adhesion tension increased to a plateau with increasing surfactant concentration. Above the critical micelle concentration, a continued decrease in contact angle was observed, leading to an increase in the adhesion tension. Experiments confirmed adsorption of surfactants to the solid substrate. Contact angle hysteresis was calculated from the experimental data. Material combinations leading to partial wetting could be converted to complete wetting by adding sufficient surfactant, but at the cost of increasing adsorption onto the solid. This restricts drop motion. This work illustrates the physico-chemical rationale for developing a biocompatible surface-active pharmacological agent that could be delivered to target dewetted areas. This should promote liquid spreading, and thereby treat or prevent the physiologic damage caused by bubble obstruction of blood flow.

Recent Honors and Awards to IME Members:

Peter F. Davies, Ph.D. was a keynote speaker at the British Heart Foundation Hemodynamics Conference at Imperial College, London, and was appointed to the "Smart Medical Team" of the NASA National Space Biomedical Research Institute. He is also a member of the NIH/NHLBI delegation to a Joint US-Russia Symposium on Basic Research in Cardiovascular and Pulmonary Diseases in Moscow in September 2001 ◆ **Valerie M. Weaver, Ph.D.** was selected to talk at the Educational Symposium at the AACR meeting in New Orleans, and for a platform presentation at the Mammary Gland Gordon Conference ◆ **John A. Quinn, Ph.D.,** presented the 2001 Alan S. Michaels Distinguished Lectureship in Medical and Biological Engineering at MIT: "Membranes in Bioprocessing: Alan Michaels' Legacy" ◆ **Natacha DePaola, Ph.D.** (RPI) was invited to a series of lectures in Japan this spring, including a Plenary Lecture at the 6th Meeting on Thrombosis and Rheology in Tokyo and invited lectures at Tohoku University in Sendai and at Okayama University Medical School. She is also the Track Chair for Health Care Technology and Biomedical Education, Internet Learning and Distance Education at the upcoming 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society in Istanbul ◆ **Scott L. Diamond, Ph.D.** was Session Chair for "Cell Adhesion and Migration" AIChE 2000 in Los Angeles; "Vascular Adhesion and Cell-Cell Adhesion" BMES 2000 in Seattle, and "Cardiovascular Therapeutics" in BMES 2001 at Duke University ◆ **Brian Helmke, Ph.D.,** (Davies Lab) was awarded a BMES Travelling Fellowship to present at the Society's meetings in Seattle ◆ ***Several students from IME members' labs won awards and fellowships this year.*** **Jason Wertheim, MD/PhD** student (Pear and Hammer Labs) won the 2001 Dr. William B. Walsh Award for Excellence in Bioengineering from Advanced Tissue Sciences. The award provides funds for an internship at the company's La Jolla site ◆ **Stavros Thomopoulos** (Soslowsky lab) won the Ph.D. Student Paper Competition Awards at the 2001 Summer Bioengineering Conference, Utah; **Tony Yeung** (undergraduate student, Janmey Lab) won an award from the Nassau Fund through Penn's Center for Undergraduate Research and Fellowships; **Ashlan Reid** and **Stephen Cranstoun** (Brian Litt's lab) were awarded National Science Foundation fellowships. **Ashlan Reid** also received a Whitaker Foundation Graduate Fellowship; **Maureen Sheehan** (Discher Lab) won an American Heart Association fellowship; and **David Derenick** (Hammer lab) won a Whitaker Foundation Graduate Fellowship. Winners of the best poster awards at the pre doc and post doc levels at the IME Symposium 2000 were **Maureen Sheehan** and **Valerie Clerin, Ph.D** (Gooch lab), respectively.

New Faces at PENN and the IME

New IME Members

Ian A. Blair, Ph.D.
A.N. Richards Professor of Pharmacology
Director of the Center for Cancer Pharmacology
Dr. Blair was recruited to the University of Pennsylvania in January 1997 from Vanderbilt University. He holds an endowed chair as the A.N. Richards Professor of Pharmacology and is Director of the Center for Cancer Pharmacology. Dr Blair's current research is involved with the development of molecular biomarkers to elucidate mechanisms of carcinogenesis with particular emphasis on lipid peroxidation.

Eric T. Boder, Ph.D.
Assistant Professor of Chemical Engineering
Dr. Boder joined the Chemical Engineering Department at Penn in August of 2000 from the Howard Hughes Medical Institute, National Jewish Medical and Research Center in Denver, where he was a post-doctoral fellow with Drs. Kappler and Marrack at the department of Immunology. Dr. Boder's research interests are biomolecular engineering, combinatorial directed evolution of proteins, quantitative molecular immunology, protein structure, dynamics, and recognition, and protein expression technologies.

Yongwon Choi, Ph.D.
Professor of Pathology and Laboratory Medicine
Yongwon Choi joined the department of Pathology and Laboratory Medicine from the Howard Hughes Medical Institute, Rockefeller University. Dr. Choi is interested in the molecular analysis of the osteoimmune system. His research focuses on two cell types: dendritic cells and osteoclasts. Specifically, he investigates the ways in which dendritic cells regulate T cell activation or tolerance, and how osteoclasts differentiate from their precursors and mature osteoclasts are activated to resorb bone. Finally, Dr. Choi's lab is interested in how bone and the immune system cross-talk with each other. Dr. Choi's web site is http://www.med.upenn.edu/abramson/choi.html

Richard ("Sal") Salcido, M.D.
William J. Erdman, II Professor and Chair
Department of Rehabilitation Medicine
Dr. Salcido joined Penn as chairman of the Department of Rehabilitation in September 2000 from the University of Kentucky School of Medicine. Dr. Salcido's goal is to enhance Penn's existing programs and expand on opportunities to care for patients with particular consideration for traumatic brain injuries and spinal cord injuries. Dr. Salcido is a member of the National Advisory Board of the National Center on Medical Rehabilitation at the NIH, and of the Professional and Technical Advisory Board for Long-term Care and Rehabilitation for the Joint Commission Accreditation of Hospital Organizations (JCAHO). His major research and clinical interests are in chronic wound care, functional mobility in aging, and urinary incontinence.

David W. Speicher, Ph.D.
Professor and Chair, Structural Biology Program,
Director, Protein Microchemistry/MS Facility
The Wistar Institute
Dr. Speicher joined the faculty of the Wistar Institute in 1986, and was appointed the Chair of its Structural Biology Program in 1996. Dr. Speicher investigates macromolecular interaction mechanisms and thermodynamics in complex protein systems; Characterization of cancer metastases using proteome analyses; Role of cell-cell adhesion proteins in tumor development; Structure, function, assembly and regulation of membrane skeletal proteins.

For a list of all IME members, please visit
http://www.med.upenn.edu/ime/research.shtml

Comings and Goings...

Brian P. Helmke, Ph.D., post doc in Peter Davies' lab was appointed Assistant Professor of Bioengineering at the University of Virginia ◆ **David Tees, Ph.D.,** Research Assistant Professor in Dan Hammer's lab will start as Assistant Professor in the Physics Department at the University of Ohio ◆ **Michael Bey, Ph.D.** from Lou Soslowsky's lab starts a faculty position in the fall ◆ **Primoz Ziherl, Ph.D.,** post doc in Randy Kamien's lab, was appointed Instructor at the University of Ljubljana, Slovenia ◆ Former post docs in Arjun Yodh's lab include **Joe Culver, Ph.D.,** now a Lecturer at Harvard Medical School, **Monica Holboke, Ph.D.** who is with a startup in Silicon Valley, and **Cecil Cheung, Ph.D.** with Advanced Biometrics, Inc. ◆ Also from the Yodh lab, **Xingde Li, Ph.D.** is Assistant Professor of Bioengineering at the University of Washington, and **Anthony Dinsmore, Ph.D.** is Assistant Professor of Physics at the University of Massachusetts, Amherst ◆ **Steve Thomopoulos** graduated with a Ph.D. from Lou Soslowsky's lab and is starting a postdoc at Columbia University ◆ **Joe Abboud, M.D.,** has completed his research fellowship in Lou Soslowsky's lab, and resumed clinical practice ◆ **Annette B. Branger** (David Eckmann's lab) received her Ph.D., and now works on vascular devices for W.L. Gore, Inc., California ◆ **Marcus Bell,** a BMB graduate student, graduated with a Ph.D. from Yale Goldman's lab ◆ **Danielle Dominic** (Weaver lab) graduated with a M.Sc. degree ◆ Graduating with Ph.Ds from Arjun Yodh's lab are **Ningping Yang, Ph.D.** now with Computer Control and Command, Inc., and **Vasilis Nziachtristos, Ph.D.,** now a Post-Doctoral fellow at Harvard University ◆ **WELCOME NEW POSTDOCS: Jenny Zilberberg** (Ph.D. Penn State) in Peter Davies lab; **Wenyu Ming, Ph.D.** in Valerie Weaver's lab; **Victor Romanenko** (Ph.D. Wayne State) in Irena Levitan's lab; **Valeria Tohver** (Ph.D. Illinois) and **Jeanene Willcox** (Ph.D. U. Mass) in Dan Hammer lab; **Sam Young, M.D.,** Penn Orthopaedic resident, **Xiang Zhou, M.D.,** an orthopaedic surgeon from West China University of Medical Sciences, **Joseph Sarver** (Ph.D. Drexel) and **Jeffrey Cartmell** (Ph.D. Rutgers and UMDNJ) in Lou Soslowsky's lab; **Lucio Florez, Ph.D.,** a former graduate student in Natacha DePaola's lab at RPI, returned as a postdoctoral research associate; **Kees Storm, Ph.D.,** a theoretical physicist from the University of Leiden, Netherlands, will be a joint Physics/IME (Paul Janmey's lab) post doc; and **Yu Guoqiang, Ph.D.,** in Arjun Yodh's lab ◆ **Joe Giamarco** is a new Research Associate in the Yodh lab ◆ **WELCOME NEW STAFF: Andrea Carpenter** (Bryn Mawr College) joined Warren Pear's lab as a research specialist ◆ **Boabin Kang** joined Valerie Weaver's lab as research specialist ◆ **Alan Sun** who worked with Irena Levitan as an undergraduate Penn student, joined her lab as a research specialist ◆ **Srinivasa Rao Mandava** is a new research specialist in Eric Boder's lab ◆ **David Wehr** is a new research specialist in Ken Ryan's lab ◆ **Wenxia Qie** joined the Hammer laboratory as a research specialist ◆ **Paramjeet Randhawa (Lena)** is a new technician in Paul Janmey's lab ◆ **WELCOME NEW GRADUATE STUDENTS: Mete Civelek** (Penn State and Merck) in Peter Davies Lab; **Bo Wen, John Arthur,** and **Paul Merolla** in Kwabena Boahen's lab; **Daniella Fuentes, Katheryn Kadash,** and **Dhaval Ghosalia** in Scott Diamond's lab; **Wade Joahnnessen, Michele Favata, Stephanie Perry** and **Amanda Filanowski** in Lou Soslowsky's lab; **Nas Zahir** in Valerie Weaver's lab, together with **Micah Chrenek** and **Brian Maclejko,** visiting graduate students from the University of Alberta; **Andrew Nields,** a Drexel graduate, joined Eric Boder's lab; **Daniel Chen, Mattuez Bryning, Ahmed Alsayed, Alper Corlu** and **Jonathan Fisher** are new Physics Ph.D. students in Arjun Yodh's lab; **Stephanie Rosenberg** is a bioengineering graduate student in Yale Goldman's lab; **Eno Eissien** and **Ana Jaklenec** from MIT joined Natacha DePaola's lab at RPI; and new graduate students in Dan Hammer's lab are **Kendra Sarrat, John Lin, Ying Zhang** and **Cindy Reinhart** ◆ **INTERNS:** This summer, Valerie Weaver's lab hosted **Kellie Machlus** and

Sommer Miller, a rotation Cell and Molecular Biology graduate student; Peter Davies lab hosted **Amy Rosen** and **Michael Jue** (both Penn Bioengineering) and **Anji Wall** from Catholic University, Washington D.C.; **Miguelina Ortiz,** an undergraduate student from the University of Cayey (Puerto Rico) was sponsored by the LRSM for summer research in Paul Janmey's lab; and **Jeanette Hardeman** from Community College of Philadelphia worked in Irena Levitan's lab. Jeanette will stay with us part time next year ◆ **GOOD LUCK TO THOSE WHO LEAVE FOR GRADUATE STUDIES IN OTHER INSTITUTIONS:** **Neha Korde** from Paul Janmey's lab starts medical school at the Robert Wood Johnson Medical School; **Sonia Bakkour** from Warren Pear's Lab starts graduate studies in Immunology at U.C. Berkeley; **Jonathan Jennings** from Ken Ryan's lab leaves to complete his undergraduate education at Princeton; and **Christy Haldis,** a research engineer from Lou Soslowsky's group, will start Business School at George Washington University.

First Collaborative Workshop on Seizure Prediction

IME member Brian Litt, M.D. (Neurology and Bioengineering), with colleagues from the US, Canada, and Europe, is organizing the First Collaborative Workshop on Seizure Prediction, in Bonn, Germany, on October 29 – November 1, 2001. The workshop will focus on sharing and comparing techniques for analyzing intracranial EEG data from patients with epilepsy to understand mechanisms underlying seizure generation in the brain. The results of the workshop will be published in a special 2002 edition of the *IEEE Transactions on Biomedical Engineering*.

THE CENTER FOR

Bioinformatics at the IME

PCBI Welcomes Artemis-Georgia Hatzigeorgiou, Ph.D.

Dr. Artemis Hatzigeorgiou will join the Center for Bioinformatics as Assistant Professor in the department of Genetics. Dr. Hatzigeorgiou received her MSc. in Computer Science from the University of Stuttgart and a Ph.D. in Natural Science from Jena University, Germany. From 1993 to 1996, she worked as a research associate in the German Cancer Research Center in Heidelberg, where she won a Best Young Researcher Performance Award. She was co-founder and chief scientist of a bioinformatics company – Synaptic Ltd. - in Crete, and received an entrepreneurship award from the Hellenic State Organization of Small and Medium Enterprises. Since 2000, she has been a Group Leader at Metagen GmbH in Berlin, where she built a bioinformatics group. Dr. Hatzigeorgiou's research uses mathematical models for feature recognition in nucleotide sequences. In particular, she focuses on using neural network techniques to identify sequence features (such as genes, promoters, translation initiators and other functional sites), and the resulting annotation of expressed sequence tags. She arrives at Penn in September 2001.

A Relational Schema for Array and Non-Array Based Gene Expression Data

Christian J. Stoeckert, Jr., Angel Pizarro, Elisabetta Manduchi, Mark Gibson, Brian Brunk, Jonathan Crabtree, Jonathan Schug, Shai Shen-Orr, G. Christian Overton

RAD (RNA Abundance Database) is designed to capture highly parallel gene expression experiments using different technologies. The design (schema) for RAD, published in *Bioinformatics, volume 17 (2001)*, grew out of efforts to build a database for collaborators working on different biological systems and using different types of platforms in their gene expression experiments as well as different types of image quantification software. RAD uses a relational database management system and has tables that are conceptually organized into 3 categories of information: Platform, Experiment (which includes image scanning and quantification), and Data. The strengths of the schema are: (i) integrating information on array elements using a gene index, (ii) describing samples using controlled vocabularies/ ontologies, (iii) reducing an experiment to a single RNA source for precise descriptions yet not losing the relationships between experiments done at the same time or for the same project, and (iv) maintaining both raw and processed (e.g., cleansed and normalized) data and recording how the data is processed. The result is a novel schema, which can hold both array and non-array (SAGE) data and is extensible for detailed experimental descriptions that are precise and consistent. Regarding experimental descriptions, RAD is compliant with the MGED guidelines for standardized descriptions of microarrays (http://www.mged.org).

IME

December 4th, 2001

2001 Symposium

Dr. Leroy Hood: Plenary Lecturer – Integrative Systems Biology

Glen A. Evans, President and CEO of Egea Biosciences (San Diego), delivers the morning plenary lecture at the IME 2000 Symposium

Dr. Leroy Hood, President of the Institute for Systems Biology and the William Gates Professor of Molecular Biotechnology at the University of Washington, Seattle, will be the plenary speaker at IME Symposium 2001 to be held at the BRB II/III auditorium on Penn's campus, on Tuesday December 4, 2001. Dr. Hood will speak on "Deciphering Life: Genomics, Proteomics, and Systems Biology". Dr. Hood co-developed the automated gene sequencing technology that enabled the Human Genome Project. Systems Biology involves the study of complex interactions of vast numbers of biological elements. This requires scientists historically separated by disciplinary boundaries to work in close collaboration to integrate genomic, proteomic, and computer technologies.

The symposium will feature Penn speakers on subjects within the theme of integrative biology and of emerging interest for the IME. A poster session will be held, with prizes ($250) for the best poster in the pre-doctoral and post-doctoral categories. Registration is required – for more information, please contact ime@pobox.upenn.edu.

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Questions, comments about the Newsletter?
Contact
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Interdisciplinary Seminar Series of the IME – 2001/2002 (as of August 15, 2001)

Unless indicated otherwise, IME Seminars are held Tuesdays, 12:00 noon (coffee at 11:45)
2nd floor conference room, Vagelos Research Labs, 3340 Smith Walk
For more information, please contact Michal Bental Roof, IME, 215-898-0048

9/25/01
Torsten Blunk, Ph.D.
University of Regensburg, Germany
"Approaches to Tissue Engineering of Cartilage and Adipose Tissue"

10/2/01
Ruth J. Muschel, M.D., Ph.D.
University of Pennsylvania
"A New Model for Metastasis Based upon Direct Observation of Tumor Cells in the Lung"
IME Cancer Metastasis Seminar

10/9/01
Noon – 4 PM
Location TBD
IME Biophysics workshop
See details below

10/16/01
Vladimir R. Muzykantov, M.D., Ph.D.
University of Pennsylvania
"Sub-Cellular Immunotargeting of Therapeutic Cargoes to Endothelial Cells"
IME Drug Targeting/Delivery Seminar

10/23/01
Catherine E Morris, Ph.D.
University of Ottawa
"Shaker is a Stretch Channel? Calcium Channels are Stretch Channels? What's Going On?"

11/6/01
Alan J. Grodzinsky, Ph.D.
Massachusetts Institute of Technology
"Chondrocyte Mechanotransduction: Cellular, Intracellular, and Molecular Responses to Tissue Level Forces"
Co-sponsored with Bioengineering

11/16/01
Friday, noon
Alain Tedgui, Ph.D.
INSERM, Paris, France
"Signal Transduction of Mechanical Stresses in the Arterial Wall"
Co-sponsored with Thrombosis/ Cardiovascular Biology Seminar Series

11/20/01
Abdul I. Barakat, Ph.D.
University of California, Davis
"Potential Role of Arterial Fluid Mechanics in Atherosclerosis - Whole Vessel and Cellular Considerations"

12/4/01
all day
BRB II/III Auditorium
IME Symposium 2001
See details above

12/6/01
Thursday, 3 PM
LRSM Auditorium
George Oster, Ph.D.
University of California, Berkeley
Title TBA
The IME/LRSM Lecture

1/8/02
George Rothblat, Ph.D.
Children's Hospital of Philadelphia
"Cholesterol Flux between Cells and Lipoproteins"

1/15/02
C. Forbes Dewey, Jr., Ph.D.
Massachusetts Institute of Technology
"Bioinformatic Architectures for Experimental Data, Physiologic Models, and Federated Databases"

2/5/02
Prasad V Shastri, Ph.D.
University of Pennsylvania
"Strategies for the Development of Synthetic Support Structures for Bone and Cartilage Regeneration"

2/19/02
Keith J. Gooch, Ph.D.
University of Pennsylvania
"Cardiovascular Tissue Engineering"

3/12/01
Michael P. Sheetz, Ph.D.
Columbia University
"Force-Sensing by the Cytoskeleton: Role of Tyrosine Phosphatases and Kinases"

3/19/02
M. Celeste Simon, Ph.D.
University of Pennsylvania
"Hypoxic Regulation of Developmental and Tumor Angiogenesis"

4/9/02
George Vann Bennett, M.D., Ph.D.
Duke University
"Role of Ankyrin-B in Cellular Targeting and Physiological Function of IP3 Receptors"

4/16/02
Irena Levitan, Ph.D.
University of Pennsylvania
"Regulation of Endothelial Ion Channels by the Lipid Composition of the Membrane"

4/30/02
Warren S. Pear, M.D., Ph.D.
University of Pennsylvania
"Notch Signaling in Lymphoid Development and Leukemia"

5/7/02
Christopher A. G. McCulloch, D.D.S., Ph.D.
University of Toronto
"Mechanotranscriptional Coupling of the Cytoprotective Protein Filamin A"

6/11/02
Valerie M. Weaver, Ph.D.
University of Pennsylvania
"Stromal-Epithelial Interactions, Apoptosis Resistance and Malignant Transformation of the Breast"

IME Biophysics Workshop – October 9, 2001

IME faculty Paul Janmey (Physiology) will lead the IME Biophysics Workshop on the afternoon of October 9, 2001. The workshop coincides with the Penn visit of Professor Reinhard Lipowsky, Director of the Max Planck Institute of Colloids and Interfaces in Potsdam, Germany. Talks by Penn speakers, mainly IME and Physics faculty, will follow Dr. Lipowsky's presentation.