



Institute for Pure and Applied Mathematics
University of California, Los Angeles presents

Cells and Materials Workshop II: Microfluidic Flow in Nature and Microfluidic Technologies

April 18 - 22, 2006

Members of the Organizing Committee include **Andrea Bertozzi** (UCLA, Mathematics), **Michael Brenner** (Harvard University, Applied Mathematics and Applied Physics), **Vittorio Cristini** (University of California at Irvine, Biomedical Engineering and Mathematics), **John Frangos** (La Jolla Bioengineering Institute), **Howard Winet** (UCLA, Orthopedic Surgery)

Scientific Background:

Convective fluid transport is critical for most physiological processes. At the microscopic level it ranges from flow around a swimming *Spirillum* bacterium to active transport of molecules across membranes by pumps. Many life threatening diseases progress due to reduction in microfluidic flows. Diabetes affects transmural exchange in kidney nephrons and capillaries. Stroke and reperfusion injury interrupt capillary bloodflow. Edema results when fluid cannot escape a tissue, as occurs in compartment syndromes. In bone microfluidic transport - bone interstitial fluid flow (BIFF) - has been identified as the stimulus that is detected by osteocyte and osteoblast mechano-receptors and modulates their physiology. There is evidence that BIFF is generated by poroelastic deformation of the bone matrix and may be influenced by bone capillary blood pressure. Since the mechanical impulse modulating endothelial cells is fluid shear stress it is reasonable to propose that the same mechanism operates in bone cells. An alternative - possibly collateral - mechanism may be streaming potentials. Enhancement of BIFF may be the key to improving fracture healing and preventing osteoporosis. Appropriate BIFF assist devices may, accordingly, be worn during healing, prolonged periods of disuse (bed rest) and microgravity exposure. Microfluidic flows are also critical for maintenance of tissue engineered scaffolds. If the implant is erodible, convection will hasten decomposition. If it carries cytokines/growth factors convection will hasten their dissemination. If it is a bioreactor, i.e. carries functioning cells, convection will supply the nutrients to keep its seeded cells alive until host vasculature can penetrate the scaffold. Mathematical modeling of such flows in and around individual cells is relatively straightforward. Observations generating data which can be used to determine model coefficients are plentiful. In the intact organism, these data are less available. Accurate measurements from within the intact organ usually involve probes which disturb the flow being measured. Mathematical modeling and computation extrapolated from data from less invasive approaches can help decide which measures are "real" and which "artifacts".

Mathematical approaches: microfluidics, flow through random media, finite elements, homogenization

Program Schedule:

Tutorials. March 14 - 17, 2006.

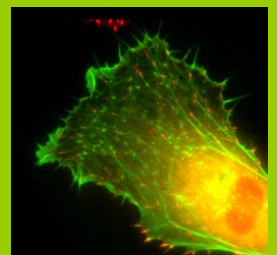
Workshop I: Membrane Protein Science and Engineering. March 27 - 31, 2006.

Workshop II: Microfluidic Flow in Nature and Microfluidic Technologies. April 18 - 22, 2006.

Workshop III: Angiogenesis, NeoVascularization and Morphogenesis. May 8 - 12, 2006.

Workshop IV: Systems Biology and Molecular Modeling. May 22 - 26, 2006.

Culminating Retreat at Lake Arrowhead. June 11 - 16, 2006.



Participation:

We have funding to support the attendance of recent PhD's, graduate students and researchers in the early stages of their career. Mathematicians and scientists at all levels who would like to learn more about this area are encouraged to apply for funding. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission and we welcome their applications.

<http://www.ipam.ucla.edu/programs/cmws2/>

Or email questions to cmws2@ipam.ucla.edu

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