“Engineering Biomaterials for Molecular Elucidation and Engineering of the Stem Cell Fate Decisions”

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Refreshments at 3:30, Upson Hall Lounge

Abstract
Elucidating the mechanisms that regulate stem cell behavior is critical for understanding the roles these cells play in organismal development and function as well as for harnessing stem cells to repair tissues damaged by disease or injury. It has become increasingly clear that stem cells are regulated not only by biochemical signals in the niche, but also by biophysical features in the way these signals are presented, though investigating the latter is challenged by experimental complexities in investigating and mimicking the complexity of the extracellular matrix (ECM), cell-cell interactions, and other niche components. Recent work has demonstrated that bioactive, synthetic materials can be harnessed to emulate and thereby study the effects of solid phase, biophysical cues on cell function. For example, activation of many cellular receptors involves the formation of oligomeric protein signaling complexes with ligands presented from the matrix, the surface of neighboring cells, and in some cases even from solution. We have developed multivalent ligands – polymers conjugated to signaling proteins to yield biomimetic signals with nanoscale spatial organization – that potently induce the differentiation of human pluripotent stem cells in vitro and neural stem cells in vivo. Furthermore, we discovered that mechanical properties of materials regulate the differentiation of both neural stem cells and embryonic stem cells. Finally, such biomimetic materials can be integrated into safe, scaleable, and robust bioprocesses for pluripotent stem cell expansion and differentiation.

Biographical sketch
David Schaffer is a Professor of Chemical and Biomolecular Engineering, Bioengineering, and Neuroscience at University of California, Berkeley, where he also serves as the Director of the Berkeley Stem Cell Center. He graduated from Stanford University with a B.S. degree in Chemical Engineering in 1993. Afterward, he attended Massachusetts Institute of Technology and earned his Ph.D. also in Chemical Engineering in 1998. Finally, he did a postdoctoral fellowship in the laboratory of Fred Gage at the Salk Institute for Biological Studies in La Jolla, CA before moving to UC Berkeley in 1999. At Berkeley, Dr. Schaffer applies engineering principles to enhance stem cell and gene therapy approaches for neuroregeneration, work that includes novel approaches for molecular engineering and evolution of new viral vectors as well as new technologies to investigate and control stem cell fate decisions. David Schaffer has received an NSF CAREER Award, Office of Naval Research Young Investigator Award, Whitaker Foundation Young Investigator Award, and was named a Technology Review Top 100 Innovator. He was also awarded the Biomedical Engineering Society Rita Shaffer Young Investigator Award in 2000, the American Chemical Society BIOT Division Young Investigator Award in 2006, and was inducted into the College of Fellows of the American Institute of Medical and Biological Engineering in 2010.