Bio-X *fellowships*

2012

The Bio-X Fellowships are made possible by various gifts in order to promote interdisciplinary research for promising scientists working on projects that bridge the gap between biology and other fields.

Students are encouraged to work collaboratively with professors in different departments or schools, drawing on expertise campus-wide.

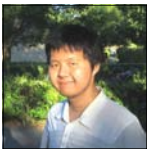
NEW ADVANCES IN SCIENCE AND ENGINEERING

Bio-X Fellowships

Bio-X Graduate Student Fellowships 2012

Daniel Bechstein
Bio-X Bowes Fellow
Mechanical Engineering

Profs. Shan Wang (Materials Science & Engineering, Electrical Engineering), Juan Santiago (Mechanical Engineering), Stephen Quake (Bioengineering), and Gary Schoolnik (Medicine, Microbiology & Immunology)
2.5 million vaccine-preventable childhood deaths occur annually. While these vaccines are very affordable, ensuring a full immunization is a bottleneck in vaccination programs. Daniel proposes a novel point-of-care diagnostic device combining advantages of microfluidic sample processing, biomarker-based immunoassays, and integrated circuit-based magnetic sensing to test the immunization status and display results. Magnetic sensor technology, originally developed for computer hard drive read heads, is used to quantify analyte concentrations in biological samples. This allows multiple orders of magnitude lower limits of detection than the current gold standard technology. The point-of-care platform can be expanded to detect cancer and other diseases.



Fang-Chieh Chou
Honorary Fellow
Chemistry

Profs. Rhiju Das (Biochemistry) and William J. Greenleaf (Genetics)
RNA controls gene expression and regulation and is known to be associated with various genetic disease when aberrant. Understanding the atomic structures of RNAs is important for obtaining accurate pictures of their functions in cells. Fang-Chieh's research in the Das lab focused on modeling and predicting RNA 3D structures *in silico*. Fang-Chieh has previously developed an automatic tool to help experimentalists in modeling and refining RNA crystal structures with less time and higher accuracy. His current research aims to understand the energetic rules underlying the RNA folding process and to develop an accurate computational method for modeling RNA-protein interface.

Soah Lee
Bio-X Bowes Fellow
Materials Science & Engineering

Profs. Fan Yang (Bioengineering) and Renee Pera (Obstetrics & Gynecology)
Pluripotent stem cells are promising cell sources for tissue engineering and regenerative medicine; however, due to the lack of understanding of complex, multifunctional cell surroundings, it is difficult to direct the stem cell differentiation into functional, mature cell types. Working at the interface of biology, materials science & engineering, and medicine, Soah's goal is to develop novel systems that allow her to rapidly test a variety of combinations of the surrounding signals using high-throughput strategies. The system will help to understand how the complex interplay of the signals influences stem cell fate in 3D and to optimize stem cell surroundings for stem cell differentiation into the cell types needed.

"The Bio-X Program and Fellowship allowed me to do riskier research for my Ph.D. because we didn't have outside funding for that [specific] project. I think it directly contributed to the success of that work, specifically in the publication of the work in the Proceedings of the National Academy of Sciences."
Amanda Malone, Ph.D. (Bio-X Bowes Fellow 2004)

Trevor Martin
Bio-X Bowes Fellow
Biology

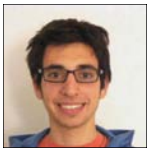
Professor Hunter Fraser (Biology)
A core concern of genomics is the connection of genotypic variation, at the level of DNA sequence, with phenotypic variation, such as disease status. Many studies have shown that connecting these two levels of variation directly can be difficult and that a useful intermediary is variation at the level of gene expression. Trevor's research focuses on developing novel statistical methods to understand how gene expression variation has evolved that allow for new ways of studying the intersection between genetics and disease.

Jeffrey Quinn
Bio-X Bowes Fellow
Bioengineering

Profs. Howard Chang (Dermatology), Asifa Akhtar (Epigenetics), Rhiju Das (Biochemistry, Physics), Stephen Quake (Bioengineering), Christina Smolke (Bioengineering, Chemical Engineering), and Michael Lin (Bioengineering)
RNAs not only encode the blueprint for making proteins – they also fold into complex structures, regulate gene expression, sense biomolecules, catalyze reactions, and direct important biological processes. One class of these regulatory RNAs is long noncoding RNAs (lncRNAs). The past decade of genomic research has revealed the pervasiveness of lncRNAs in higher organisms; however, very few have been characterized. What are their cellular roles? How do they participate in biological functions? Jeffrey's work aims to answer these questions, focusing on fruitflies' roX lncRNAs in particular. By bridging biochemical, structural, genetic, and next-generation sequencing tools together, he plans to build a mechanistic map of how roX and other lncRNAs function.

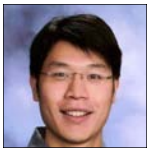
Joel Sadler
Bio-X Bowes Fellow
Mechanical Engineering

Profs. Sakti Srivastava (Surgery), Larry Leifer (Mechanical Engineering), and Kenneth Salisbury (Computer Science)
Joel's research explores the design of low-cost modular medical robotics and prosthetics that enhance physical and cognitive human ability. Medical telerobotics has great potential to augment the operating room with real-time distributed collaboration. These surgical robotic systems currently allow many endoscopic procedures to be performed remotely but are (i) expensive, (ii) complex, and (iii) unable to provide a sense of haptic touch. The goal of this research is to develop an affordable telerobotic platform that may be used in cost-constrained environments such as developing world hospitals. They are currently developing a novel system that demonstrates how modular design and low-cost fabrication techniques can enable affordable gestural-haptic interactions in medicine.



Lucien Weiss
Bio-X Bowes Fellow
Chemistry

Profs. W. E. Moerner (Chemistry) and Matthew Scott (Developmental Biology)
Sonic Hedgehog (SHH) signaling plays an important role in human development, particularly in determining the fate of stem cells and regulating cell division in some tissues. Defects in the signaling pathway can lead to serious birth defects and cancer. Despite its importance, the mechanism is not well understood. In this project, Lucien is using single-molecule imaging to characterize the motion and interactions of key proteins in the signaling pathway on the surface of live cells. This work will contribute to the understanding of how the SHH signal is received, transduced, and interpreted.



Jin Chen
Bio-X SIGF
Lubert Stryer Interdisciplinary Fellow
Applied Physics

Profs. Joseph Puglisi (Structural Biology) and Michael Levitt (Structural Biology)
Ribosome translation is one of the most fundamental processes in organisms, converting the genetic code stored in RNA to proteins. Translation is an important regulatory and control point for gene expression, and links to misregulation of protein translation are being identified in an increasing number of diseases. Thus, understanding how ribosomes synthesize protein and how other protein factors interact with the ribosome during the process is crucial. The goal of Jin's project is to use a combination of fluorescence, nanophotonic, and computational techniques to study the dynamics of single ribosomes in real-time as they synthesize proteins. Through a multiplexed detection technique, thousands of "single" ribosomes can be observed simultaneously. The single-molecule approach allows the study of the intrinsic dynamics of translation and the detection of rare translational events that may be linked to diseases.

Roshni Cooper
Bio-X SIGF
Morgridge Family SIGF Fellow
Electrical Engineering

Profs. Kang Shen (Biology) and Mark Horowitz (Electrical Engineering)
Synapses, the critical links between neurons and the body, have many intricacies that can be visualized with modern fluorescence imaging. Computer Vision can extract maximal information from these images, both by eliminating subjectivity and human error and by illuminating insights about synapses too complex to capture by eye. Using this visual information to perform forward genetic screens on *C. elegans* can isolate individual genes linked to synapse apposition, including genes with homologs in humans. Today, however, accurate and efficient screens are nearly impossible without a significant computational component, which Roshni will be developing through her research as a Bio-X fellow.

Stephen Fried
Bio-X SIGF
Chemistry

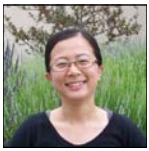
Profs. Steven Boxer (Chemistry) and Vijay Pande (Chemistry)
If the cell is a self-running city, then proteins are the nano-robots that carry out all the vital functions that keep the city alive and running. Amazingly, the only "program" proteins need to perform their respective operations is the laws of physics, which endow them with specific movements. Understanding how proteins' motions enable their respective functions has been a longstanding question in molecular biophysics; one barrier has been that insights from experiment and theory are difficult to synthesize. Stephen's research is aimed at opening a new dialogue between experiment and theory by utilizing a Markov state model description. By combining multiple approaches, we can hope to build more physically realistic models and to obtain a more rigorous understanding of protein function.

Xiaojing Gao
Bio-X SIGF
Enlight Foundation Interdisciplinary Graduate Fellow
Biology

Profs. Manu Prakash (Bioengineering), Liqun Luo (Biology), and Thomas Clandinin (Neurobiology)
We intuitively sense pleasant or noxious smells, and olfactory attraction or aversion prevails in many organisms. How does the brain make this binary decision about an odor? Almost nothing is known about the neural circuit for this computation. Xiaojing is using fruit flies as a model to address this question. To reveal the roles of specific neurons in olfactory behavior, he non-invasively manipulates their activity with state-of-the-art genetic tools and quantitatively analyzes the change in the animal's response to odors. His work may advance our general knowledge regarding how sensation leads to action and help pest control.

Kathryn Montgomery
Bio-X SIGF
William and Lynda Steere Fellow
Bioengineering

Profs. Scott Delp (Bioengineering, Mechanical Engineering) and Karl Deisseroth (Bioengineering, Psychiatry)
Kate is designing and developing devices to control muscles. She is using optical activation of neurons to achieve better muscle control than electrical stimulation. This project combines the fields of electrical engineering, material science, neuroscience, and molecular biology. Research in this field will improve the available therapies for people with paralysis and movement disorders caused by brain and spinal cord damage.



Wendy Ni
Bio-X SIGF
Bruce and Elizabeth Dunlevie Fellow
Electrical Engineering

Profs. Greg Zaharchuk (Radiology), Dwight Nishimura (Electrical Engineering), and Michael Moseley (Radiology)
Many pathological conditions change oxygen metabolism (oxygenation) in brain tissues. However, there is currently no fast and reliable way to acquire high-resolution whole-brain oxygenation maps. In particular, existing MRI methods suffer from inadequate signal models and rely on potentially toxic contrast agents for the vital measurement of cerebral blood volume (CBV). This project aims to implement a novel numerical modeling approach for clinical MRI and to develop a novel CBV measurement technique that does not require contrast agents. Ultimately, these methods will be optimized for improved assessment of the condition and progress of stroke patients.

Pankaj Sharma
Bio-X Bowes Fellow
Electrical Engineering

Profs. Sakti Srivastava (Surgery), Krishna Shenoy (Electrical Engineering), and Kenneth Salisbury (Computer Science, Surgery)

Pankaj is designing and developing an interactive tool for the objective assessment of manual dexterity, with an emphasis on surgical tasks. His approach involves breaking a complex task into fundamental surgical manipulations and performing a task analysis using optical and electronic motion capture techniques. This project combines the fields of surgery, electrical engineering, computer science, robotics, and neuroscience. This research will help surgeons to efficiently and effectively learn surgical skills. It will have an impact in the field of rehabilitation and will also help significantly in developing highly functional upper limb prostheses.

Manuel Rausch
Bio-X SIGF
Affymetrix Bio-X Fellow
Mechanical Engineering

Profs. Ellen Kuhl (Mechanical Engineering) and D. Craig Miller (Medicine)
Cardiovascular disease has been and will be one of the most devastating health conditions in the USA and around the world. Being trained as a mechanical engineer, Manuel is using engineering methods to understand the physiology and pathology of the heart and its surrounding tissues. He cares particularly about the structure function relationship of cardiovascular soft tissues that he studies *in vitro*, *in vivo*, and *in silico*. His goal is to translate information gained from these experiments into meaningful knowledge that he hopes will ultimately advance medical procedures and devices related to cardiovascular disease.

Jennifer Yong
Bio-X SIGF
Morgridge Family SIGF Fellow
Mechanical Engineering

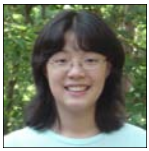
Profs. Scott Delp (Bioengineering, Mechanical Engineering) and Michael Fredericson (Orthopaedic Surgery)
Running is a popular recreational activity with notoriously high injury rates. Though running injuries are often attributed to overtraining, the specific causes of injury remain unknown. Barefoot or minimalist running has recently experienced a resurgence, being touted as a more natural running pattern that can reduce injuries. Barefoot runners often run with a different foot strike pattern, landing on their forefoot rather than heel striking, and have reported fewer injury rates associated with skeletal loading such as lower limb stress fractures. The goal of this project is to investigate potential injury mechanisms in rear foot striking runners compared to forefoot striking runners in order to reduce running injuries.

Andrew Weitz
Bio-X Bioengineering Fellowship

As a graduate student at Stanford, Andrew anticipates that his research to focus on the development of optogenetic techniques for neural stimulation. This research will be a nice transition from his previous work on electrical stimulation of the brain and will serve as a wise investment in future bioengineering technologies. Further advancement of optogenetics – a field that has been pioneered at Stanford – will make it possible to treat and perhaps cure patients who suffer from severe neurological disorders. His dream is to help make these clinical applications of optical stimulation a reality.

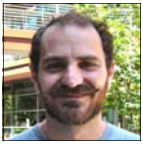
Noah Young
Bio-X Bioengineering Fellowship

When the human heart is damaged, modern biotechnology provides a bevy of artificial parts to replace anything from valves to the entire heart. When the brain becomes damaged, there is no artificial cerebellum or other synthetic part to repair the harm. As a preliminary step to designing neural implants that can restore function to the brain, Noah hopes to use optogenetics and other modern techniques to study how small networks of neurons interact, compute, and adapt. Standing at the intersection of neuroscience, electrical engineering, and bioengineering, this research may also lead to low-power electronics, better prosthetics, and more intelligent machines.



Anne Ye
Bio-X Bioengineering Fellowship

Anne is most interested in studying the structure, function, and, in particular, the applications of proteins. She plans to apply protein engineering as a tool not only for answering questions in pure biology, but also for designing powerful solutions to real-world problems. Specifically, she hopes to focus her graduate research on using scientific principles of protein dynamics to inform a structure- and mechanism-based approach toward designing effective and stable protein therapeutics as well as novel platforms by which these therapies can be administered. This rational design approach will lead to the development of a new generation of highly specific, effective protein drugs.



Ron Alfa
Bio-X Bowes Fellow
Neurosciences/MSTP

Profs. Seung Kim (Developmental Biology) and Shan Wang (Engineering)
Diabetes mellitus is a chronic disease defined clinically by increased blood glucose levels resulting from decreased peripheral insulin sensitivity or impaired in insulin secretion by pancreatic beta cells. While diabetes mellitus is historically one of the oldest diseases, the complex genetics underlying the most prevalent form, type-2 diabetes mellitus (T2DM), are only beginning to be elucidated. Ron's work is directed at harnessing the powerful genetics of the fruit fly, Drosophila melanogaster, to study the genetics of diabetic states. To this end, he is drawing on approaches from the neurosciences and bioengineering to study metabolism and glucose homeostasis in the fly.

Craig Buckley
Bio-X Bowes Fellow
Chemical Engineering

Profs. Alex Dunn (Chemical Engineering) and James Nelson (Molecular & Cellular Physiology)
Cytoplasmic dynein is a motor protein that transports cellular cargo along microtubules and functions in spindle formation in cell division; loss of dynein function is associated with several types of neurological conditions. Dynein contains a component termed the linker that is predicted to generate the force that drives its motion; however, its actual abilities have never been directly examined. Craig is testing the hypothesis that the linker is the primary force-generating mechanical element in dynein by tracking linker motion in real time. This will be an important advance toward understanding not only dynein but how enzymes convert the chemical energy in ATP into the mechanical energy of motion.

Jing-yu Cui
Bio-X Bowes Fellow
Electrical Engineering

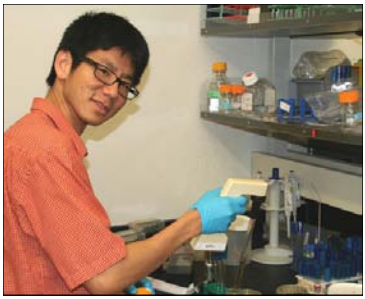
Profs. Craig Levin (Radiology), Dwight Nishimura (Electrical Engineering), Michael McConnell (Cardiovascular Medicine), and Stephen Boyd (Electrical Engineering)
Jing-yu is designing algorithms and systems for real-time cardiac Positron Emission Tomography (PET) for non-invasive *in vivo* visualization of molecular signatures of disease and for guidance of surgical interventions. Jing-yu applies the state-of-the-art technologies in computer graphics, optimization, and computer vision for removing motion artifacts and speeding up the imaging process by hundreds of times to enable real-time visualization of molecular activities in cardiology.

Christopher Emig
Bio-X Bowes Fellow
Bioengineering

Professor Stephen Quake (Bioengineering)
Synthetic DNA assembly enables the programmatic control of biological systems, paving the way for advances in biological research, molecular medicine, biofuels, materials, and numerous industrial processes. Chris is developing technologies for the rapid fabrication of DNA molecules to enable iterative engineering of biological systems.

Denitsa Milanova
Bio-X Medtronic Fellow
Mechanical Engineering

Profs. Annelise Barron (Bioengineering), Juan Santiago (Mechanical Engineering) and Eric Shaqfeh (Chemical Engineering, Mechanical Engineering)
To capitalize on advancing pharmacogenomic/proteomic knowledge and make personalized medicine available to patients near-term, we need compact, ultra-fast technologies to extract medical and diagnostic information from complex biological samples. Denitsa aims to develop an entirely new class of integrated viral diagnostic devices for the isolation and direct identification of pathogenic viruses. The foundation of the device is a new nanoscale field effect transistor (FET) detector, which is uniquely capable of detecting and counting single biomolecules as they pass over the transistor gate. Rapid, low-cost virus detection and classification from patient samples could enable better control of the spread of communicable infections.



Ton Subsoontorn (see pg. 16 for research)

Patricia Ortiz-Tello
Bio-X Bowes and Amgen Fellow
Genetics

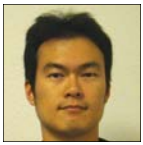
Profs. Carlos D. Bustamante (Genetics) and Julie Baker (Genetics)
Preeclampsia, a disorder that complicates 3-8% of pregnancies worldwide and jeopardizes the life of the mother and newborn, occurs at 2-3 fold higher prevalence at higher altitudes – most likely due to the hypoxic environment. Interestingly, the higher prevalence of preeclampsia observed at high altitudes is linked to those individuals with higher European ancestry, leading us to believe that the Amerindian population living at high altitude for over 10,000 years have developed a genetic adaptation protective against preeclampsia. We aim to use whole-genome DNA analysis, local functional expression, and clinical and histopathology data to disentangle the genetic basis of preeclampsia.

Steven J. Petsche
Bio-X Bowes Fellow
Mechanical Engineering

Profs. Peter M. Pinsky (Mechanical Engineering) and Marc E. Levenston (Mechanical Engineering)
The unique structure of the human cornea results in a tissue that is mechanically strong yet completely transparent. Advances in imaging and experimentation at small scales have allowed better understanding of the molecular mechanisms that give rise to its mechanical properties. Steven follows a "multi-scale" modeling approach where improved macro-scale mathematical models are directly linked to micro-scale models of these mechanisms. A coordinated approach between modeling and novel experimentation combines areas of biology, chemistry, imaging, and applied mechanics to engineer a computational model of the cornea with direct clinical applications in refractive surgery and the study of corneal pathologies.

Jack Wang
Bio-X Bowes Fellow
Neurobiology

Profs. Ben Barres (Neurobiology), Tom Clandinin (Neurobiology), Tom Wandless (Chemical & Systems Biology), and Ricardo Dolmetsch (Neurobiology)
Degeneration of the nerve fibers, or axons, is a pivotal event in many neurodegenerative diseases such as glaucoma, Alzheimer's, multiple sclerosis, and stroke; however, the mechanisms that regulate this process remain largely unclear. How do the axons degenerate, and how can we delay or prevent the process from occurring to improve clinical outcome in nerve injuries or diseases? To address this question, Jack studies a genetic mutation (Wlds) that confers robust axonal protection from various physical injuries and chemical insults. Through a series of genetic, biochemical, and proteomic approaches, he proposes to understand the neuroprotective mechanism of the mutant Wlds protein and through this understand what molecular events orchestrate the process of axon degeneration and how this knowledge may be used to identify therapeutic targets to treat neurological injuries and diseases.



Jongmin Kim
Bio-X SIGF
Bruce and Elizabeth Dunlevie Fellow
Chemical and Systems Biology

Profs. Margaret Fuller (Developmental Biology) and Josh Elias (Chemical & Systems Biology)
Most of our tissues are constantly replenished by tissue specific adult stem cells. The goal of Jongmin's research is to understand how the switch from proliferation to differentiation in adult stem cell lineages is regulated. He has developed an *in vivo* differentiation system that can trigger proliferating progenitor cells to synchronously differentiate in the male germ line of fruit flies. By employing this differentiation assay, he will identify genes critical for the switch and will determine how those genes are regulated. Understanding this switch will be important in regenerative medicine and cancer therapy.

Ryan Squire (see pg. 11 for research details)

Paul Lebel
Bio-X SIGF
Applied Physics

Profs. Zev Bryant (Bioengineering), Hideo Mabuchi (Applied Physics), Joseph Puglisi (Structural Biology), and Stephen Quake (Bioengineering)
Paul's goal is to further our mechanistic understanding of both DNA and molecular motors by capturing the motion of single molecules at unprecedented speed and resolution. He has developed an imaging and data acquisition system to track gold nanoparticles as precise probes of length and twist of single DNA molecules at upwards of 20,000 frames per second. Their lab exploits the resolution of this technique as a tool to study various systems: they observe individual torque-generating steps of a single ATP-powered enzyme as it winds up DNA, and they measure the basic physical properties of DNA itself when single bases are unwound with tension and torque. Additionally, through independent collaboration with Jody Puglisi, he is developing nanoparticle-based assays for real-time dynamics of translating ribosomes.

Mark Longo
Bio-X SIGF
Morgridge Family Fellow
Biology

Profs. Ward Watt (Biology) and Jay McClelland (Psychology)
In the course of Mark's research in evolutionary genetics, he has noticed striking parallels between certain aspects of the cognitive and biological sciences. He intends to explore these similarities further in pursuit of a complex adaptive systems conception of genetics. This work will yield a book-length manuscript with the working title *The Genetic Mind: Genes as Learning Networks.* At issue is the very way we think of evolution and what exactly it means for genes to be "for" things.

Samir Menon
Bio-X SIGF
Colella Family Fellow
Computer Science

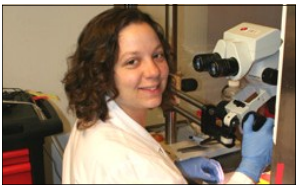
Profs. Oussama Khatib (Computer Science), Kwabena Boahen (Bioengineering), Samuel McClure (Psychology), Scott Delp (Bioengineering), and Mark Cutkosky (Mechanical Engineering)
The ability to coordinate muscles and resolve inter-task conflicts is fundamental to human motor control and underlies even simple motions like holding a cup with a hand and flipping a switch with the same arm's elbow. Samir is combining robotic control theory and biomechanics to predict musculoskeletal control strategies for individuals and is using functional magnetic resonance imaging to determine how the brain's motor regions could implement them. His work promises to help diagnose motor disorders before physical deficits appear, to develop therapies that simultaneously target multiple brain regions and circuits, and to improve how neural prosthetics decode the brain's motor activity.

Daniel Newburger
Bio-X SIGF
Morgridge Family Fellow
Biomedical Informatics

Profs. Serafim Batzoglou (Computer Science) and Hanlee Ji (Oncology)
Each year more than three hundred thousand people develop colorectal cancer (CRC) due to inherited genetic risk factors. Identifying the germline mutations responsible for CRC susceptibility in affected families dramatically improves preventative care and clinical outcome, but the vast majority of these mutations remain uncharacterized. In order to identify these unknown mutations, Daniel will help develop machine learning algorithms for evaluating genomic data from high-throughput DNA sequencing technologies. They hope this work will provide genetic findings that immediately inform clinical intervention and that it will illuminate new aspects of CRC pathogenesis.

Ruth Sommese
Bio-X SIGF
Paul Berg Fellow
Biochemistry

Profs. James Spudich (Biochemistry) and Euan Ashley (Medicine)
In the United States, cardiovascular disorders are a leading cause of morbidity and mortality. Familial cardiomyopathies are among the most frequently occurring inherited cardiac diseases, and many result from mutations in the fundamental force-generating system of cardiac muscle, myosin and the thin filament. The interaction between myosin and the thin filament has been fine-tuned in cardiac muscle in terms of power output and the rates of force generation and relaxation. The goal of this project is to characterize how cardiomyopathy mutations affect force-producing capabilities of cardiac muscle at the single molecule, single cell, and whole organ levels.



Joanna Mattis (see pg. 11 for research details)

Carolina Tropini
Bio-X SIGF
Bruce and Elizabeth Dunlevie Fellow
Biophysics

Profs. KC Huang (Bioengineering) and Daniel Fisher (Applied Physics)
The mechanism by which cells select and maintain a particular shape is a long-standing question. Bacteria are known to adopt a wide variety of forms, including crescents, spheres, and branched cells. Shape depends on the environment; in several cases it changes as bacteria become pathogenic. Carolina has developed a method to study cell shape by systematically transplanting proteins responsible for cell growth between bacteria of different shapes. Single-cell microscopy and biochemical analysis are combined with a computational model of cell growth, shedding light on how changes at the molecular scale cause large differences in cell size and shape.

Austin Lee-Richerson
Bio-X Bioengineering Fellowship

Professor Michael Lin (Pediatrics)
Controlling protein activity with light has long been a goal of scientists and engineers seeking to study protein interaction networks and develop novel medical therapeutics. Light-responsive proteins have been engineered for specific applications; however, a broadly applicable platform is still needed to study a variety of proteins. The aim of this project is to construct and characterize such a platform using fluorescent proteins, proteins that typically absorb and emit light. Currently, the project focuses on optimizing a light-control system for a specific set of signaling proteins. The eventual goal is to apply this platform to control a wide variety of signaling proteins.

Graham Dow (see pg. 13 for research details)

Carmichael Ong
Bio-X Bioengineering Fellowship

Currently in rotation
Carmichael's research interest is in using engineering concepts to better understand injuries related to human movement. Currently, he is focusing on determining which movements put people at higher risk of injuring the anterior cruciate ligament (ACL), an injury that is seen most often with athletes during maneuvers such as cutting and landing. He is using and creating simulation tools to quantify ACL injury risk during a given movement trial. With this knowledge, we can decrease injury rates by informing people about which movements are dangerous as well as by designing better protective equipment.

Sungwon Lim
Bio-X Bioengineering Fellowship

Professor Jennifer Cochran (Bioengineering)
Regenerating blood vessels (angiogenesis) has been a spotlighted research area for a long time because of its importance as a potential solution to treat chronic cardiovascular disease and other ischemia. Various approaches using genes, proteins, and cells have been made but have failed to induce sufficient amounts of blood vessel formation in clinical studies. Sungwon's project develops molecular therapeutics and delivery systems to achieve a synergistic combination of the different approaches that maximize therapeutic effects for ischemic diseases. Genes and proteins inducing angiogenesis can be engineered and delivered safely and efficiently to the ischemic region with the help of a novel delivery system.

Jayodita Sanghvi (see pg. 17 for research details)

Jaimie Adelson
Honorary Fellow
Neurosciences

Profs. Carla Shatz (Biology, Neurobiology) and Karl Deisseroth (Bioengineering)
Our brains have the remarkable ability to change and learn. The cerebral cortex has intrinsic mechanisms that limit or promote plasticity by converting neural activity into lasting structural changes at synapses. Jaimie considers the model that, in neurons, two major histocompatibility complex class I genes, Kb and Db, signaling via the innate immune receptor PirB, act as a brake on cortical plasticity. The goal of her research is to "release the brake" in mutant mice that lack these molecules and examine if it is possible to not only increase cortical plasticity but also to promote faster recovery following acute cortical injury.

Jennifer J. Brady
Bio-X Skippy Frank Fellow
Microbiology & Immunology

Profs. Helen M. Blau (Microbiology & Immunology) and Marius Wernig (Pathology)
Jennifer's research focuses on understanding how cells can change their fate. How does a cell change its identity, and what factors are important for making this decision? All the cells in our body have an identical genome; what makes cell types differ from one another is the combination of genes they express. This is controlled by transcription factors and epigenetic modifications, which determine whether a gene is on or off. Jennifer uses a cell fusion based system to identify factors controlling specific gene expression. This enables us to change one cell type into another for the purpose of regenerative medicine.

Alex Grant
Bio-X Bowes Fellow
Bioengineering

Profs. Craig Levin (Radiology), Shanhui Fan (Electrical Engineering), James Harris (Electrical Engineering), and Martin Fejer (Applied Physics)
Alex is working on novel technology for improving PET (positron emission tomography) system performance. PET allows non-invasive cellular and molecular assays of a subject's tissues and is widely used for cancer diagnosis and staging. His project involves using nanophotonic crystals to optically process PET signals in order to achieve faster system response times and eliminate costly processing electronics. This work has the potential to increase PET image signal-to-noise ratio, enabling significant improvements in disease visualization and quantification. This will allow better detection and diagnosis of cancer and other diseases and make these procedures more widely available.

Andrew Lee
Bio-X Bowes Fellow
Chemical & Systems Biology

Profs. Joseph Wu (Radiology, Medicine), Paul Wender (Chemistry) and Sanjiv Gambhir (Radiology, Bioengineering)
Coronary artery disease (CAD) is the leading cause of death in the Western world and is responsible for 1 out of every 5 deaths in America. Stem cell therapy is a novel method of treating CAD through the replacement of injured myocardium with healthy cells capable of restoring contractility to the heart. While initial clinical trials for this therapy have shown some short-term restoration of function, beneficial results have rarely persisted due to donor cell death. Andrew aims to improve donor cell engraftment in the ischemic heart through the development of a pro-survival nanoparticle-molecular transporter complex.

Jonathan Leong
Bio-X Bowes Fellow
Neurosciences, MSTP

Profs. Thomas Clandinin (Neurobiology) and Steven Boxer (Chemistry)
Many functions of the human brain, such as reading, are distinctly human. Brain function depends on how cells in the brain connect together to process information and to direct behavior. In turn, patterns of cellular connectivity are reflected in the shapes of individual cells and, in particular, neurons. The overarching goal of Jonathan's work is to discover morphological features of the human brain that give rise to distinctly human brain function. To this end, he is developing novel DNA-based dyes that will enable him to better visualize neuronal morphology, especially over the long distances spanned by neurons in the human brain.

> *"One of the many ways Bio-X led me to what I'm doing now is by getting me initially connected to people in the device and venture community, and these connections led to others that helped get the company started and funded."*
> *David Myung, Ph.D. (Bio-X Bowes Fellow 2005)*

Joanna Mattis
Bio-X Bowes Fellow
Neurosciences

Profs. Karl Deisseroth (Bioengineering, Psychiatry) and John Huguenard (Neurology & Neurological Sciences)
The mammalian brain has been widely studied on the scale of individual neurons and large brain regions, but the intermediate, circuit-level scale is poorly understood. A recently developed technique, optogenetics, uses light-sensitive bacterial proteins targeted to defined cell populations, enabling light-driven control of just those circuit elements in order to determine their role in brain activity and behavior. Joanna is enhancing these techniques and using them to study the circuit connecting the hippocampus and the medial septum, two brain regions involved in learning and memory.

William Noderer
Bio-X Bowes Fellow
Chemical Engineering

Profs. Cliff Wang (Chemical Engineering), Tom Wandless (Chemical & Systems Biology), Laura Attardi (Genetics, Radiation Oncology), and Markus Covert (Chemical & Systems Biology)
The protein p53 protects the fidelity of the genome and limits mutations that could lead to cancer. The Wang lab uses γ-irradiation to induce double stranded breaks in the DNA to trigger a p53 response. Under these harsh conditions, p53 levels oscillate with a period of about 8 hours. It is unclear what function the p53 oscillations have. Does oscillatory behavior aid the cells in responding to DNA damage? William has created a synthetic p53 oscillator to decouple the stress signal (DNA damage) from the p53 oscillations. By manipulating the period, amplitude, and duration of oscillations, William can directly show how p53 dynamics affect DNA repair, cell survival, gene expression, and ultimately tumor suppression.

Joo Yong Sim
Bio-X Bowes Fellow
Mechanical Engineering

Professor Beth Pruitt (Mechanical Engineering)
Joo Yong Sim is interested in the research on mechanobiology, studying the interaction of cells and tissues with mechanical forces from micro to macro scale. He has been working in the Pruitt Lab and collaborating with the Nelson lab on the mechanics of cell-cell adhesions. He is developing mechanical stimulation systems to study how cells respond to mechanical loading and find the key proteins to sense the signal and cascade it further to change their functions. His research will focus on revealing the role of the mechanical forces on regulating the cell-cell adhesion and the signaling pathways using the microfabricated devices and advanced microscopy techniques.

Ryan Fox Squire
Bio-X Bowes Fellow
Neurosciences

Profs. Tirin Moore (Neurobiology) and Karl Deisseroth (Bioengineering, Psychiatry)
The ability to pay attention is a central feature of our day-to-day life that enables us to selectively process some aspects of our sensory world while ignoring others. Identifying the specific brain cells and circuits that bring about attention is essential for understanding both normal and impaired cognition, yet this is currently beyond the reach of established neurobiological techniques. Ryan's research utilizes new technologies to measure, turn off, and turn on specific brain circuits as primates perform attention-demanding tasks. This research hopes to understand at an unprecedented level of specificity how brain activity underlies cognitive functions such as attention.

Limor Freifeld
Bio-X SIGF
Bruce and Elizabeth Dunlevie Fellow
Electrical Engineering

Profs. Mark Horowitz (Electrical Engineering, Computer Science), Thomas Clandinin (Neurobiology), and Mark Schnitzer (Biological Sciences, Applied Physics)
How do neural circuits process sensory information and perform the computations required to drive behavior? How do specific neurons in the fly brain extract visual information, and what algorithms do they implement to drive its behavior? Using *in vivo* imaging to record neural activity and statistical modeling to quantify behavioral responses in wild-type and genetically modified flies, Limor is attempting to resolve how different components of neural circuits gradually transform visual input into behavioral output. By focusing on a model organism, the fruit fly, she hopes to gain insight into the general mechanisms of neural computation relevant even to humans.

William Parsons
Bio-X SIGF
Chemistry

Profs. Justin Du Bois (Chemistry), W.E. Moerner (Chemistry), and Dave Yeomans (Anesthesiology)
Voltage-gated sodium channels (VGSCs) mediate electrical conduction in neurons and play an essential role in pain sensation. Consequently, VGSC malfunction, improper regulation, and abnormal cellular localization have been implicated in a number of medical conditions. To better understand the causative link between VGSCs and pain, William has designed small molecule probes derived from the potent VGSC blocker saxitoxin that can be used for real-time imaging of this protein class. William's studies capitalize on the interplay of complex molecule synthesis, molecular biology, electrophysiology, fluorescent imaging, and live animal experiments to investigate fundamental aspects of VGSC dynamics.

Xiaoxue Zhou
Bio-X SIGF
Larry Yung Fellow
Chemistry

Professor Lynette Cegelski (Chemistry)
Solid-state NMR spectroscopy has emerged as a powerful tool to study biological systems such as macromolecules, assemblies, and whole-cell systems, which are not accessible by conventional structural biology approaches. Xiaoxue is engaged in efforts to apply solid-state NMR combined with other biophysical and biochemical tools in order to examine two important assemblies: peptidoglycan (a cage-like macromolecule in bacterial cell walls that preserves cell integrity and maintains cell shape and is a major target of antibiotics) and biofilms (bacteria communities which have emerged as virulence hallmarks of serious, persistent infectious diseases).

Melina Mathur
Bio-X Bioengineering Fellowship

Melina Mathur
Profs. Christina Smolke (Bioengineering)
Engineered biological systems hold great promise for developing solutions for human health; however, building genetic systems that can integrate with native biological functions is currently limited by the availability of tools to engineer sophisticated behaviors. Alternative splicing is a mechanism used by cells to produce one of several related proteins from a single DNA sequence depending on environmental cues. The goal of this project is to engineer precise alternative splicing patterns in human cells to dynamically control cellular fate and function.

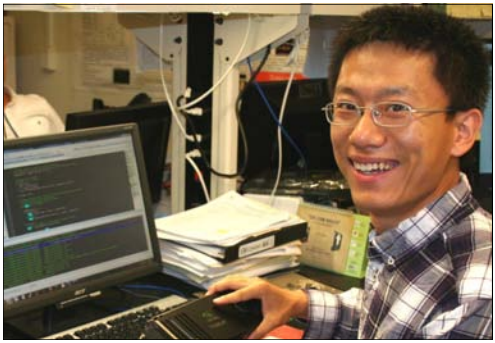
Haisam Islam
Bio-X Bioengineering Fellowship

Professor Gary Glover (Radiology)
Haisam is working on developing new methods to improve the performance of MRI. Currently, he is working on acquiring functional magnetic resonance imaging data more rapidly with no signal-to-noise ratio loss in uniform brain regions. The method involves exciting two slices simultaneously and using specific information obtained from a calibration scan to reconstruct each slice separately. By acquiring two slices at a time instead of one, the temporal resolution is effectively doubled, allowing better resolvement of brain activity. Haisam wants to push the limits of MRI capabilities.

Remus Wong
Bio-X Bioengineering Fellowship

Professor Christina Smolke (Bioengineering)
Remus plans to pursue research in synthetic biology with specific goals to design, construct, and engineer biological functions in cells. Adoptive T-cell therapy is a promising treatment for cancer, and the approach of using genetically engineered T cells is currently the subject of intensive research in this field. Remus hopes to develop RNA-based genetic regulatory systems to control T-cell antigen reactivity, proliferation, and survival in response to pharmaceutical drug inputs.

The following student fellows from 2010 have graduated:
Remy Durand (Bio-X SIGF Fellow)
Aaron Wenger (Bio-X SIGF Fellow)
For more details, see page 20.



Jing-yu Cui (see pg. 6 for research details)

Aakash Basu
Bio-X Bowes Fellow
Applied Physics

Professor Zev Bryant (Bioengineering)
Certain bio-molecules act as molecular scale machines that draw energy from energy rich bonds in compounds like ATP. Aakash tries to understand how energy transduction, from chemical energy stored in ATP to mechanical work, takes place in molecular machines. He studies DNA gyrase, a machine responsible for supercoiling DNA and an important target for antibacterial drugs, by mapping out a series of structural transitions through which the machine cycles and studying how transitions between these intermediates are coupled to substeps in the ATP hydrolysis cycle. A detailed understanding of this mechanochemical coupling in biological molecular machines will enable the engineering of artificial molecular machines with novel functions.

Elsa Birch
Bio-X Bowes Fellow
Chemical Engineering

Profs. Markus Covert (Bioengineering) and Alfred Spormann (Chemical Engineering)
A virus is only a set of instructions for making more of itself; to replicate, it must commander the necessary tools and building blocks from the host it infects. The Covert lab uses mathematical tools to better understand this host-viral metabolic interaction. Bacteriophage are viruses that infect bacteria. They have been modeled computationally, as have their bacterial hosts, and the Covert lab's recent work has been to combine these two different types of models so that they communicate and limit each other during a simulation of infection. The results enable observation in more detail than is available experimentally and provide high throughput predictions about perturbations of viral replication.

Patricia Ortiz-Tello (see pg. 7 for research details)

Graham Dow
Bio-X Bowes Fellow
Biology

Professor Dominique Bergmann (Biology)
Plants are dependent on their ability to sense and respond to their surrounding environment in order to successfully grow and reproduce. Stomata are specialized cells on the above ground surface of plants that control the flux of gases, such as CO_2 and H_2O, between internal plant structures and the outside world. Stomatal development and physiology are finely tuned to environmental conditions and ultimately help plants optimize their relationship with the environment. The goal of this project is to elucidate the molecular mechanisms that underlie the relationship between stomata and the environment, particularly with respect to development of stomata and its feedback on physiology.

Alia Schoen
Bio-X Bowes Fellow
Materials Science & Engineering

Professor Sarah Heilshorn (Materials Science & Eng.), Nicholas Melosh (Materials Science & Eng.), Andrew Spakowitz (Chemical Engineering), and Sebastian Doniach (Applied Physics)
The size, shape, phase, and hierarchical organization of inorganic materials are all important factors that define the materials' properties and are not yet easily controllable on the nanoscale. Proteins have great potential for use as templates to direct the growth and assembly of inorganic nanomaterials due to the wide array of naturally available nanoscale architectures they offer. Clathrin in particular is a protein that offers access to multiple 2D and 3D architectures through self-assembly, making it an attractive candidate to template a variety of nanoscale morphologies. The goals of this project are to gain insight into the self-assembly process of clathrin to enable predictive control of the size and shape of clathrin protein templates and to develop a robust and versatile strategy to functionalize self-assembled clathrin templates with designer bi-functional peptides for the synthesis of inorganic nanomaterials in a specific and controlled manner.

James H. Clark Center, Stanford University

Jong Min Sung
Bio-X Bowes Fellow
Applied Physics

Profs. James Spudich (Biochemistry), Alexander Dunn (Chemical Engineering), Euan Ashley (Cardiovascular Medicine), and Sebastian Doniach (Applied Physics)
Hypertrophic (HCM) and dilated (DCM) cardiomyopathies are the two most common genetic heart diseases. HCM affects nearly 0.2% of the general population. They often result from single point mutations in sarcomeric proteins especially in β-cardiac myosin heavy chain (β-cMHC), a molecular engine for muscle contraction, yet the molecular mechanism of how the mutations cause the diseases is not clearly understood. The goal of Jongmin's project is to understand the molecular mechanism of the disease at a single molecular level by characterizing the change in function of β-cMHC in the force generation role by using an optical trap.

Liang Liang
Bio-X SIGF
Applied Physics

Profs. Liqun Luo (Biology) and Mark Schnitzer (Biology, Applied Physics)
Liang is interested in the organization and information processing principles of neural circuits. She uses the fruit fly olfactory system as a model to study the functional connections and computation in the central nervous system. For example, she is trying to understand where and how the olfactory circuitry integrates food, sex, and alarm signals. She is incorporating advanced fly genetics, light-activated microbial opsins, and genetically-encoded calcium indicators to manipulate and record neuronal activity with high spatiotemporal resolution. The novel noninvasive optogenetic approach will help us to better understand the neural coding in the olfactory circuitry and to gain insight into the organizational principles of neural systems.

One of the wonderful things about the Bio-X program here at Stanford is its commitment to multidisciplinary collaborations, bringing teams together to help solve these otherwise unanswerable questions. It gives you the freedom to ask a challenging question, and facilitates the means to pursue it. These collaborations result in a much more diverse educational experience where students can benefit from the mentorship of professors in different fields.
- Jennifer Brady, Ph.D. candidate in Microbiology & Immunology

Peter Olcott
Bio-X SIGF
Bioengineering

Profs. Craig Levin (Radiology) and Jim Harris (Electrical Engineering)
Positron emission tomography (PET), which uses an injected radioactive tracer that is later imaged by a large scanner to investigate molecular processes inside the body, and magnetic resonance imaging (MRI), which can see the physiological and morphological features of the brain, are among several clinical imaging methods used to investigate the brain. Peter is currently developing a new PET clinical scanner that brings these two technologies together for simultaneous imaging for the brain to make very sensitive maps of the deposition of the Amyloid beta precursor protein. This can be used to investigate the potential therapeutic efficacy of novel drugs in the treatment of Alzheimer's disease.

Shawn Ouyang
Bio-X SIGF
Affymetrix Fellow
Chemical & Systems Biology

Profs. James Chen (Chemical & Systems Biology) and Michael Longaker (Surgery)
Zebrafish have the unique ability to regenerate several of its tissues (heart, retina, spinal cord, and fins). Understanding the molecular mechanisms that underlie the regeneration process should provide insights into how tissue regeneration is achieved and reveal strategies for their reactivation in humans. The goal of this project is to decipher the molecular and cellular events associated with larval tail regeneration. They have identified a number of genes that are upregulated in the posterior cells after the tail is amputated and are working to determine their roles in the regenerative process.

Samir Menon (see pg. 8 for research details)

Kathryn Montgomery
Bio-X Bioengineering Fellowship

Profs. Scott Delp (Bioengineering, Mechanical Engineering) and Karl Deisseroth (Bioengineering, Psychiatry)
Kate Montgomery was awarded a Bio-X SIGF in 2012. *See page 4 for research information.*

Rebecca DiMarco
Bio-X Bioengineering Fellowship

Profs. Sarah Heilshorn (Materials Science & Eng.) and Calvin Kuo (Hematology)
As the cost and duration of clinical trials continue to increase, a rising emphasis is being placed on improving preclinical testing methods for new drug candidate molecules. Despite its prevalence of use, the current standard preclinical absorption model suffers from multiple limitations, including poor reproducibility and marked inaccuracies in predicting drug bioavailability. The goal of Rebecca's work is to create an improved *in vitro* mimic of intestinal tissue, the primary point of absorption for most orally administered drugs, by exploiting the molecular-level precision of protein-engineered scaffold materials to control cellular behavior.

Yen-Hsiang Wang
Bio-X Bioengineering Fellowship

Professor Christina Smolke (Bioengineering)
Yen-Hsiang is interested in controlling cells with synthetic RNAs. These synthetic RNA controllers are capable of fine-tuning genes and pathways, which gives scientists greater control over intricate cellular networks. He is building an operational amplifier (op-amp), which is a fundamental building block in most electrical circuits like computers. An op-amp is generally composed of three stages - differential stage, amplification stage, and output stage - each of which has its own key functional features. He is currently working on the first stage: a RNA sensor that is able to detect the difference between two inputs using antisense.

The following student fellows from 2009 have graduated:
Li Ma (Bio-X SIGF 2009)
Noureddine Tayebi (Bio-X Bowes Fellow)
Sanaz Saatchi (Bio-X Amgen Fellow)
For more details, see page 20.

Jennifer Brady Mihalis Kariolis Elsa Birch Jack Wang

Mihalis Kariolis
Bio-X Bioengineering Fellowship

Professor Jennifer Cochran (Bioengineering)
Directed evolution is a powerful method that can be used to engineer proteins for therapeutic applications. Using this method, Mihalis is engineering proteins to target and inhibit receptors on the cancer cell surface that are crucial for cell growth and survival. The engineered proteins also hold potential to disrupt critical signaling pathways important for disease progression. As such, they have potential value as targeted therapeutics agents as well as diagnostic imaging probes.

Ton Subsoontorn
Bio-X Bioengineering Fellowship

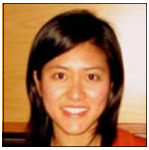
Profs. Drew Endy (Bioengineering) and Michele Calos (Genetics)
An ability to store modest amounts of information within living systems would enable new approaches to the study and control of biological processes. For example, a simple data storage device functioning as an 8-bit counter which can count and report up to 256 discrete biochemical events (e.g. cell division) is sufficient for tracking and controlling entire cell lineages during the development and aging across most known organisms; however, state-of-the-art genetically encoded data storage devices can reliably handle only a few states. The goal of Ton's project is to develop a platform for using rewritable site-specific recombination to enable combinatorial data storage architectures on DNA which could help expand storage capacity by orders of magnitudes.

Grace Tang
Bio-X Bioengineering Fellowship

Professor Russ Altman (Bioengineering, Genetics)
Fragment-based drug design, a drug discovery approach, takes small chemical compounds that bind to the protein target and expands or combines them into larger compounds with potent effects on the protein target. Crucial to this process is the identification of the starting small compounds (fragments). The increasing availability of 3D protein structures in complex with diverse chemical compounds provides a valuable source of information on the binding preferences of these compounds. Thus, the Altman lab is using unsupervised machine learning algorithms to identify these binding preferences and to apply this knowledge to drug design and drug repurposing.

The following student fellows from 2008 have graduated:
Andreas Rauschecker (Bio-X Bowes Fellow)
Mark Sellmyer (Bio-X Bowes Fellow)
Adam de la Zerda (Bio-X Skippy Frank Fellow)
Viviana Gradinaru (Bio-X SIGF)
Tyler Hillman (Bio-X Bowes Fellow)
Melinda Cromie (Bio-X SIGF)
Mario Diaz de la Rosa (Bio-X Bowes Fellow)
Lisa Gunaydin (Bio-X Bowes Fellow)
Ian Marshall (Bio-X Bowes Fellow)
Brian Wilt (Bio-X Bowes Fellow)
Gaurav Krishnamurthy (Bio-X Medtronic Fellow)
For more details, see page 20.

Denitsa Milanova (see pg. 6 for research details)



Frances Lau
Bio-X Bowes Fellow
Electrical Engineering

Profs. Craig Levin (Radiology) and Mark Horowitz (Electrical Engineering, Computer Science)
Frances is developing an ultra-high resolution Positron Emission Tomography (PET) system dedicated to breast cancer imaging. PET is a non-invasive, *in vivo* molecular imaging technology that has shown promise for early identification of breast cancer due to its ability to visualize biochemical changes in malignant tissue well before structural changes occur. She applies hardware design and signal integrity concepts to develop data acquisition electronics that read out and process the small signals detected. She is also using ideas from high-speed data communication circuits to propose and design a novel integrated circuit for a future PET system.

Rebecca Taylor
Bio-X Bowes Fellow
Mechanical Engineering

Profs. Ellen Kuhl (Mechanical Engineering) and Beth Pruitt (Mechanical Engineering)
Stem cell-derived heart cells hold promise for creating therapeutic patches or "cellular bandaids" to heal the heart after a heart attack. In Rebecca's research, she conditions these cells using microfabricated, dynamic cell culture systems that mimic the electromechanical environment of the heart. She has created tools to measure the forces generated by single stem cell-derived heart cells and to measure their electrical properties when cultured on heart-like soft stretching substrates. These measurements are critical for understanding the development and maturation in heart muscle. They can also tell us when stem cell-derived heart cells are ready for use in grafts and capable of assisting an ailing heart.

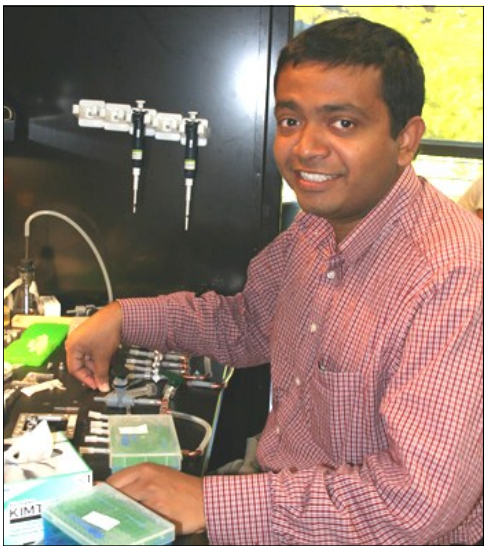
Kathryn Montgomery (see pg. 4 for research details)

Jacob Hughey
Bio-X Bioengineering Fellowship

Profs. Markus Covert (Bioengineering) and Matt Porteus (Pediatrics, Cancer Biology)
Jake is focused on uncovering the molecular signaling events of the innate immune response, which orchestrates the first actions against an invading pathogen. To accomplish this, he is using a combination of live-cell fluorescence microscopy, microfluidics, and computational modeling.

Jayodita Sanghvi
Bio-X Bioengineering Fellowship

Professor Markus Covert (Bioengineering)
Jayodita, along with her colleagues, has built the first comprehensive computational model of a living cell that describes all of the cell's molecular functions and interactions. Given the complexity of this problem, she started with the smallest known bacterium, the human pathogen Mycoplasma genitalium. The model includes all known gene functions and cellular processes and contains the highest level of detail of such a model to date. Currently, she is doing experiments to help validate the model. This model will enable a better understanding of cell physiology and help uncover unknown cell mechanisms.



Aakash Basu (see pg. 13 for research details)

Min-Sun Son
Bio-X Bioengineering Fellowship

Profs. Marc Levenston (Mechanical Engineering), Garry Gold (Radiology), and Brian Hargreaves (Radiology)
Min-Sun's work involves investigating the role of the meniscus in the progression of knee osteoarthritis, a debilitating joint disease. She studies the gene expressions of various proteins that are known to be important in the degeneration of cartilage and the meniscus. Her research will provide a target to test various tissue engineering strategies. She is also working on detecting meniscal degeneration in the clinical setting by extracting information from MRI images of osteoarthritic knees. As the meniscus lacks a self-healing response and often shows signs of degeneration before the cartilage does, such methods would contribute to early diagnosis of osteoarthritis and prevent further progression of the disease.

Nan Xiao
Bio-X Bioengineering Fellowship

Profs. Charles Taylor (Bioengineering, Mechanical Engineering) and Markus Covert (Bioengineering)
Recent advances in modern medical imaging and computing have enabled researchers to build increasingly realistic computer models of the cardiovascular system. Understanding the propagation of pressure and flow waves as a function of arterial stiffness is a crucial factor in unveiling the mechanisms behind diseases such as hypertension. Nan's work involves combining medical image data and other non-invasive clinical measurements with computational mechanics to construct realistic, three-dimensional simulations of blood flow in the large arteries of the human body in order to study the impact of changing arterial stiffness on the wave propagation behavior of arterial blood flow.

BIO-X AT STANFORD
TO EDUCATE...
TO DISCOVER....
BIO-X TO INVENT....

The following student fellows from 2007 have graduated:
Cory McLean (Bio-X Bowes Fellow)
Larry Wang (Bio-X Bowes Fellow)
Jennifer Hicks (Bio-X Bowes Fellow)
Kitchener Wilson (Bio-X Bowes Fellow)
Sheng Ding (Bio-X Bioengineering Fellow)
Kelsey Clark (Bio-X Bowes Fellow)
For more details, see pages 20-21.

Bio-X Graduate Student Fellowships 2006

Daniel Kimmel
Bio-X SIGF
Affymetrix Fellow
Neurosciences, Medicine

Professor William Newsome (Neurobiology)
When we make decisions, we must consider both the costs and benefits associated with each choice. In the world of economics, this problem is often solved by reducing costs and benefits to a common currency, namely money. The Newsome laboratory believes the brain may solve the problem similarly by representing benefit, cost, and net value as discrete neural signals. To test this, they make economic offers to monkeys while they record from or manipulate the activity of neurons that may underlie the animals' decision to accept or reject their offers. Their results will shed light on how the brain represents value and uses this information to make decisions.

The following student fellows from 2006 have graduated:
Ian Chen (Bio-X Bowes Fellow)
Guillem Pratx (Bio-X Bowes Fellow)
Aaron Wang (Bio-X Bowes Fellow)
Namiko Abe (Bio-X SIGF Paul Berg Medical Fellow)
Bertrand Lui (Bio-X SIGF Lubert Stryer Fellow)
Murtaza Mogri (Bio-X Bioengineering Fellow)
Peggy Yao (Bio-X Bowes Fellow)
Jennifer Blundo (Bio-X Bowes Fellow)
Edith Arnold (Bio-X Bowes Fellow)
Sanjay Dastoor (Bio-X Bowes Fellow)
Katy Keenan (Bio-X Bowes Fellow)
Angela Wu (Bio-X Bioengineering Fellow)
For more details, see page 20.

"The diversity of science [in Bio-X and the Clark Center] enables you to become a real generalist—to feel comfortable jumping into a new field. My work in Bio-X, the Neurosciences Program, and at Stanford allowed me to look for something interesting [when ready to graduate], knowing that I had the ability to learn quickly, solve problems, and work with researchers from many different fields."
-Leslie Meltzer, Ph.D. (Bio-X Bowes Fellow 2004)

Bio-X Graduate Student Fellowships 2005

The following student fellows from 2005 have graduated:

Afsheen Afshar (Bio-X Bowes Fellow)
Georgios Asimenos (Bio-X Bowes Fellow)
David Myung (Bio-X Bowes Fellow)
Rachel Kalmar (Bio-X Bowes Fellow)
Yufeng Yang (Bio-X Bowes Fellow)
Vincent Chu (Bio-X Pfizer Fellow)
Virginia Chu (Bio-X Bioengineering Fellow)
Stephen Lee (Bio-X Bioengineering Fellow)
Jules VanDersarl (Bio-X Bowes Fellow)
Mindy Chang (Bio-X Bioengineering Fellow)
Prasheel Lillaney (Bio-X Bioengineering Fellow)
For more details, see pages 21-22.

Bio-X Graduate Student Fellowships 2004

The following student fellows from 2004 have graduated:

Relly Brandman (Bio-X Bowes Fellow)
David Camarillo (Bio-X Bowes Fellow)
Samuel Kim (Bio-X Bowes Fellow)
Andreas Loening (Bio-X Bowes Fellow)
Leslie Meltzer (Bio-X Bowes Fellow)
Sara Zhao (Bio-X Bowes Fellow)
Amanda Malone (Bio-X Bioengineering Fellow)
Adam Grossman (Bio-X Bioengineering Fellow)
Sergio Moreno (Bio-X Bowes Fellow)
For more details, see page 22.

Bio-X Postdoctoral Fellowships

Tristan Ursell
Bio-X Postdoctoral Fellowship 2009
Bio-X Genentech Fellow
Bioengineering

Professor Julie Theriot (Biochemistry)
Single celled bacteria, like *E. coli*, serve important metabolic roles; however, at times they present significant risks to human health via infection. Understanding how to proficiently but selectively kill these bacteria requires that we untangle the relationships between the myriad proteins that serve to build the sugary wall that enshrouds the cell. Tristan uses a combination of high-resolution microscopy and computational modeling to track the construction of the cell wall and the movements of key constructor proteins over the life cycle of the cell. Analysis of this data helps elucidate how single proteins build entire cells and how perturbations to key proteins via antibiotics mechanically disrupt cell wall structure, ultimately leading to cell death.

William Noderer (see pg. 11 for research details)

The following students have completed their postdoctoral program:
Shilpa Sambashivan
Elena Rykhlevskaia
Tiffany Chung
Sergey Solomatin
Yu-Shan Lin
For more details, see page 22.

Carolina Tropini (see pg. 9 for research details)

Where are they now?

Remy Durand (2011) works for L.E.K. Consulting as a business strategy consultant for companies in the life sciences space.

Aaron Wenger (2012) is leading the technical efforts of NomoPay, a startup company, which he co-founded.

Li Ma (2011) is an assistant professor in the department of statistical science at Duke University.

Sanaz Saatchi (2011) is a Principal R&D Engineer in the CardioVascular group at Medtronic. She is in an engineering research role focused on cardiovascular medical device innovation and development and collaborates with marketing and business development for opportunity assessment and concept development, as well as with R&D product development for technical feasibility and development.

Noureddine Tayebi (2011) is a research scientist within the Integrated Biosystems Laboratory, Intel Research Labs, Intel Inc., Santa Clara, CA.

Melinda Cromie (2012) is in the process of finalizing a postdoctoral position.

Mario Diaz de la Rosa (2012) is in the process of interviewing.

Lisa Gunaydin (2012) is a postdoctoral scholar at UCSF.

Ian Marshall (2012) begins his postdoctoral fellowship at Aarhus University in Denmark in October 2012.

Brian Wilt (2011) is a data scientist for Intuit in Mountain View.

Gaurav Krishnamurthy (2011) is a Senior R&D Engineer at Abbott Vascular, Structural Heart, Menlo Park, CA.

Andreas Rauschecker (2011) returned to medical school after completion of his Ph.D. in July 2011.

Mark Sellmyer (2010) has graduated from the Stanford MD/PhD program and will begin a research track residency in radiology at the University of Pennsylvania in 2013.

Adam de la Zerda (2011) is a Damon Runyon Cancer Research Foundation Postdoctoral Fellow at the University of California-Berkeley. In September 2012, he begins his appointment as an Assistant Professor of Structural Biology at Stanford University.

Viviana Gradinaru (2010) is an Assistant Professor of Biology at California Institute of Technology (Caltech).

Tyler Hillman (2010) completed his MD/PhD at Stanford in 2012. He is now a resident in Ob/Gyn at University of California-San Diego and plans to eventually pursue specialty training in maternal-fetal medicine.

Kelsey Clark (2012) is a postdoctoral student in Tirin Moore's lab at Stanford University.

Cory McLean (2010) is a computational biologist at 23andMe, working on exome- and whole-genome sequencing analysis.

Larry Wang (2009) currently works for the Stealth Mode mobile start-up, which he co-founded.

Jennifer Hicks (2010) currently serves as the Associate Director of the National Center for Simulation in Rehabilitation Research, an NIH-funded center at Stanford that brings state-of-the-art engineering tools to rehabilitation scientists. She oversees the center's Visiting Scholar Program, Pilot

Projects, workshops, webinars, and online resources. In addition, she is the Research and Development Manager for the OpenSim software platform, guiding the project's development team and serving as the voice of the software user/researcher.

Kitchener Wilson (2010) is a Clinical Pathology resident at Stanford University. He is training to be a physician-scientist in personalized medicine, and he plans to one day direct a clinical lab that performs next generation genome sequencing in addition to a basic research lab that focuses on stem cell technologies.

Sheng Ding (2011) works for a biotech start-up company as a research scientist, focusing on developing protein therapeutic drugs with extended half-life.

Edith Arnold (2012) is working at St. Jude Medical as a staff scientist doing research in the Cardiac Rhythm Management Division.

Sanjay Dastoor (2012) is starting a company, Boosted Boards, that designs and builds ultralight electric vehicles.

Katy Keenan (2011) has an NRC postdoctoral scholar position at the National Institute of Standards and Technology (NIST) in Boulder, Colorado.

Angela Wu (2012) is doing independent technical consulting for a start-up company, Home Dialysis Plus, researching how to improve dialysis experience and outcomes for patients with end-stage renal disease.

Ian Chen (2008) is an internal medicine resident at Stanford University and will be starting his cardiology fellowship in July 2012.

Guillem Pratx (2010) is a postdoctoral fellow in radiation oncology at Stanford University, where he is exploring novel and unconventional approaches to biomedical imaging.

Aaron Wang (2009) is at Johns Hopkins University for his residency in ophthalmology.

Namiko Abe (2007) is a postdoctoral scholar at Columbia University in the biochemistry and molecular biophysics department.

Bertrand Lui (2011) is an associate at McKinsey & Company, a global management consulting firm.

Murtaza Mogri (2011) focuses on strategy projects in the medical device and broader healthcare sector as a consultant in the Minneapolis office of Boston Consulting Group (BCG).

Peggy Yao (2011) is working on supply chain management optimization for Oracle.

Jules Vandersarl (2011) is a postdoctoral scholar at École Polytechnique Fédérale de Lausanne in Switzerland.

Mindy Chang (2011) is in the process of interviewing.

Prasheel Lillaney (2012) is a postdoctoral fellow at the University of California-San Francisco's department of Radiology, Interventional Radiology Lab China Basin.

Afsheen Afshar (2008) is working at the Goldman Sachs Group, developing quantitative models to help them conduct their businesses with less risk, greater speed, and more efficacy.

Georgios Asimenos (2009) is Director of Science and Engineering at DNAnexus, a startup company founded by two Stanford faculty members (Serafim Batzoglou and Arend Sidow) and a former student of Serafim Batzoglou's, Andreas Sundquist.

Where are they now?

David Myung (2008) co-founded Biomimedica, a biomaterials-focused orthopaedic startup company after finishing his Stanford Bio-X fellowship and is doing his ophthalmology residency at the Byers Eye Institute at Stanford.

Rachel Kalmar (2010) was a postdoctoral scholar at Stanford University before she set off to explore applications of mobile technology in the field. She spent 7 months doing informal research as she traveled through Southeast Asia, India, and Brazil. In the past year she co-founded a startup in the health sensor space and is currently the Global Health teaching fellow at Singularity University.

Yufeng Yang (2009) is a Professor/Investigator in the Institute of Life Sciences at Fuzhou University.

Vincent Chu (2009) is an engineer at Twitter in San Francisco.

Virginia Chu (2009) is a postdoctoral fellow at the Rehabilitation Institute of Chicago working with Dr. Brian Schmit and Dr. George Hornby. She was awarded a 2-year postdoctoral fellowship grant from the American Heart Association to study loading perception during walking in stroke survivors.

Stephen Lee (2010) is currently finishing his first year as an MBA candidate at Stanford GSB. He is doing a summer internship with Dalberg Global Development Advisors, a strategy consulting firm focused on international development issues.

Sergio Moreno (2012) is working in Professor Levitt's lab as he is in the process of interviewing.

Relly Brandman (2009) is a postdoctoral scholar in the department of Pharmaceutical Chemistry at University of California-San Francisco.

David Camarillo (2008) is an Assistant Professor of Bioengineering at Stanford University.

Samuel Kim (2009) is a postdoctoral scholar at Stanford/Postech.

Andreas Loening (2006) is a radiology resident at Stanford University.

Leslie Meltzer (2008) is the Associate Director of US Neurology Medical Affairs at Biogen Idec in Cambridge, Massachusetts.

Amanda Malone (2007) is the VP COO at Auritec Pharmaceuticals.

Adam Grossman (2010) is co-founder and Metainformation Scientist at Praedicat, Inc., a company dedicated to improving the underwriting and management of liability catastrophe risk.

Postdoctoral Fellows:

Tiffany Chung is currently a chemist for the Hong Kong government.

Yu-Shan Lin has a faculty position in the Chemistry department at Tufts University.

Elena Rykhlevskaia is an Analytics Infrastructure Researcher for The Walt Disney Company.

Shilpa Sambashivan is a scientist in the neuroscience group at Amgen. She is involved in early stage drug discovery efforts focused on Alzheimer's Disease and related protein misfolding diseases.

Graduated Bio-X Fellows

Student	Department	Degree Year
Namiko Abe	Neurosciences	2007
Afsheen Afshar	Electrical Engineering	2008
Edith Arnold	Mechanical Engineering	2012
Georgios Asimenos	Computer Science	2009
Jennifer Blundo	Mechanical Engineering	2010
Relly Brandman	Chemical & Systems Biology	2009
David Camarillo	Mechanical Engineering	2008
Mindy Chang	Bioengineering	2011
Ian Chen	Bioengineering	2008
Vincent Chu	Applied Physics	2009
Virginia Chu	Bioengineering	2009
Kelsey Clark	Neurosciences	2012
Melinda Cromie	Mechanical Engineering	2012
Sanjay Dastoor	Mechanical Engineering	2012
Adam de la Zerda	Electrical Engineering	2011
Mario Diaz de la Rosa	Chemical Engineering	2012
Sheng Ding	Bioengineering	2011
Remy Durand	Bioengineering	2011
Viviana Gradinaru	Neurosciences	2010
Adam Grossman	Bioengineering	2010
Lisa Gunaydin	Neurosciences	2012
Jennifer Hicks	Mechanical Engineering	2010
Tyler Hillman	Genetics, Medicine	2010
Rachel Kalmar	Neurosciences	2010
Kathryn Keenan	Mechanical Engineering	2012
Samuel Kim	Chemistry	2009
Gaurav Krishnamurthy	Mechanical Engineering	2011
Stephen Lee	Bioengineering	2010
Prasheel Lillaney	Bioengineering	2012
Andreas Loening	Bioengineering	2006
Bertrand Lui	Bioengineering	2011
Li Ma	Statistics	2011
Amanda Malone	Bioengineering	2007
Ian Marshall	Civil & Environmental Engineering	2012
Cory McLean	Computer Science	2010
Leslie Meltzer	Neurobiology	2008
Murtaza Mogri	Bioengineering	2011
Sergio Moreno	Physics	2012
David Myung	Chemical Engineering	2008
Guillem Pratx	Electrical Engineering	2010
Andreas Rauschecker	Neurosciences	2011
Sanaz Saatchi	Bioengineering	2011
Mark Sellmyer	Chemical & Systems Biology	2010
Noureddine Tayebi	Electrical Engineering	2011
Jules VanDersarl	Materials Science & Engineering	2011
Aaron Wang	Bioengineering	2009
Larry Wang	Materials Science & Engineering	2008
Aaron Wenger	Computer Science	2012
Kitchener Wilson	Bioengineering	2010
Brian Wilt	Applied Physics	2011
Angela Wu	Bioengineering	2012
Yufeng Yang	Neurosciences	2009
Peggy Yao	Biomedical Informatics	2011
Sara Zhao	Mechanical Engineering	2005

Completed Bio-X Graduate Fellowships

Student	Department	Yr completed
Elsa Birch	Chemical Engineering	2012
Rebecca DiMarco	Bioengineering	2012
Graham Dow	Biology	2012
Limor Freifeld	Electrical Engineering	2012
Jacob Hughey	Bioengineering	2010
Mihalis Kariolis	Bioengineering	2011
Daniel Kimmel	Neurosciences, Medicine	2009
Frances Lau	Electrical Engineering	2010
Liang Liang	Applied Physics	2012
Christine McLeavey	Neurosciences	2010
Peter Olcott	Bioengineering	2012
Shawn Ouyang	Chemical & Systems Biology	2012
Jayodita Sanghvi	Bioengineering	2008
Alia Schoen	Materials Science & Engineering	2012
Min-Sun Son	Bioengineering	2010
Ton Subsoontorn	Bioengineering	2011
Jong Min Sung	Applied Physics	2012
Grace Tang	Bioengineering	2011
Rebecca Taylor	Mechanical Engineering	2010
Yen-Hsiang Wang	Bioengineering	2012
Nan Xiao	Bioengineering	2010

Bio-X Fellows 2009 group photo

Bio-X Fellows 2010 group photo

Current Bio-X Bowes Fellows

Student	Department
Jaimie Adelson	Neurosciences
Ron Alfa	Neurosciences
Aakash Basu	Applied Physics
Daniel Bechstein	Mechanical Engineering
Jennifer Brady	Microbiology & Immunology
Craig Buckley	Chemical Engineering
Jin Chen	Applied Physics
Fang-Chieh Chou	Chemistry
Roshni Cooper	Electrical Engineering
Jing-yu Cui	Electrical Engineering
Christopher Emig	Bioengineering
Stephen Fried	Chemistry
Xiaojing Gao	Biology
Alex Grant	Bioengineering
Haisam Islam	Bioengineering
Jongmin Kim	Chemical & Systems Biology
Paul Lebel	Applied Physics
Andrew Lee	Chemical & Systems Biology
Soah Lee	Materials Science & Engineering
Austin Lee-Richerson	Bioengineering
Jonathan Leong	Neurosciences, MSTP
Sungwon Lim	Bioengineering
Mark Longo	Biology
Trevor Martin	Biology
Melina Mathur	Bioengineering
Joanna Mattis	Neurosciences
Samir Menon	Computer Science
Denitsa Milanova	Mechanical Engineering
Kathryn Montgomery	Bioengineering
Daniel Newburger	Biomedical Informatics
Wendy Ni	Electrical Engineering
William Noderer	Chemical Engineering
Carmichael Ong	Bioengineering
Patricia Ortiz-Tello	Genetics
William Parsons	Chemistry
Steven J. Petsche	Mechanical Engineering
Jeffrey Quinn	Bioengineering
Manuel Rausch	Mechanical Engineering
Joel Sadler	Mechanical Engineering
Joo Yong Sim	Mechanical Engineering
Ruth Sommese	Biochemistry
Ryan Squire	Neurosciences
Carolina Tropini	Biophysics
Jack Wang	Neurobiology
Lucien Weiss	Chemistry
Andrew Weitz	Bioengineering
Remus Wong	Bioengineering
Anne Ye	Bioengineering
Jennifer Yong	Mechanical Engineering
Noah Young	Bioengineering
Xiaoxue Zhou	Chemistry

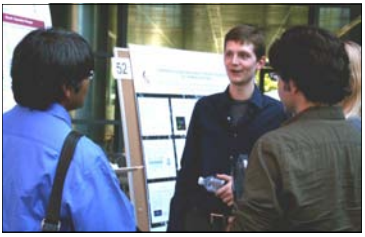
Bio-X Endowed SIGF Fellows

Student	Department
Namiko Abe	Neurosciences
Limor Freifeld	Electrical Engineering
Jin Chen	Applied Physics
Roshni Cooper	Electrical Engineering
Melinda Cromie	Mechanical Engineering
Remy Durand	Bioengineering
Stephen Fried	Chemistry
Xiaojing Gao	Biology
Viviana Gradinaru	Neurobiology
Jongmin Kim	Chemical & Systems Biology
Daniel Kimmel	Neurosciences, Medicine
Paul Lebel	Applied Physics
Liang Liang	Applied Physics
Mark Longo	Biology
Bertrand Lui	Bioengineering
Li Ma	Statistics
Samir Menon	Computer Science
Kathryn Montgomery	Bioengineering
Daniel Newburger	Biomedical Informatics
Wendy Ni	Electrical Engineering
Peter Olcott	Bioengineering
Shawn Ouyang	Chemical & Systems Biology
William Parsons	Chemistry
Manuel Rausch	Mechanical Engineering
Ruth Sommese	Biochemistry
Carolina Tropini	Biophysics
Aaron Wenger	Computer Science
Jennifer Yong	Mechanical Engineering
Xiaoxue Zhou	Chemistry

Industry and Donor Sponsored Awards

Student	Award	Department
Jennifer Brady	Skippy Frank Foundation	Microbiology & Immunology
Vincent Chu	Pfizer	Applied Physics
Tiffany Chung	Stanford Faculty funded	Radiology
Adam de la Zerda	Skippy Frank Foundation	Electrical Engineering
Gaurav Krishnamurthy	Medtronic Foundation	Mechanical Engineering
Denitsa Milanova	Medtronic Foundation	Mechanical Engineering
Patricia Ortiz-Tello	Amgen	Genetics
Elena Rykhlevskaia	Lubert Stryer	Psychiatry
Sanaz Saatchi	Amgen	Bioengineering
Shilpa Sambashivan	Genentech	Chemical & Systems Biology
Sergey Solomatin	Stanford Faculty funded	Chemistry
Tristan Ursell	Genentech	Bioengineering

Shawn Ouyang (see pg. 14 for project details)



William Parsons (see pg. 12 for project details)

Bio-X Fellows 2008 group photo

Bio-X Fellows 2011 group photo

Professor Carla Shatz
Director of Bio-X
James H. Clark Center
318 Campus Drive, W157
cshatz@stanford.edu

Heideh Fattaey, Ph.D.
Executive Director of Operations and Programs
James H. Clark Center
318 Campus Drive, S135
hfattaey@stanford.edu

Gabriella Martelino
Bio-X Education and Fellowship Coordinator
James H. Clark Center
318 Campus Drive, S131
gfsm@stanford.edu

Olgalydia Urbano-Winegar
Bioengineering Student Services Manager
James H. Clark Center
318 Campus Drive, S166
ourbano@stanford.edu

Bio-X Program

To learn more about the Bio-X Program at Stanford, please visit the Bio-X website at:

http://biox.stanford.edu

BIO-X

Brochure designed by F. Sincock
August 2012