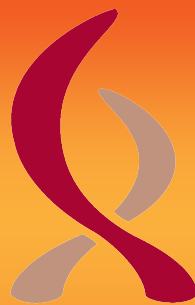
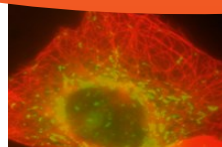


BIO-X

2010 Undergraduate Research Program



BIO-X
Stanford University



Bio-X Undergraduate Research Program



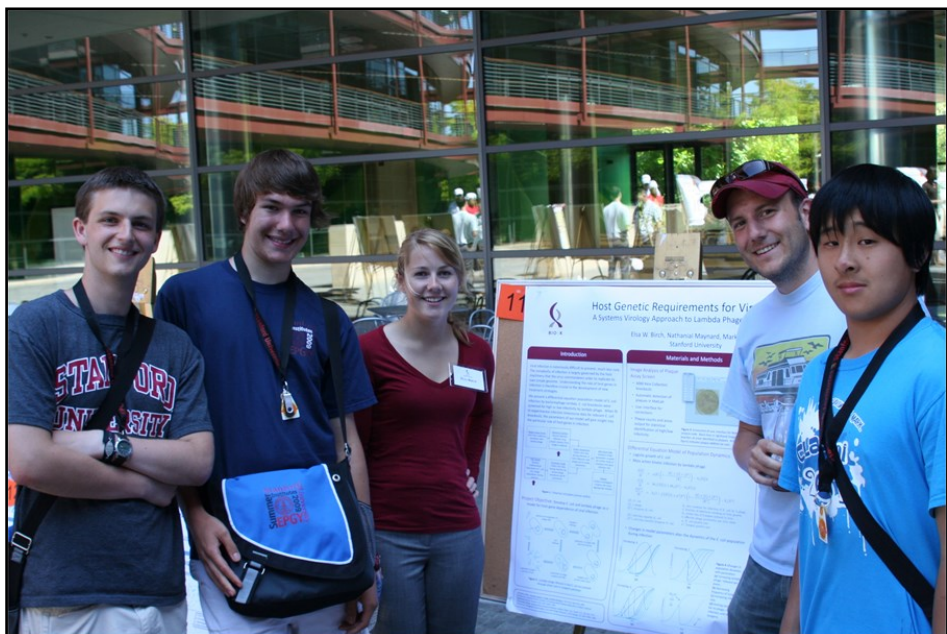
The Bio-X Summer Undergraduate Research Program funds undergraduates research training through an award designed to support interdisciplinary undergraduate summer research projects. Awards are made through an application process available to any Bio-X affiliated faculty across campus (over 450 Faculty are affiliated with the Bio-X program). Student awardees receive a stipend equivalent to ten weeks of laboratory work.

The program is an invaluable opportunity for students to conduct hands-on research, learn how to carry out experiments in the laboratory, and develop the skills to read and analyze scientific literature. To date, 81 students have been awarded the opportunity to participate in the Bio-X Summer Undergraduate Research Program.

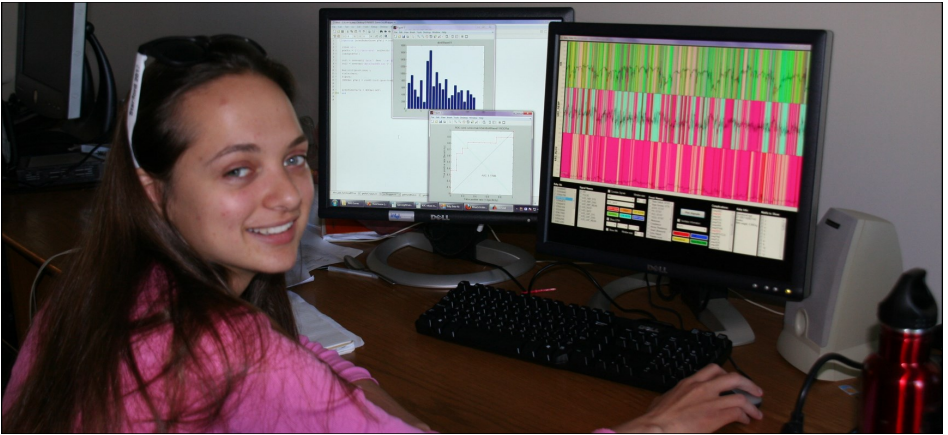
The program offers weekly Faculty talks in order to expose students to a variety of scientific fields and to enrich their summer research experience. These talks are also open to the entire Stanford community. This is a unique opportunity for students to hear more about the broad range of research within Stanford, to meet faculty in a variety of scientific fields, and to meet each other as potential future collaborators and colleagues. In 2010, students learned about the research in the laboratories of 32 Faculty and learned about new areas of research to which they may not otherwise have been exposed. At the conclusion of the 10 week period, the students present the results of their summer research experience in the form of a poster presentation open to the public.

Funding for the support of our undergraduate summer research program was provided by generous contributions from the Bio-X Director, Dr. Carla Shatz, and various other generous donors, including the Rose Hills Foundation, Pitch Johnson, Burroughs Wellcome Fund, and Dr. Richard and Linda Kelley.

In 2010, we supported 34 participants, the largest group of undergraduate students in the history of the Bio-X Undergraduate Summer Research Program.



Bio-X Undergraduate Research Program



2010 Bio-X Undergraduate Research Talks given by Stanford Faculty:

June 16

Jennifer Cochran "Engineered Protein Therapeutics and Diagnostic Agents Inspired by Nature"

Jill Helms "Saving the Cheerleader, Saving the World: What Can Regenerative Medicine Really Achieve?"

Paul Brown "3-D Digital Anatomy"

June 23

KC Huang "How Bacteria Get Into Shape"

Joseph Lipsick "Epigenetic Regulation by Proteins Encoded by Cancer Genes"

Liquan Luo "Studying Imprinting Chromosome by Chromosome in Mice"

June 30

Daphne Koller "Machine Learning for Systems Biology and Medicine"

Manpreet Singh "Prevention of Early Onset Bipolar Disorder: Clues from Genetics and Neurobiology"

Bruce MacIver "Using EEG to Measure Loss of Consciousness in Fighter Jet Pilots"

July 7

Vijay Pande "Folding@home: Pushing the Limits of Molecular Simulation"

Gerald Fuller "Creating a Cellular Pied Piper"

Tobias Meyer "Systems Biology of Cell Migration"

July 14

Shaul Hestrin "Definition of Cortical Circuits"

Marius Wernig "Direct Conversion of Fibroblasts to Neurons"

Michael Longaker "Stem and Progenitor Cell Recruitment Following Injury"

July 21

Theo Palmer "Stem Cell Therapies for Neurological Disease"

Fan Yang "Stem Cell and Biomaterials Engineering for Tissue Regeneration"

Matt Scott "Controlling Growth of the Cerebellum"

Bio-X Undergraduate Research Program



July 28

Suzanne Pfeffer "How the Golgi Works"

Joachim Hallmayer "The Genetics of Autism and Pervasive Developmental Disorders"

Richard Zare "Making Nanoparticles for Drug Delivery"

Annelise Barron "Toxic Granulocyte Peptides of Innate Immunity: Disease Culprits, Hiding in Plain Sight?"

August 4

Joseph Wu "Clinical Hurdles of Pluripotent Stem Cell Therapy"

Anne Brunet "Mechanisms of Aging and Longevity"

Karen Parker "Oxytocin Biology and the Social Deficits of Autism Spectrum Disorders"

August 11

Merritt Maduke "Inhibiting Chloride Transport: Why and How"

Jianghong Rao "Building Molecules to Spy on Cells"

Michael Clarke "Regulation of Self Renewal in Stem Cells"

August 18

Marc Levenston "Biophysical and Biochemical Cues in Controlling Cell Behavior"

Alan Pao "Development of a New Class of Aquaretics for the Treatment of Hyponatremia"

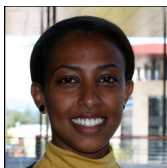
Karl Deisseroth "Optogenetics: Development and Application"



Bio-X Undergraduate Research Program



2010 Program Participants:

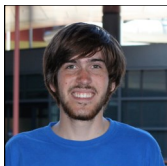


Fasika Asrat *Chemical Engineering*

Supported by: Burroughs Wellcome Fund

Mentor: Prof. Gerald G. Fuller, Chemical Engineering

Fasika Asrat is pursuing a Chemical Engineering degree at Stanford University. She is currently working in the lab of Professor Gerry Fuller to produce glass substrates coated with oriented collagen fibers. Topographical cues provided by the collagen fibers will allow cells cultured upon them to elongate in the direction of the collagen orientation. They hope to gain a thorough understanding of the mechanical properties of aligned cell monolayers using a cell monolayer rheometer. If understood, this proposes a method for early ailment detection and diagnosis. Fasika aims to explore the intersection of chemical engineering, biology, and medicine this summer through her research.



Nathan Barnett *Bioengineering*

Supported by: Bio-X Program

Mentor: Prof. Annelise E. Barron, Bioengineering

Nathan Barnett is a rising junior who discovered his passion for Bioengineering when he attended the Mississippi School for Mathematics and Science. Nathan is currently working under Dr. Annelise Barron, whose lab primarily studies the function and application of "peptoids," peptide mimics where the functional "R" group is bonded to the amide nitrogen rather than the α -carbon. Currently, Nathan and his teammates are running binding assays of DNA to peptoids as well as the human cathelicidin LL-37 to determine the molecule's effect on intracellular aggregation. Nathan is hoping that this experience broadens his understanding of the medical applications of molecular engineering.

Bio-X Undergraduate Research Program



Shire Beach *Biology, Music*

Supported by: Bio-X Program

Mentor: Prof. Anthony Oro, Dermatology

Shire Beach just finished her freshman year at Stanford. Originally from Livermore, CA, she became interested in science after taking an awesome biology class in high school. She is currently pre-med with plans of double majoring in Biology and Music. This summer, Shire is working in the Oro lab on a project which investigates the functioning and localization patterns of various isoforms of MIM, a protein required in ciliary maintenance. This research will help clarify steps to cilia formation related cancer progression. Shire is grateful that the Bio-X program has given her the opportunity to participate in research this summer!



Sarah Cheng *Biology*

Supported by: Rose Hills Foundation

Mentor: Prof. Geoffrey C. Gurtner, Surgery

Sarah Cheng is about to begin her junior year at Stanford. She first became interested in the biology major through taking biology core. This summer, Sarah is researching whether hydrogel-imbedded mesenchymal stem cells can achieve enhanced survival in wounds and whether hydrogel-imbedded mesenchymal stem cells can enhance angiogenesis and accelerate wound closure. Sarah chose this project because she is interested in surgical applications of stem cells.

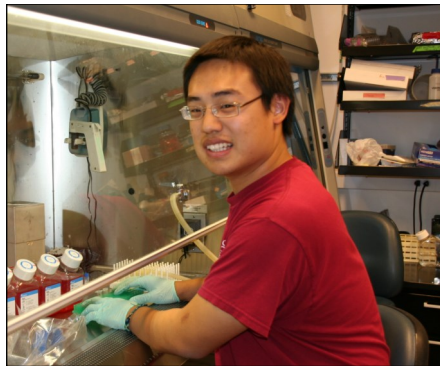
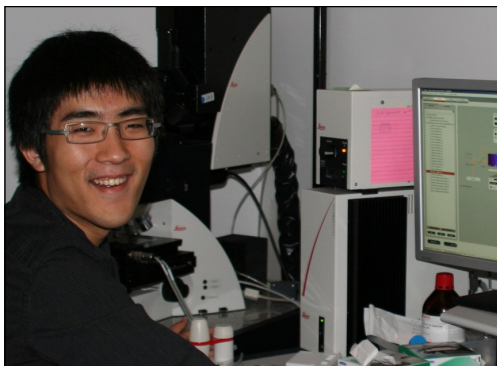


Andrew Chou *Biochemical Engineering*

Supported by: Pitch Johnson

Mentor: Prof. Jennifer Cochran, Bioengineering

Andrew Chou is originally from Taipei, Taiwan, and designed his own major in Biochemical Engineering because of interest in protein engineering and regenerative medicine. His research is currently aimed at optimizing rational mutations to create a single chain mutant of the platelet derived growth factor (PDGF). Since PDGF is heavily implicated in angiogenesis and proliferation of multiple types of solid tumors, PDGF is an attractive target for engineering novel protein based cancer therapeutics.



Bio-X Undergraduate Research Program



Ian Connolly *Biology*

Supported by: Rose Hills Foundation

Mentor: Prof. Tobias Meyer, Chemical & Systems Biology

Ian Connolly is a Biomechanical Engineering major about to begin his senior year at Stanford. He is originally from Newport Beach, California and first became interested in cell migration after observing and learning from Meyer Lab post doc, Sean Collins, and graduate student, Feng-Chiao Tsai, last summer. This summer, Ian is researching the role of podosomes in the migration of invasive cancer cells. Specifically, he is attempting to modify a photoactivatable plasmid to artificially recruit podosomal proteins to the plasma membrane with the goal of artificially inducing the formation of these structures. Ian chose this project because, as an engineer, he enjoys creating things and because he is interested in bioengineering and cancer biology.

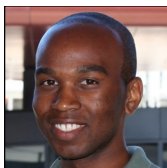


Dominique Dabija *Bioengineering*

Supported by: Bio-X Program

Mentor: Prof. KC Huang, Bioengineering

Dominique is starting her sophomore year at Stanford. She first became interested in Bioengineering during her internship in the Altman lab two years ago. Her interest in interdisciplinary methods for devising medical cures is grounded in her desire to help improve quality of life. Dominique is currently executing a project involving experimental evolution of E. coli bacterial cells with a nonnative cell shape to investigate links between cell shape and fitness and the accurate division regulation by Min-protein oscillations. She hopes that her research will help to answer some fundamental questions regarding cell division with implications in improving the human immune system.



Nick Davis *Bioengineering*

Supported by: Bio-X Program

Mentor: Prof. Richard N. Zare, Chemistry

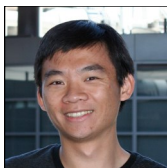
Nick Davis is beginning his sophomore year as a Bioengineering major and Chemistry minor. He hopes to further introduce the quantitative methods employed in chemistry to the fields of bioengineering and medicine. This summer, he is working on a project under Professor Richard Zare. For the first time ever, with Dr. Richard Perry, Nick has detected reaction intermediates in a ruthenium-catalyzed hydrogenation reaction via desorption electrospray ionization mass spectrometry (DESI-MS). The next line of attack in Nick's research is probing transition-metal-catalyzed and organocatalytic reactions by DESI. Nick foresees the DESI method as a promising ambient technique for the study of reaction dynamics at a fundamental level.

Bio-X Undergraduate Research Program



Cheri Dijamco *Human Biology*
Supported by: Pitch Johnson
Mentor: Prof. Joachim Hallmayer, Psychiatry

Cheri Dijamco graduated from Stanford this past spring with a B.A. in Human Biology. She is originally from Houston, Texas. For Bio-X, this summer, Cheri is investigating the role of CAG/CTG trinucleotide repeat expansions in bipolar candidate genes to determine if these dynamic mutations influence anticipation, which is characterized by earlier age-at-onset and increased severity of a disorder with each subsequent generation. Since early detection and intervention of bipolar disorder is key, Cheri hopes her research will benefit families by providing insight on the genetic basis of bipolar disorder in order to improve its future identification and treatment.



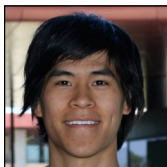
Tru-Khang Dinh *Biomechanical Engineering*
Supported by: Bio-X Program
Mentor: Prof. Marc E. Levenston, Mechanical Engineering

Khang is originally from San Jose, California and will be a coterminial student next year in the Bioengineering program here at Stanford. He became interested in cartilage tissue engineering and regenerative medicine out of a profound fear of death, which he believes to be a common preoccupation among people. This summer, Khang is studying the interactions between human marrow stem cells and the extracellular matrix, which are mediated by adhesion to synthetic peptides in sodium alginate hydrogels. The goal of his research is to develop finely-tuned 3D scaffolds to control the differentiation of progenitor cells down the cartilage cell lineage.



Claire Durkin *Bioengineering*
Supported by: Dr. Richard and Linda Kelley
Mentor: Prof. Shaul Hestrin, Comparative Medicine

Claire Durkin is about to begin her junior year at Stanford. She is originally from Columbus, Ohio and became interested in bioengineering because of the many applications of technical, analytical, and mathematical knowledge to biological situations. She has enjoyed working in a neuroscience lab this summer as part of the Bio-X undergraduate program and researching the electrophysiology of the layer six of the cortex. She is looking forward to learning a variety of engineering and natural science disciplines while here at Stanford.



Mark Fang *Biology, Mathematical and Computational Sciences*
Supported by: Burroughs Wellcome Fund
Mentor: Prof. Jill Helms, Surgery

Mark Fang entered freshman year set on majoring in physics but became interested in developmental biology and regenerative medicine when a friend described the research going on in the Helms Lab. Mark met Professor Jill Helms and joined the lab, where he is currently investigating the pharmacology of a therapeutic that may enhance repair of injured tissues through Wnt signaling. Wnt signaling is important in the regeneration of a wide range of tissues, and Mark hopes that his contribution may help see the therapeutic applied successfully in the future clinic.

Bio-X Undergraduate Research Program

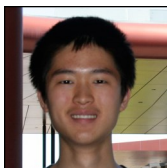


Daniel Fuentes *Biology*

Supported by: Dr. Richard and Linda Kelley

Mentor: Prof. Marius Wernig, Pathology

Daniel Fuentes is entering his junior year at Stanford, where he is majoring in biology. He is currently studying the direct cell reprogramming of mouse fibroblasts to motor neurons in the Wernig lab. This process uses motor neuron-specific genes cloned into retroviral vectors to overexpress proteins fundamental for motor neuron development. This upregulation causes the fibroblasts to acquire motor neuron-like properties (which should ultimately include functional maturity) including the ability to form synapses with muscle fibers. He chose this research because it merges several fields of great interest to him, including neurobiology, developmental biology, and stem cell biology.

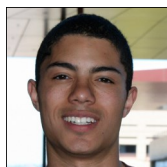


Linyi Gao *Chemistry*

Supported by: Bio-X Program

Mentor: Prof. Jianghong Rao, Chemistry and Radiology

Linyi Gao is a rising sophomore at Stanford from Moscow, Idaho. He is especially interested in biomedical research and plans to major in chemistry. This summer, Linyi is working in the Radiology department under Professor Jianghong Rao to help develop a new method for *in vivo* fluorescence imaging of proteins that uses derivatives of a novel reagent, 2-cyanobenzothiazole, to selectively label N-terminal cysteine residues. He is excited about the potential of this method to study protein dynamics and to learn from this great experience. In his spare time, Linyi enjoys piano, distance running, basketball, fishing, and ancient Chinese poetry.



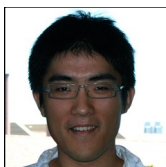
Jeremy Goodman *Human Biology*

Supported by: Rose Hills Foundation

Mentor: Prof. Amy Ladd, Orthopedic Surgery

Jeremy Goodman is a rising senior at Stanford originally from Los Angeles. Jeremy was drawn to Human Biology as a major because of its unique multidisciplinary approach. He is researching the human wrist and is trying to figure out what normal wrist motion is and how it compares to a diseased or injured one. Jeremy chose to study the wrist this summer in hopes of eventually being able to help patients that suffer from wrist diseases that have serious consequences such as carpal tunnel and osteoarthritis. Jeremy hopes that his research will one day benefit medical doctors and patients in diagnosing and treating wrist injury and disease.

Bio-X Undergraduate Research Program



Minsuk Hyun *Biology*

Supported by: Pitch Johnson

Mentor: Prof. Karl Deisseroth, Bioengineering and Psychiatry

Minsuk Hyun is a freshman at Stanford from South Korea. He is majoring in Biology and is particularly interested in the field of neural engineering.

Minsuk works in Karl Deisseroth's lab, where he studies optogenetics, an emerging field combining optical and genetic techniques to probe neural circuits. In the Deisseroth Lab, Minsuk researches the delivery method and different characteristics of opsins. He personally thinks that optogenetics is a very interesting way to study neuroscience, and he is excited to think about how it can be expanded to other disciplines of medicine. Currently, he truly enjoys his time in the lab studying it.



Jeesun (Sunny) Kim *Bioengineering*

Supported by: Dr. Richard and Linda Kelley

Mentor: Prof. Theo Palmer, Neurosurgery

Sunny Kim is a rising junior majoring in bioengineering. Sunny is currently involved in research at the Theo Palmer lab of neurosurgery. Her project

draws from a cross disciplinary collaboration in stem cell biology and immunology and uses genetic models in mice to study the role of innate immune signaling in the outcome of neural stem cell transplantation. Specifically, the project consists of determining if toll-like receptor (TLR) expression on cells within the hippocampus of wild type mice changes following neural progenitor cell (NPC) transplantation of syngeneic or allogeneic NPCs.



Yoon Seok Kim *Computer Science, Biology*

Supported by: Bio-X Program

Mentor: Prof. Bruce MacIver, Anesthesia

Yoon Seok Kim is a biology major who is about to start his senior year at Stanford. He is pursuing his research at Professor M Bruce MacIver's

neuropharmacology lab at Grant Building this summer. His main research topic is "The Role of GABA-B-mediated Inhibition in Anesthetic-induced Depression of Hippocampal Responses." Yoon, as a student who is trying to achieve his goal to become a famous neuroscientist in the future, is trying to experience as much as he can this summer.



Laney Kuenzel *Computer Science, Mathematics*

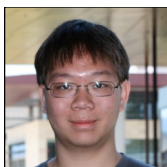
Supported by: Bio-X Program

Mentor: Prof. Daphne Koller, Computer Science

Laney Kuenzel is a rising junior from Cleveland, Ohio double majoring in math and computer science. This summer, she is working on a computer

science project in collaboration with Stanford Hospital's Neonatal Intensive Care Unit. Using machine learning techniques, she is developing a model to predict negative outcomes in premature infants based on physiological data taken within a short period after birth. Her work focuses on two outcomes in particular: intraventricular hemorrhage and bronchopulmonary dysplasia. She chose this research project because it allows her to do computer science work that has important and immediate real-world applications.

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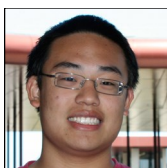


Jeremy Lai *Chemistry*

Supported by: Burroughs Wellcome Fund

Mentor: Prof. Vijay Pande, Chemistry

Jeremy Lai is about to begin his sophomore year studying chemistry and computer science. This summer, Jeremy worked on building Markov State Models for protein folding systems to explore the general nature of protein folding. There has been much interest in determining if protein folding is directed by a set of independent folding units or by the entire system. Jeremy's research hopes to settle this issue.

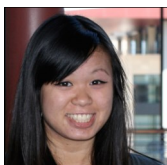


Louis Lu *Biology*

Supported by: Bio-X Program

Mentor: Prof. Matthew Scott, Developmental Biology

Originally from Philadelphia, PA, Louis Lu is a Biology major about to begin his junior year. Currently working in the Scott Lab, Louis has been studying the Sonic Hedgehog Signaling Pathway, a key regulator of animal development that has also been linked to the development of several cancers. Louis has been especially interested in one of the pathway's proteins, Smoothened, which has been a target of a variety of synthesized inhibitors. He hopes to discover mutations in Smoothened protein that may be involved in oncogenesis or the development of drug resistance, which would then better enable patient-specific drug treatment.



Catherine Nguyen *Biology*

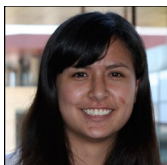
Supported by: Rose Hills Foundation

Mentor: Prof. Liqun Luo, Biology

Catherine Nguyen is a senior at Stanford majoring in Biology with a minor in Chemistry. She has been researching in Professor Liqun Luo's lab for over a year, using Mosaic Analysis with Double Markers (MADM) to characterize genomic imprinting effects in the liver and the brain. This summer, she is working on a clonal analysis to quantify the genomic imprinting effects of Chromosome 11, which show that cells with paternal disomy have a proliferation advantage in the liver. The clinical applications of her research are what initially drew her to the field.



Bio-X Undergraduate Research Program



Michelle Nii *Materials Science & Engineering*

Supported by: Rose Hills Foundation

Mentor: Prof. Fan Yang, Bioengineering and Orthopedic Surgery

Michelle Nii is a rising junior pursuing a bachelor's degree in Material Science and Engineering. During her sophomore year, Michelle started applying her material science knowledge towards bioengineering goals in the Yang Lab. Currently, she is working on determining the best microenvironment for differentiating adipose-derived stem cells into bone by controlling environmental cues from both the extracellular matrix components/growth factor signaling and the material properties (such as pore size and matrix rigidity). The ultimate goal is a better understanding of the complex interplay of microenvironment signals to create better materials that promote differentiation for tissue regeneration purposes.

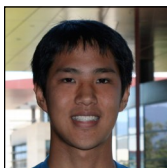


Jonathan Noguchi *Biology*

Supported by: Rose Hills Foundation

Mentor: Prof. Stephen L. Skirboll, Neurosurgery

Jonathan Noguchi is about to enter his junior year at Stanford. As a 2009 Bio-X grant recipient, Jonathan spent his last summer researching hematopoietic stem cells with the Clarke Lab. He is continuing research on cancer stem cells this year with Dr. Stephen Skirboll, M.D., in the Department of Neurosurgery. Their work focuses on the development of the Colony Forming Antibody Cell Array (CFACA), which can help identify cancer stem cell markers specific to glioblastoma multiforme, one of the most common and virulent forms of brain cancer with a median survival time of just two years after diagnosis.



Huy Phan *Biology*

Supported by: Pitch Johnson

Mentor: Prof. Alan C. Pao, Medicine

Huy Phan, a junior at Stanford, is majoring in Biology with plans to attend medical school. He has been working with the Pao Lab to characterize the water-excreting properties of the newly-discovered compound OADS. *In vitro* studies have shown that OADS inhibits the CLC-Ka channel in the thin ascending limb of the kidney; its blockage may lead to a water diuresis. In order to accurately characterize OADS, Huy has been doing *in vivo* studies to collect data on the effect of OADS on rats. Working in the lab this summer has allowed Huy to explore the world of medical research.

Bio-X Undergraduate Research Program



Erica Sanders *Psychology*

Supported by: Dr. Richard and Linda Kelley

Mentor: Prof. Kiki Chang, Psychiatry

Erica Sanders is a senior at Stanford University, majoring in Psychology with an emphasis in Neuroscience. She is the Director of Student Affairs of the Stanford Undergraduate Psychology Association and thinks psychology (particularly cognitive psychology and emotion regulation) is fascinating! This summer, Erica is exploring her interest in emotion through the Pediatric Bipolar Disorders Program, looking at the volumes of amygdalae and hippocampi in bipolar, prodromal, and healthy control populations. She hopes to learn how to trace these structures in MRI images and to find out how the sizes of amygdalae and hippocampi compare in the three populations previously mentioned.

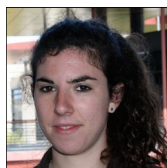


Robert Schiemann *Biology, Computer Science*

Supported by: Rose Hills Foundation

Mentor: Prof. Joseph Lipsick, Pathology

Robert Schiemann will be beginning his senior year in the fall. He is in the process of completing a major in biology and another in computer science. His research project this summer is focused on uncovering the role of the oncogene Myb and its role in spermatogenesis. To accomplish this, he is making use of both bioinformatics and genetics. Gene expression data about Myb is first computationally analyzed, and candidate genes discovered in the process are then tested with *Drosophila* genetics. He hopes that his research will help to further elucidate the role of Myb in chromatin remodeling and oncogenesis.



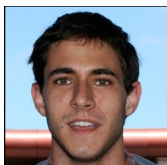
Carmel Schindelheim *Chemistry, Biology*

Supported by: Bio-X Program

Mentor: Prof. Suzanne Pfeffer, Biochemistry

Carmel Schindelheim is a senior at Stanford from Marin County, California. She is majoring in Chemistry and Biology. Since both subjects are equally fascinating to her, she is carrying out research in biochemistry and studying the molecular basis of how proteins are sorted and trafficked throughout the cell, specifically how Rab GTPases regulate membrane traffic as well as how regulating autophagy could be a potential role for Rabs. She is excited about this research because understanding basic trafficking pathways in the cell will help us understand the molecular basis of diseases such as cancer and diabetes in greater depth.

Bio-X Undergraduate Research Program

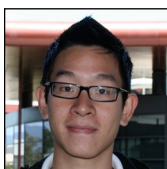


Kamen Simeonov *Biology*

Supported by: Burroughs Wellcome Fund

Mentor: Prof. Michael F. Clarke, Cancer Biology

Kamen Simeonov will be starting his senior year at Stanford in the autumn, during which he will complete a major in biology. He is currently working in a cancer stem cell lab where he is using a qPCR based assay to measure the differences in telomere length that arise from the consecutive cellular divisions between the adult stem cells and the final terminally differentiated cells of the colon, mammary, and hematopoietic tissue systems. Kamen believes that this assay has the potential to quickly and efficiently characterize how telomere length correlates with specific populations of cells in normal, premalignant, and malignant tissue.



Kevin Tran *Biology*

Supported by: Rose Hills Foundation

Mentor: Prof. Merritt Maduke, Molecular & Cellular Physiology

Kevin Tran will be a junior this fall and hopes to enter medical school after graduation. He is working in the Maduke Lab researching the molecular mechanisms of chloride-selective ion channels expressed in the kidneys. Producing effective inhibitors of these channels can help treat hyponatremia, which develops in heart failure patients when kidneys fail to excrete free water. Kevin's summer project involves using the two-micro electrode voltage clamp technique and microinjections of oligomers and compounds in *Xenopus* oocytes. His goal is to develop a strategy to reduce the presence of undesired byproduct currents when recording the chloride ion channel currents and testing their inhibition in these cells.



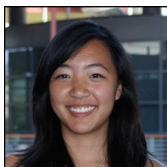
Tania Tran *Human Biology*

Supported by: Bio-X Program

Mentor: Prof. W. Paul Brown, Surgery

Tania Tran is beginning her senior year at Stanford as a Human Biology major and pre-dental student. She is from Portland, Oregon. This summer, Tania is working with the Department of Surgery, Division of Clinical Anatomy, at Stanford Medical School to create a virtual, 3-D time-lapse model of human skull development using whole-body CT datasets. It is the first of a number of projects planned to study factors related to mid-face and cranium growth and development. Having an accurate 3-D model of the human skull will change the way anatomy is learned, taught, portrayed, and treated in medicine and dentistry.

Bio-X Undergraduate Research Program

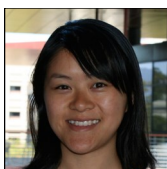


Kaeli Yuen *Psychology, Biology*

Supported by: Rose Hills Foundation

Mentor: Prof. Karen J. Parker, Psychiatry

Kaeli Yuen is a Biology student about to begin her junior year at Stanford. She is originally from southern California, where she became interested in biology as a research assistant at Harbor-UCLA medical center. This summer, she is investigating the relationship between oxytocin biology and social functioning in autism by attempting to uncover distinct social phenotypes that would reduce heterogeneity of the disorder and streamline biomarker discovery efforts. This will allow for more homogeneous analysis of biological data, increased efficacy in future clinical trials, and insights into the biology underlying social endophenotypes.

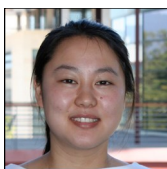


Elisa Zhang *Human Biology*

Supported by: Bio-X Program

Mentor: Prof. Anne Brunet, Genetics

Elisa Zhang is a rising senior majoring in Human Biology. She has been working with the short-lived African killifish, *Nothobranchius furzeri*, in Professor Anne Brunet's lab in the department of Genetics since her sophomore year. Her group aims to develop *N. furzeri* as a novel model organism in aging and longevity studies. Elisa's research interest involves testing whether tail fin regeneration differs between the short-lived and long-lived strains of *N. furzeri*, and she is currently quantifying regeneration using both phenotypic and cellular methods. She hopes that her research will illuminate potential connections between tissue regeneration and aging.



Wendy Zhang *Human Biology*

Supported by: Pitch Johnson

Mentor: Prof. Joseph C. Wu, Radiology and Medicine

Wendy Zhang, a member of the Wu lab in the Departments of Radiology and Medicine, is a rising sophomore. This summer, she is using non-invasive imaging technologies developed at Stanford to develop novel treatments for the formation of embryonic stem cell (ESC) derived tumors. Currently, ESCs hold exciting promise in the field of regenerative medicine due to their ability to form any cell type of the adult human body; however, because these cells can also give rise to complex tumors called teratomas following their transplantation *in vivo*, it is critical that methods to treat these tumors be developed before ESC-based therapies are translated to the clinic.

Bio-X Undergraduate Research Program



2010 Poster Titles:

The Diuretic Effect of a Small Molecule Inhibitor of CLC-K1 in Rats

Huy D. Phan¹, Paru P. Kathpalia, MD¹, Andrew E. Howery², Justin Du bois², Lise Bankir, PhD³, Merritt Maduke, PhD¹, and Alan C. Pao, MD¹

(¹Stanford University School of Medicine, Palo Alto, CA, United States; ²Department of Chemistry, Stanford University, Palo Alto, CA, United States; ³INSERM UMRS 872, Paris, France)

Amygdalar and Hippocampal Volumes of Children and Adolescents at High Risk for Bipolar Disorder

Erica Marie Sanders, B.A.; R. Kelley, B.S.; L. Bararpour, B.S.; A. Garrett, Ph.D.; M. Howe, M.S.W.; K. Chang, M.D.; A. Reiss, M.D.

Center for Interdisciplinary Brain Sciences Research, Division of Psychiatry, Stanford University School of Medicine

Exploration of ERDA1, SEF2-1B, and MAB21L Trinucleotide Repeat Expansion Influence on Anticipation in Pediatric Bipolar Disorder

Cheri Ann Dijamco, B.A., Meghan Howe, M.S.W., Kiki Chang, M.D., Joachim Hallmayer, M.D.
Division of Psychiatry, Stanford University School of Medicine

Mesenchymal Stem Cell Fate in a Biomimetic Collagen Hydrogel: A Regenerative Matrix for Enhanced Cutaneous Wound Healing

Sarah M. Cheng, Kristine C. Rustad, Victor W. Wong, Michael Sorkin, Jason P. Glotzbach, Dean Nehama, Melanie R. Major, Jayakumar Rajadas, Michael T. Longaker, Geoffrey C. Gurtner

Biology, Surgery, Neurology; Stanford University

Targeting of VEGF-Receptor for Imaging and Treatment of Embryonic Stem Cell Derived Tumor Formation

Wendy Zhang, Andrew Lee, Kevin Guo, Edwin Chang, Jayakumar Rajadas, Shawn Chen, Zhen Cheng, Joseph Wu

Human Biology, Cardiovascular Medicine; Stanford University

Using Markov State Models to Study the Folding of Protein Fragments

Jeremy D. Lai, Vincent A. Voelz, Vijay S. Pande

Chemistry, Stanford University

What a Difference an Exon Makes: A Comparison of MIM Isoforms

Shire Beach, Scott Atwood, Tony Oro

Biology, Dermatology; Stanford University

Neocortical Circuit Activity in Layer 6 Neurons

Claire Durkin and Shaul Hestrin

Bioengineering, Comparative Medicine; Stanford University

Bio-X Undergraduate Research Program



2010 Poster Titles continued

Characterization of Imprinting Effects of Mouse Chromosome II Using Mosaic Analysis with Double Markers (MADM)

Catherine Nguyen, Simon Hippenmeyer, and Liqun Luo
Biology, Stanford University

Identifying Cancer Stem Cells in Human Malignant Gliomas Using the Colony Forming Antibody Cell Array (CFACA)

Jonathan Noguchi, Vanita S. Natsu, Stephen Skirboll, M.D.
Biology, Neurosurgery; Stanford University

Solid Phase Sub-Monomer Synthesis of Poly-N-Substituted Glycines (Peptoids) for Capillary Electrophoresis

Nathan Barnett, Zachary Urdang, Rinki Kapoor, Annelise Barron
Bioengineering, Biophysics; Stanford University

The Role of Toll-Like Receptors in Neurogenesis and Neural Progenitor Cell Allotransplantation

Jeesun Kim, Lori K. Phillips, Theo Palmer
Bioengineering, Medicine, Neurosurgery; Stanford University

3d motion analysis of wrist kinematics

Jeremy Goodman, Julia Lee, Amy Ladd
Human Biology, Orthopedic Surgery; Stanford University

A Platform for the Shearing of Cell Monolayers

Fasika T. Asrat, Claire M. Anderson, Gerald G. Fuller.
Chemical Engineering, Stanford University

Improving Electrophysiological Recordings: Using morpholinos to reduce background signal

Kevin Tran, Merritt Maduke, Sierra Simpson
Biology, Molecular & Cellular Physiology; Stanford University

Combinatorial 3D matrices for Optimizing Stem Cell Niche towards Osteogenesis

Michelle Nii, Galym Imanbayez, and Fan Yang
Materials Science & Engineering, Orthopedic Surgery; Stanford University

Effect of GABA A Antagonist on Epileptic Brain Slice

Yoon Seok Kim, Vytas Dargis-Robinson, and M Bruce MacIver
Computer Science, Biological Science, Anesthesia; Stanford University

A potential role for the Rab GTPase activating protein RUTBC1 in regulation of autophagy

Carmel Schindelhaim, Ryan M. Nottingham, Peter L. Lee, Suzanne R. Pfeffer
Chemistry, Biology, Biochemistry; Stanford University

Bio-X Undergraduate Research Program



2010 Poster Titles continued

Engineering a stable single-chain platelet derived growth factor variant using yeast surface display

Andrew Chou, Mihalios Kariolis, and Jennifer Cochran

Biochemical Engineering, Bioengineering; Stanford University

Evolutionary and imaging approaches to assaying the fitness of rod-shaped and round bacteria

Dominique Dabija and KC Huang

Bioengineering, Stanford University

Early Prediction of Bronchopulmonary Dysplasia in Premature Infants by Integration of Physiological Markers

Laney Kuenzel, Suchi Saria, and Daphne Koller

Computer Science, Mathematics; Stanford University

Measuring Telomere Length at the Single Cell Level in Normal and Malignant Colon Stem Cells

Kamen Simeonov, Michael Rothenberg, Ysbrand Nusse, Piero Dalerba, Michael Clarke

Biology, Medicine, Stem Cell Biology and Regenerative Medicine Institute; Stanford University

Characterizing tail regeneration and wild populations' genetic structure in the short-lived fish *Nothobranchius furzeri*

Elisa Zhang, Dario Valenzano, Anne Brunet

Human Biology, Genetics; Stanford University

Detection of Reaction Intermediates Using Desorption Electrospray Ionization (DESI) Mass Spectrometry

Nick Davis, Richard H. Perry, Maurizio Splendore, Allis Chien, Richard N. Zare

Bioengineering, Materials Science, Chemistry; Stanford University

The Hedgehog Pathway: Discovering Smoothed Mutations that Confer Drug Resistance

Louis Lu, Nicholas Conley, Tyler Hillman, Matthew Scott

Biology, Radiology, Medicine; Stanford University

The Role of Adaptor Proteins, Tks4 and Tks5, in Podosome Formation: A Photoactivation Approach

Ian Connolly, Sean Collins, Silvia Carrasco, Milos Galic, Samuel Bandara, Tobias Meyer

Biology, Chemical & Systems Biology; Stanford University

Improving visualization of opsin-transduced neuronal cell bodies with a 2A self-cleaving peptide

Minsuk Hyun, Joanna Mattis, Charu Ramakrishnan, Karl Deisseroth

Biology, Neurosciences; Stanford University

Developing a New Method for Protein Labeling Using Fluorescent Derivatives of the Firefly Luciferin Precursor 2-cyanobenzothiazole

Linyi Gao, Dr. Ke Zhan, and Prof. Jianghong Rao

Chemistry, Radiology; Stanford University

Bio-X Undergraduate Research Program



2010 Poster Titles continued

Direct Conversion of Fibroblasts to Motor Neurons

Daniel Fuentes, Thomas Vierbuchen, Troy Yang, Marius Wernig
Biology, Medicine, Engineering; Stanford University

Generation and Testing of a Myb Regulatory Network in Drosophila Spermatogenesis

Schiemann, Robert; Stalker, Heather; Lipsick, Joseph
Biology, Computer Science, Genetics, Pathology; Stanford University

Peptide-Modified Alginate as Tissue-Engineered Cartilage Scaffolds

T. Khang Dinh and Marc E. Levenston
Biomechanical Engineering, Mechanical Engineering; Stanford University

Pharmacology of liposomal Wnt3a

Mark Y. Fang, Nicholas D. Evans, Steven F. Lee, Samuel D. Bockenhauer, Jill Helms
Biology, Math and Computational Sciences, Surgery, Chemistry, Physics; Stanford University

A Virtual, 3-D Time-lapse Model of Human Skull Development Utilizing High Resolution Digital Imaging

Tania Tran, Sarah Hegmann, Robert Cheng, W. Paul Brown
Human Biology, Surgery; Stanford University

2009 Poster Presentations:

Quantification of Abdominal Aortic Aneurysms During Disease Progression Using Small Animal Magnetic Resonance Imaging

Kyla N. Barr¹, Craig J. Goergen^{2,3}, Maj Hedehus³, Junya Azuma⁴, Charles A. Taylor², Philip S. Tsao⁴, Joan M. Greve³

¹Mechanical Engineering, Stanford University, ²Bioengineering, Stanford University, ³Biomedical Imaging, Genentech, Inc., ⁴Medicine, Stanford University Medical Center

Identifying the Role of Land Use in Coastal Water Quality in Northern California

Debbie Lee, Sarah P. Walters, Alexandria B. Boehm
Environmental Engineering, Stanford University

An ErbB ligand inhibits hippocampal neural progenitor cell differentiation

Rafael Wabl, Harish Babu, Theo Palmer
Neurosurgery, Stanford University

Improving the Efficiency of Cell Transplantation through Biomaterials Development

Brian Aguado¹, Sarah C. Heilshorn²

¹Biomechanical Engineering, Stanford Univ., ²Materials Science & Eng., Stanford University

Creating a Lentivirus Expressing USPI6, a Possible Negative Player in Self-Renewal

Jonathan Noguchi, Maddalena Adorno, Ph.D., Michael F. Clarke, M.D.
Stanford University Stem Cell Biology and Regenerative Medicine Institute

Bio-X Undergraduate Research Program



2009 Poster Titles continued

Toward Holistic Diagnostic Models: Time Series Modeling of Neonate Laboratory Tests

Andrew Duchi, Suchi Saria, Prof. Daphne Koller, Anna Penn M.D.
Computer Science, Stanford University

Determining the roles of Aromatic and Hydrophobic Residues of an Interacting Amphipathic *Caenorhabditis elegans* MEC-6 Helix via Electrophysiological Expression in *Xenopus laevis* Oocytes

Don Vongviphot, Amy L. Eastwood, Valeria Vásquez, Miriam B. Goodman
Cellular Physiology, Stanford University

Development of a Recombinase-Driven Mammalian DNA Oscillator

Kim Tran, Wes Overton, Cliff Wang
Chemical Engineering, Stanford University

Intradermal Scaffold Implantation Model For Improved Acellular Dermal Matrix Incorporation

Melanie Major, Michael Galvez BA, Victor Wong MD, Geoffrey C. Gurtner MD FACS
Surgery, Division of Plastic and Reconstructive Surgery, Stanford University

Characterization of Skin Wound Healing in Axin2LacZ/+ Reporter Mice

Dani Zhao, Nick Evans, Zachary Stein, Alan Chen, Jill Helms
Plastic and Reconstructive Surgery, Stanford University

The association of polymorphisms in circadian genes CLOCK and PERIOD3 and risk for developing pediatric bipolar disorder

Arpine Davtyan, Hallmyer Joachim
Psychiatry and Behavioral Science, Stanford University

The Taming of the Ion

Simon H. Ye, Griffin K. Barbula, Matthew D. Robbins, Richard N. Zare
Chemistry, Stanford University

Synthesis and Evaluation of Matriptase-Selective Activity-Based Probes

Tinh Nguyen Duc^{1,2}, Margot Paulick³, and Matthew Bogoy^{3,4}

¹Biological Science and ²Chemistry, Stanford University, ³Pathology, Stanford University,

⁴Microbiology and Immunology, Stanford University

Protein Interactions with MHC Class I at the Mouse CNS Synapse

Xuchen Zhang, Barbara K. Brott, Carla Shatz
Biology and Neurosciences, Stanford University

BMP Induced Healing of Calvarial Defects in the Athymic Nude Mouse Model

Ankur Gupta, Nicholas Panetta MD, Deepak Gupta MD,
Michael Longaker MD MBA FACS

Bio-X Undergraduate Research Program



2009 Poster Titles continued

Thalamocortical Oscillations in the 4th Dimension: Calcium Imaging of an Epileptic Network

Max Kleiman-Weiner, Mark P. Beenhakker, John R. Huguenard
Neurology & Neurological Sciences, Stanford University

Matrix Rigidity Regulates Skeletal Muscle Stem Cell Self Renewal in Culture

Penney M. Gilbert, Karen Havenstrite, Alessandra Sacco, Nora Leonardi, Nghi Nguyen, Peggy Kraft, Matthias P Lutolf, Helen M. Blau
Baxter Lab. in Genetic Pharmacology, Microbiology and Immunology, Stem Cell Institute

Analyzing the Efficacy of Protein-Engineered Vaccines Against B-Cell Lymphoma

Alejandro Virrueta, Patrick Ng
Levy Laboratory, Division of Oncology, Stanford University

Intraarterial transplantation results in superior delivery of neural stem cells to the ischemic brain in contrast to intravenous infusion

Arjun V Pendharkar, Xavier Gaeta, Josh Y Chua, Nancy Wang, Hui Wang, Abhijit De, Raymond Choi, Robert H. Andres, Shawn Chen, Brian Rutt, Sanjiv S Gambhir, Raphael Guzman
Neurosurgery, Stanford University

Single Cell Genomics: Shining Light on Microbial 'Dark Matter'

Geoff Schiebinger, Paul Blainey, Stephen Quake

Characterizing the Rwandan HIV Epidemic in 1990-1993 Through Sequencing Analysis of Archived Plasma Specimens and Insights on Mother-to-Child Transmission

Philip Bulterys, Sudeb Dalai, Betsy Johnston, David Katzenstein, Dmitri Petrov
Biology, Stanford University

Characterization of the Role of the Heparosulfate Proteoglycans Dally-like and Syndecan in *Drosophila* Germline Stem Cells

Maryam Zamanian, Shrividhya Srinivasan, Margaret T. Fuller
Developmental Biology, Stanford University

Toward high-throughput analysis of processive stepping by engineered myosin motors

Sanjay Saraf, Tony D. Schindler, Zev Bryant
Bioengineering, Stanford University

Identification of Endogenous Substrates of the Group II Chaperonin Mm-cpn from the Archaeal Methanogen *Methanococcus maripaludis* using computational and biochemical approaches

Anthony Tuan Nguyen¹, Lukasz Joachimiak¹, Jeremy Dodsworth², Murray Hackett³ and Judith Frydman¹

¹ Biology and Bio-X Program, Stanford University, ² School of Life Sciences, University of Nevada, ³ Chemical Engineering, University of Washington

Bio-X Undergraduate Research Program

2009 Bio-X Undergraduate Research Talks given by Stanford Faculty:



June 24

Zev Bryant "Engineering Molecular Motors"

Sarah Heilshorn "Designing New Medical Materials for Stem Cell Transplantation"

Dmitri Petrov "Studies of Molecular Adaptation"

July 1

Miriam Goodman "Using C. elegans to Understand Pleasant and Painful Touch Sensation"

Geoff Gurtner "Understanding the Role of Progenitor Cell Mediated Repair Following Injury"

Cliff Wang "Evaluation of Combinatorial Gene Expression in Lymphocytes"

July 8

Carla Shatz "Brain Tuning"

Matthew Bogoy "Applications for Small Molecules in the Study of Protease Function"

July 15

Judith Frydman "Protein Folding and Misfolding in the Eukaryotic Cytosol"

Michael Longaker "Adipose-derived Cells for Skeletal Tissue Engineering"

Charles Taylor "Biomechanical Factors in Vascular Disease"

July 22

Kevan Yamahara "California Beach Sands - Reservoirs for Fecal Indicator Bacteria"

Margaret Fuller "Regulation of Self-renewal and Differentiation in Adult Stem Cell Lineages"

Suchi Saria "Towards Holistic Diagnostic Models"

July 29

Helen Blau "Bioengineering Stem Cell Fate"

Jill Helms "Wnt-mediated Tissue Regeneration"

Steve Quake "Turning the Spotlight to Dark Matter in Biology"

August 5

Matthew Scott "Genetic Control in Development and Disease"

John Huguenard "Dissecting Neural Circuitry One Cell at a Time"

August 12

Richard Zare "Cell, Cell, Cell!"

Michael Clarke "Molecular Regulation of Self Renewal"

August 19

Patrick Ng "Vaccines for the Treatment of Lymphomas"

Theo Palmer "Functional Roles for New Neurons in Old Neural Networks"

Raphael Guzman "Multimodality Imaging in Stroke Stem Cell Therapy"

August 26

Joachim Hallmayer "Genetics of Autism"

Kang Shen "Small Connections in Tiny Worms: Molecular Mechanisms of Synapse Formation"

Bio-X Undergraduate Research Program



Some student comments about the program:

This program helped reinforce the fact that I was going to be a bioengineer/medical researcher. I will be attending Northwestern University in the fall for my PhD in biomedical engineering, and I feel that this program helped me get a positive outlook on the research process.

-Brian Aguado

This program...gave me a chance to explore an area which I may not have otherwise explored. I am very grateful for the opportunity and the chance to hear speakers from such a diversity of fields.

- Philip Bulterys

I learned critical thinking skills and lab techniques that will be helpful for me in the future. The program confirmed what I already knew about my future goals, but this confirmation was very important to me.

- Arpine Davtyan

The process of composing and presenting a poster was an experience that has made me a more well-rounded scientist. It is not enough to propose and carry out experiments if you cannot clearly and enthusiastically relate the findings to others in different fields.

- Xavier Gaeta

(The program) provided me the unique experience of formulating research questions and thinking critically about my project. I think that the Bio-X research program really affords students the opportunity to get a hands-on experience to apply concepts learned in classes in real-life situations and thereby buttress the material in textbooks.

- Debbie Lee

The program provided structure and support as I approached my research project last summer. I now realize that science is a collaborative effort, and it is sometimes important to reach out to peers and other labs when questions arise.

- Melanie Major

The program showed me the power of research to innovate and probe unanswered questions in the biomedical sciences...The financial support is key to the program, and it is great that the stipend has been increased to compete with other fellowships.

- Anthony Nguyen

My experience working during the summer has made me consider taking a more research-oriented direction in some of my future academic plans.

- Maryam Zamanian

If you're interested in performing cutting-edge research, hearing fascinating guest seminars, and getting paid to live at Stanford for a summer, Bio-X makes it all possible!

- Xuchen Zhang

Professor Carla Shatz

Director of Bio-X
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To learn more about the Bio-X
program at Stanford, please visit
the Bio-X website at:

<http://biox.stanford.edu>



Undergraduate Research Program Participants 2009