Ashley Utz, 2017 cohort, will complete her summer research training in Dr. Carolyn Bertozzi’s lab.
The Stanford Bio-X Undergraduate Summer Research Program (Stanford Bio-X USRP) is now 13 years old and has partnered with 246 Stanford faculty mentors in order to provide a ten-week summer research opportunity to 501 students to date.

The program aims to foster the interdisciplinary spirit of Stanford Bio-X in a new generation of up-and-coming scientists by exposing Stanford undergraduates to ten weeks of hands-on laboratory research experience. In addition to the ten weeks of laboratory research, students attend weekly faculty talks by thirty Bio-X faculty affiliates to introduce them to the cutting-edge research taking place in laboratories across campus. The program concludes with a scientific poster session alongside graduate students, faculty, and Stanford Bio-X community members from across campus and beyond.

In 2017, 65 students are participating in the program.
June 28
Carla Shatz “Saving the Synapse”
Paul Nuyujukian “Brain-Machine Interfaces”
Melanie Hayden-Gephart “Malignant brain tumor surgery and science”

July 5
Sandy Napel “Images are not just pictures; they are data: Applications to Radiology & Medicine”
Alistair Boettiger “Single molecule imaging of gene expression and genome structure”
Alison Marsden “Computational Methods for Personalized Medicine in Cardiovascular Disease”

July 12
Thomas Südhof “How to wire a neural circuit: Initial approaches to a difficult problem”
Karen Parker “Novel approaches for detecting and treating autism”
Anson Lee “Multidisciplinary Approach to Treating Arrhythmia”

July 19
Edward Graves “Migration of Tumor and Immune Cells”
Maria Barna “Specialized Ribosomes: A New Frontier in Gene Regulation, Organismal Biology, & Evolution”
Liqun Luo “TRAPing active neurons”

July 26
Creed Stary “MicroRNAs in Cerebral Ischemia”
Carolyn Bertozzi “Tuberculosis diagnostics powered by chemistry”
Helen Bronte-Stewart “Brain and movement in Parkinson's disease melding a background in Dance and Neuroscience”

August 2
Joseph Woo “The Fusion of Biology, Engineering, and Surgery in Treating Cardiovascular Disease”
Helen Blau “Building muscles by juvenating muscle stem cell function”
Peter Jackson “Before neurons: sensory and metabolic signaling in primary cilia”

August 9
Anthony Oro “Cells as Drugs for Incurable diseases”
Marc Levenston “See it Squish: Using Medical Imaging to Study Cartilage Deformation In Vivo”
Ian Gotlib “Understanding and Reducing Risk for Depression”

August 16
Ivan Soltesz “Organization and Control of Hippocampal Networks”
Stephen Quake “Single Cell Genomics”
Karl Deisseroth “Nature’s gift: how the discovery of structural principles in a microbial protein helped illuminate the pathophysiology of psychiatry”

August 23
Gerlinde Wernig “The unifying mechanism of fibrotic diseases”
Tanya Stoyanova “Defining new biomarkers and therapies for prostate cancer”
Kim Butts Pauly “Blood Brain Barrier Opening with MRI Guided Focused Ultrasound”

August 30
Lucy O’Brien “Gutting to the truth of the matter: Life and death in the Drosophila intestine”
Anne Brunet “Understanding and modeling aging”
Justin Annes “Developing a regenerative therapeutic for diabetes”
Stanford Bio-X Undergraduate Summer Research Program Alumni:

Alumni of the program are extremely successful. They have gone on to pursue doctorates and medical degrees all over the world, published in high-impact journals, and accepted exciting positions in industry and beyond.

Nick Davis, 2010 and 2012 cohort (pictured at right), will be completing a PhD in Biological Engineering at MIT in the fall of 2017. Nick also leads a consulting group that serves pre-IPO and growth-stage biotech and life science companies in Boston, New York and San Francisco. So far, this group has helped over three dozen teams solidify their IP estates, access equity financing, and foster productive commercial partnerships.

Jenelle Wallace, 2011 cohort (left, photo courtesy Harvard MCB Graphics), is now a 4th year PhD student at Harvard in the Molecules, Cells, and Organisms program. Jenelle recently received an NIH F31 NRSA fellowship to fund her last two years of graduate school.

Zahra Harati Taji, 2012 and 2013 cohort (right), graduated with a M.Sc. in Chemistry from the University of Zurich. Next, she started working in business development at a pharmaceutical company specializing in vaccines. Her chemistry research background greatly enhances her ability to represent the company, as an important part of her position is communicating about science and research.

Helena Scutt, 2013 cohort, and her sailing partner qualified for the Rio 2016 Olympics, finishing 10th overall. Helena then returned to Stanford to finish her Master’s in Mechanical Engineering and will soon be training to prepare for the 2020 Olympics. Helena now sails a type of boat which hydrofoils—the technical development and engineering involved unite Helena’s passions for sailing and science.

Eric Lopez, USRP 2014 cohort (pictured at left), is currently in the MD program at UCSF School of Medicine, planning to eventually specialize in neurology. Eric is also working on a historical investigation of mental health policy in California, and an ethnography of patients with amnesia secondary to autoimmune encephalitis. Next, Eric aims to start clinical research in neuroimmunology.

Bora Erden, 2015 cohort (pictured at right with Dr. William Newsome), was selected as a winner of the Firestone Medal for Excellence in Undergraduate Research for his thesis in Dr. Newsome’s lab, which was based on his Stanford Bio-X USRP research.

Michael Chen, 2016 cohort (pictured at left), is currently a junior at Stanford studying Chemistry and is planning to pursue an MD-PhD. Michael recently received the Goldwater Scholarship, and a paper from his Bio-X USRP research was published in Neuron in May of 2017. Michael says the Bio-X USRP played a major role in his decision to pursue a career in medical research.
Michelle Bach, Science, Technology, & Society  
**Mentor: Paul Bollyky, Medicine (Infectious Diseases) and Microbiology & Immunology**

Chronic endobronchial infection with *Pseudomonas aeruginosa* (Pa) is present in the majority of patients with cystic fibrosis (CF) and is associated with decreasing lung function and increased morbidity and mortality. Through the Bio-X USRP, Michelle will help investigate the links between the levels of a virus that infects Pa and clinical outcomes in CF. The results of this work will inform potential efforts to use virus levels as predictors for pulmonary exacerbation and to guide antibiotic choices in Pa infection in high-risk patients with CF.

Ankit Baghel, Computer Science  
**Mentor: Philip Beachy, Developmental Biology and Biochemistry**

The Sonic hedgehog (Shh) signaling protein expressed in brainstem neurons has an unexpected but critical role in maintenance and regeneration of taste receptor cells in taste buds on the tongue. Ankit’s project will explore how Shh from brain stem neurons controls taste receptor cell regeneration by using a tagged version of Shh to track its long-range movement along axons to the taste receptor cells on the tongue.

Rishi Bedi, Computer Science  
**Mentor: Ron Dror, Computer Science**

An important question to address in drug development is how to accurately predict the three-dimensional conformation that proteins will adopt when forming a complex with each other. A protein’s importance is conferred by its ability to interact with other molecules (especially other proteins), and understanding the exact interaction conformation is a prerequisite to rationally designing drugs. Rishi will leverage recent machine learning advances in deep neural networks to "learn" the features of likely protein interactions from a large publicly available dataset, the Protein Data Bank.

Sarah Bell, Human Biology  
**Mentor: Allan Reiss, Psychiatry & Behavioral Sciences and Radiology**

Sarah’s research will involve the evaluation of a novel intervention to improve executive function (EF) in children with Attention Deficit Hyperactivity Disorder (ADHD). There are many school-aged children in the US with ADHD—some reports estimate as many as 1 in 10—and it is therefore a costly burden on the US health-care system. Through the Bio-X USRP, Sarah will be working to evaluate the effect of a targeted intervention (involving cognitive rehabilitation and neurofeedback) that enhances the neural networks subserving executive functions in ADHD in order to treat the underlying disorder.
Alisha Birk, Bioengineering  
*Mentor: Sharon Pitteri, Radiology*  
Alisha is investigating small molecule drugs that are potent against breast cancer cell lines using quantitative proteomics technology. She will compare treated and untreated cells to identify which proteins have altered levels in the treated cells. The experiment is being conducted to gain a deeper understanding of what proteins and pathways these drugs are targeting, in order to design more potent analogs that will ultimately be more successful in killing breast cancer cells.

Alexandra Bourdillon, Computer Science  
*Mentor: Joseph Woo, Cardiothoracic Surgery*  
On the path to building completely autonomous surgical robots, Alexandra’s Bio-X USRP project will explore the challenge of building a simulated surgical environment using computer visualization and graphics. In this virtual environment, she will test motion planning algorithms to execute surgical tasks.

Ryan Buchanan, Biomechanical Engineering  
*Mentor: Creed Stary, Anesthesia, Perioperative & Pain Medicine*  
Astrocytes protect the brain against injury. Ryan will be comparing astrocytes from two regions of the brain—one that is resistant to low blood flow, and one that is vulnerable—to develop new treatments to protect the brain from injury.

Tucker Burnett, Chemistry  
*Mentor: Ronald Davis, Biochemistry and Genetics*  
With the development of CRISPR-Cas9 mediated gene editing technology, the world of scientific and medical research has been given an incredibly powerful tool. Tucker will be optimizing a new high throughput editing system for improved efficiency and mismatch tolerance using high fidelity CRISPR systems. Higher fidelity genetic engineering will ensure the safety and reproducibility of these editing systems as they are employed at ever larger scales. An understanding of the fidelity of these CRISPR systems will help ensure that only the intended genomic changes are made.

Tae-León Butler, Human Biology  
*Mentor: Kathleen Sakamoto, Pediatrics*  
Tae’s research explores the dynamics of cell signaling pathways involved in induction or production of leukemias. Specifically, she will be analyzing biological assays and real-time reverse transcriptase PCR to investigate how cellular transcription factor CREB-inhibiting small molecules can be utilized in an effective, less toxic therapy for Acute Myeloid Leukemia.
Alexandra Bourdillon, 2017 cohort, will complete her Stanford Bio-X summer research training in Dr. Joseph Woo’s lab

**Sharon Chen, Biology**  
**Mentor: Anne Brunet, Genetics**

Frontotemporal Lobar Degeneration (FTLD) is a protein aggregation-associated neurodegenerative disease. The probability of developing FTLD increases with age. Sharon’s project focuses on examining the regulation of lysosomal transmembrane protein TMEM106B, a gene identified in a genome-wide association study to have protective effects against FTLD. Sharon will investigate the role of TMEM106B in proteostasis and healthy cognitive aging by studying TMEM106B in the brain of the newly pioneered model organism African Turquoise Killifish.

**Isaac Cinquini, Computer Science**  
**Mentor: Alistair Boettiger, Developmental Biology**

The expression state of a gene is determined by the interaction of regulatory sequences distributed along the chromosome. The packaging of the chromosome in the three-dimensional volume of the cell’s nucleus places constraints on this communication, and thus understanding the spatial organization of the genome is key to understanding gene expression. Zack will extend existing super-resolution microscopy techniques to study these interactions in single cells with substantially finer spatial and genomic resolution than achievable with current technology.

**Kendall Costello, undeclared**  
**Mentor: Liqun Luo, Biology**

Memories are vital to our everyday existence, and yet little is known about their specific neuronal basis. Using a new technology in the Luo Lab, Kendall’s research will investigate the relationship between the prefrontal cortical neuronal circuits active during fear-induced learning and those involved in memory recall weeks later. Then, through a combination of optogenetics and viral-genetic tracing, Kendall plans to develop a more precise mapping of the neuronal circuits underlying long-term fear memories, which will be useful for better understanding PTSD, anxiety, and other stress-related mental health disorders.

**Cole Deisseroth, Computer Science**  
**Mentor: Gill Bejerano, Developmental Biology, Computer Science, and Pediatrics**

Currently, the Bejerano lab has an effective Mendelian-disease-diagnosing tool, but it still has room for improvement. Cole is working on improving the tool’s knowledge base by finding a way to efficiently search the web for papers that discuss pathogenic Single Nucleotide Variants (SNVs), and loading them into the system to improve future diagnoses.
A genome wide association study (GWAS) is a powerful tool to discover genetic variants responsible for a specific disease or heritable trait. For this project, a GWAS will be conducted on approximately 120,000 individuals who have undergone a submaximal exercise test to determine novel genetic loci that could be responsible for increased aerobic fitness. These loci could be utilized to prescribe exercise over medicine, create a drug that mimics the benefits of exercise, and elucidate the relationships between physical activity and other diseases.
James Hu, Bioengineering  
**Mentor:** Sean Wu, Medicine (Cardiovascular)

Clinical attempts at myocardial tissue grafting have shown limited success due to the insufficient vascularization and poor control on the scaffold structure. James is utilizing the 3D bioprinting of iPSC-derived cardiomyocytes, endothelial cells, and biomaterials to create and test various vascular network designs in order to address these challenges. The proposed research could establish design principles that lead to the creation of the first 3D bioprinted, patient-specific, vascular myocardium, which can be broadly applicable to other tissues and organs.

Akshay Jaggi, undeclared  
**Mentor:** Sandy Napel, Radiology

When will computer vision surpass human vision? It’s happening right now: at Google, at Tesla, and right here at Stanford Bio-X. Using novel machine learning algorithms, Akshay is training computers to determine the malignancy of indeterminate lung tumors. Currently, radiologists cannot accurately classify these nodules, but, by going beyond human vision, these algorithms will aid doctors in making crucial clinical decisions.

Mika Jain, Physics and Computer Science  
**Mentor:** Stephen Quake, Bioengineering and Applied Physics

Mika is interested in developing precision measurement tools for probing the dynamics of gene regulation at the single-molecule and single-cell level. To do so, he intends to leverage precision measurement techniques from applied physics. Such tools have the potential to answer questions in both fundamental biology and medicine.

Ketan Jain-Poster, Biology  
**Mentor:** Steven Chang, Neurosurgery

Cerebral arteriovenous malformations (AVMs) are poorly understood, yet potentially devastating lesions of cerebral vasculature that can lead to high feeding artery pressures, venous drainage, and other hemodynamic abnormalities such as hemorrhages, migraines, or seizures. Using an endothelial cell tube-formation assay that is currently well-established in the lab for studying tube formation and vessel dilation during development, Ketan will work to quantify and describe the relationship between the microenvironment and abnormal vasculature development present in the progression of AVMs, as well as develop an *in vitro* model for studying the disease.

Tiffany Jiang, Biology and Music  
**Mentor:** Paul Khavari, Dermatology

Mutations in proteins responsible for controlling signaling pathways drive cancer development. In particular, RAS GTPases are the most frequently mutated oncogene family in human cancer. By characterizing the role of novel interactors in RAS activation and their effect on signaling inhibition, Tiffany will identify potential new treatment targets in RAS-driven cancers.
Yong-hun Kim, Computer Science  
**Mentor: Gerlinde Wernig, Pathology**  
Yong-hun is researching the pathways in idiopathic pulmonary fibrosis. Focusing on the gene c-Jun, which is required for fibrosis proliferation, he will study the activation status of signaling networks in dissociated mouse lungs over time in response to c-Jun expression and its subsequent deletion using CRISPR/Cas9. Understanding how the signaling network is activated will help in studies working to inactivate the network of pulmonary fibrosis.

Hee Joo Ko, Human Biology  
**Mentor: Josef Parvizi, Neurology**  
Utilizing the superior temporal and spatial resolution of intracranial electrocorticography (ECoG) data and a unique three-task experimental paradigm, Hee Joo aims to gain a more comprehensive understanding of the effects of race on face processing. She will be measuring ECoG signals directly from the fusiform face area, a region in the human visual system that is specialized for facial recognition, as human subjects view own-race and other-race faces under different task conditions.

Pallavi Krishnarao, Biology  
**Mentor: Maria Barna, Genetics and Developmental Biology**  
In order to effectively study translational regulation in the context of embryonic development *in vivo*, there is a need to develop a method to quickly and gently isolate small populations of cells. Pallavi will develop such a method by immunoprecipitating (immunopanning) cells marked by a versatile, exogenous cell-type specific surface marker.

Jason Li, Computer Science and Biology  
**Mentor: Thomas Südhof, Molecular & Cellular Physiology**  
Astrocytes, a type of non-neuronal cell, are hypothesized to have a critical role in the formation, specification, and regulation of synapses. The goal of Jason’s project is to identify novel proteins that mediate the interaction between astrocytes and the pre- and post-synapse, which will in turn elucidate the underlying mechanisms regarding the role of astrocytes in synapse development.

Cindy Liu, undeclared  
**Mentor: Stephen Skirboll, Neurosurgery**  
Using a novel live cell array technology, nearly 300 cell surface markers have been screened to determine the 12 best candidate positive markers that may identify cancer stem cells in human glioblastoma (GBM). Cindy will use 2 classic *in vitro* validation studies to help determine which of these 12 top markers have higher propensity for forming tumors. Cindy will also use the assays to study combinations of the top 2-4 markers to determine which combination best identifies the critical cancer stem cell subpopulations in GBM.
Elisa Liu, Bioengineering  
*Mentor: Fan Yang, Orthopaedic Surgery and Bioengineering*  
Glioblastoma represents one of the most common brain cancers, yet effective therapies remain elusive as tumor cell phenotypes are poorly understood. Elisa is working on a platform that uses a 3D gradient hydrogel which can provide a high-throughput screening of how tumor microenvironment affects cell behavior. The platform offers the opportunity to study the physiological behavior of tumor cells and provide a system for studying potential novel treatments.

Helen Liu, undeclared  
*Mentor: Helen Blau, Microbiology & Immunology*  
Many of the receptors that regulate cell fate and self-renewal are G-protein coupled receptors (GPCRs). Discovering drugs for muscle repair is challenging because it has been difficult to discover drugs for cell fate regulating GPCRs. To overcome this issue, Helen will develop an innovative new system to create a library of single variable chain antibodies (nanobodies) that will be able to target GPCR as agonists to the receptors and may also lead to other novel treatments.

Hannah Llorin, Human Biology  
*Mentor: William Talbot, Developmental Biology*  
Oligodendrocytes and Schwann cells are supportive cells that produce the myelin sheath around axons in the nervous system. Cyclic adenosine monophosphate (cAMP) is a messenger that regulates differentiation of these cells, which affects proper development of axons. Using zebrafish as a model organism, Hannah will investigate the function of cAMP by using fluorescent tagging and observing myelin sheath development around the axon and gene expression at various stages of development. A better understanding of the disruption of myelin has important implications for diseases such as multiple sclerosis (MS) and peripheral neuropathy.

Alexander Lu, Biomedical Computation  
*Mentor: Alison Marsden, Pediatrics and Bioengineering*  
Kawasaki disease is the leading cause of acquired heart disease during childhood in developed countries, with complications such as coronary artery aneurysms that present risk of heart attack and sudden death. While current determination of an individual’s risk looks mainly at aneurysm size, it may be more informative to look at blood flow through the aneurysm. Alex will address this hypothesis by generating patient-specific blood flow models with a patient’s imaging data that may then non-invasively guide clinical decisions. Simulation results will be compared with clinical outcome data.
Anoop Manjunath, Biology and Economics  
Mentor: Irving Weissman, Developmental Biology, Pathology Stem Cell Institute  
Prostate cancer metastasizes to the bone with the help of CDCP1, a surface protein shared by hematopoietic stem cells (HSC), which allows cancer cells to colonize the HSC niche. Anoop is investigating the effectiveness of a CDCP1 antibody in preventing the growth and spread of metastatic prostate cancer. He also aims to understand the effect of the antibody on tumor-associated immune cells by applying novel RNA sequencing techniques to treated and untreated models.

Michael Mariscal, Human Biology  
Mentor: Karen Parker, Psychiatry & Behavioral Sciences  
A part of the Parker Lab’s research efforts is testing children with autism spectrum disorder (as well as typically developing children) for contagious yawning or laughter. Michael’s research will test whether children with autism spectrum disorder exhibit diminished contagious yawning and laughter responses, and how social neuropeptides oxytocin and vasopressin affect these contagion responses.

Sarah Matsunaga, Human Biology  
Mentor: Anthony Wagner, Psychology  
Flexible planning for the future is critical for achieving beneficial health, educational, social, and financial outcomes; however, under acute stress, prospective thought is impaired. Sarah will examine whether these impairments are solely caused by glucocorticoid effects of stress acting on neural regions involved in memory and cognitive control, or by divided attention induced by the stressor. These insights will provide a neuroscientific framework for understanding the precise mechanisms underlying the profound impacts that stress can have on prospective planning and behavior.

Jonathan Mak, Electrical Engineering  
Mentor: Anson Lee, Cardiothoracic Surgery  
Jonathan is creating a portable medical device to study those who suffer from post-operative atrial fibrillation, an illness that is characterized by abnormal heart beats and can lead to stroke. Jonathan hopes to utilize the data from the device to properly learn how to treat this illness as well as to find out more about this uninvestigated area of medicine.
Maxwell Melin, Biology
Mentor: Thomas Südhof, Molecular & Cellular Physiology
Essential tremor is the most common movement disorder, but our understanding of this disease is still very primitive. Max’s project seeks to locate the brain region(s) responsible for the tremor phenotype in mouse models lacking the synaptotagmin 2 protein. He is utilizing several neuroscience techniques, including rodent surgery, cryosection, microscopy, and behavioral testing.

Taylor Merkel, Biology
Mentor: Tony Wyss-Coray, Neurology
While recent headlines have lauded young blood as the “fountain of youth,” the ability of aged blood plasma to induce brain aging is an equally interesting phenomenon. Taylor hopes to further elucidate the exact mechanism by which aged blood plasma affects neuron formation in the hippocampus, focusing in particular on vascular cell adhesion molecule 1 (VCAM1) as a mediator of crosstalk between blood and brain tissues. This knowledge could be the key to mitigating the impact of memory loss, Alzheimer’s disease, and other neurodegenerative diseases in an ever-growing elderly population.

Clare Moffatt, Biology
Mentor: Laura Attardi, Radiation Oncology and Genetics
The transcription factor p53 is critical in suppressing tumorigenesis in humans and mice. The Attardi lab has used affinity purification and mass spectrometry to identify novel transcriptional co-repressors of mouse p53, and one of these is the protein Spen, which is known as a negative regulator of cancer signaling pathways. Clare will be validating the interactions between p53 and Spen using co-immunoprecipitation assays and then determining how Spen may function as a co-repressor of p53 target gene expression and in tumor suppression through Spen inhibition.

Grace Ng, Symbolic Systems
Mentor: Ivan Soltesz, Neurosurgery
The dentate gyrus area of the hippocampus plays an important role in memory and behavior, and should be represented in computational models of the brain. Using the NEURON simulation environment, Grace’s research project aims to construct a computational model of granule cells in the dentate that accurately represents the input-output transformations performed in the mammalian dentate gyrus. This model can then be integrated into a full network model of the dentate to study learning and memory in the hippocampus, as well as the cognitive deficits associated with diseases like epilepsy.
Sang Ngo, Biology
**Mentor: Lucy O’Brien, Molecular & Cellular Physiology**
In healthy organs, a network of differentiated cells—collectively called the ‘niche’—directs stem cells on when to properly divide. When stem cells become tumorigenic, they stop listening to directions given by their niche; currently, little is known about how this mechanism works. Using the fruit fly intestinal tract as a model, Sang is looking at how manipulating key factors in the cell division pathway influences tumor development.

Cindy Nguyen, Bioengineering
**Mentor: Lei Stanley Qi, Bioengineering and Chemical & Systems Biology**
Cindy is investigating the role that the three-dimensional organization of the human genome plays in regulating gene expression. She will be using CRISPR/dCas9 technology, a catalytically dead version of the CRISPR genomic editing system, to study the functional consequences of gene repositioning and the potential for developing a tool for long-term transcriptional control in human cells.

Kira Oskirko, Psychology
**Mentor: Ian Gotlib, Psychology**
Puberty is a time of dramatic and important changes. Neurologically, puberty is marked by an increase in cortical thickness followed by a period of thinning, likely due to synaptic pruning. More aggressive pruning has been associated both with depressed children and with girls who are characterized by high levels of sex hormones during puberty; however, there has been little research examining the neural basis of suicidal ideation, a critical precursor of suicidal behaviors and attempts. Kira will examine trajectories of cortical thickness over puberty in a sample of girls characterized by high levels of suicidality and their low-suicidal peers.

Enoch Park, Human Biology
**Mentor: Calvin Kuo, Medicine (Hematology)**
Modeling cancer in vitro offers a strong tool to study pathways and identify and test new therapies in gastric cancer. Enoch will be developing novel methodologies through which the ErbB2 mutation in gastric cancers can be modeled in tissue cultures and explore how acquiring this mutation specifically alters normal gastric tissue.

Jennifer Parker, Bioengineering
**Mentor: Anthony Oro, Dermatology**
The overarching goal of this project is to understand chromatin dynamics in tissue engineering of skin for the scalable production of personalized, genetically corrected skin sheets for patients with the debilitating disease Epidermolysis bullosa. The lab has previously published the Therapeutic Reprogramming method, and, now, Jennifer aims to detail high-fidelity lineage commitment by detailing the transcription factor network and its interactions.
Jordan Parker, Psychology  
*Mentor: Helen Bronte-Stewart, Neurology*  
Jordan will be investigating the role of augmented reality as a tool for teaching Parkinson’s Disease patients to regain rhythmicity in their movement. This disease deteriorates one’s capacity for coordinated, complex movements, and Jordan will be exploring how the augmented reality component in the Moving Through Glass program (developed for Google Glass in collaboration with Dance for PD and the Mark Morris Dance Group) could use external timing mechanisms to compensate for the loss of internal timing in PD patients.

Tess Rinaldo, undeclared  
*Mentor: Theo Palmer, Neurosurgery*  
Mutations in genes implicated in Autism Spectrum Disorder (ASD) may be linked to changes in cortical thickness in ASD individuals. Tess’s project investigates cell proliferation in fetal mouse brains that have one of two different gene mutations. Studying the neurological effects of certain gene mutations in embryonic mice models may offer critical insight into potential ASD pathways and their neurological effects.

Julia Schulz, Bioengineering  
*Mentor: Lars Steinmetz, Genetics*  
Protein phosphorylation is essential for cellular process, and deregulation in phosphorylation networks is linked to the progression of cancer. Julia’s project will utilize massively parallel genome editing, which uses CRISPR Cas9 to systematically mutate all phosphosites in the yeast proteome, and assess the phenotypic consequences in a variety of stress conditions. This will help us to understand the functional architecture of cell signaling networks and give insight into how deregulation results in cancer progression.

Maricela Sistos, Biology  
*Mentor: Russell Fernald, Biology*  
Social rank is important in all social systems, and regulates reproduction. Gonadotropin releasing hormone is the main actor, and the neurons producing this peptide change as a function of status in the animals studied. Maricela will identify how and where these neurons change and how that is regulated at a molecular level.
Austin Su, undeclared  
**Mentor: Tanya Stoyanova, Radiology**  
Austin is studying how gene deregulation could lead to the development of prostate cancer. Specifically, he is working with mouse models to investigate the role of the glycosyltransferase GCNT1 in prostate cancer initiation.

Daniel Tang, undeclared  
**Mentor: Karl Deisseroth, Bioengineering and Psychiatry & Behavioral Sciences**  
Daniel is investigating how individual groups of neurons respond to specific stimuli over time by studying shock-responsive neurons in the medial prefrontal cortex. The biggest challenge that Daniel will address is the capability to permanently label the neurons so that they can be reexamined at later time points without losing intensity. By implementing techniques from molecular biology, optics, and imaging, including the CLARITY technique developed in the Deisseroth lab, Daniel will be using an activity-dependent labeling system to bring better understanding to shock-responsive neurons in the medial prefrontal cortex.

Nicole Ticea, Bioengineering  
**Mentor: Liqun Luo, Biology**  
Nicole’s project will use synthetic biology to develop new genetic methods for accessing and manipulating neurons. These efforts will help us gain insights into how populations of neurons process information and drive behavior.

Bruce Tiu, Biology  
**Mentor: Kathleen Sakamoto, Pediatrics**  
The Ribosomal S6 Kinase (RSK) has been linked to the proliferation of acute myeloid leukemia, and efforts at targeting RSK have had differential effects on normal and leukemic cells. Bruce will work to characterize the role of RSK in the myeloid development of normal hematopoietic cells. This project seeks to better profile important players in myelopoiesis and study signaling pathways downstream of RSK that may be appropriate for future therapeutics.
Brain metastases which originate from primary thymic tumors currently have limited therapies. Using next generation sequencing technologies, Kevin aims to discover the unique thymic tumor mutations that predispose some patients to develop brain metastases. By comparing genes of thymic tumors that lead to brain metastases to those that cause metastases outside of the CNS, Kevin can better understand the genetic basis of thymic brain metastases and find new targets for treatment.

There is a critical need for point-of-care diagnostic tools that rapidly and selectively label *Mycobacterium tuberculosis*, the causative agent of tuberculosis. Ashley will be developing new environment-sensitive small molecule tools that can only be metabolized by *M. tuberculosis*, allowing detection of this specific bacterium in biological samples. She will be optimizing the tools’ biophysical properties and pharmacokinetics to not only diagnose but also study infection in humans and live model organisms.

Jonathan is working to determine the role macrophages play in tumor recurrence following radiotherapy. He is setting up several models observing macrophage migration after irradiation, and analyzing the effect these have on tumor cell recruitment and recurrence. This research may shed light on the mechanisms behind radiation therapy and tumor recurrence, helping researchers to discover potential clinical solutions and more effective post-radiotherapy treatments.

Memories are stored at synapses, and if mechanisms driving the loss and extensive pruning of synapses known to occur in Alzheimer’s Disease (AD) were understood, then this devastating disease could be halted or even reversed. The aim of Alan’s project is to study the role of a neuronal receptor, PirB, in synapse pruning during normal developmental critical periods and in the adult mouse cerebral cortex. These experiments should expand our understanding of how PirB receptor works in mice, and may even aid in translating the results to Alzheimer’s disease in human patients.
David Wu, undeclared  
**Mentor: Peter Jackson, Microbiology & Immunology and Pathology**  
David’s work is to examine how the Kras oncogene regulates cell migration and adhesion, an important determinant of how cancer cells move within the body. Using proteomic and bioinformatic methods, he is looking for unknown factors that could couple cell migration to tumor metastasis, the deadliest part of cancer progression.

Michelle Xiao, Biomechanical Engineering  
**Mentor: Marc Levenston, Mechanical Engineering**  
Osteoarthritis (OA) of the knee is a debilitating disease, and degradation of the meniscus during OA compromises its ability to stabilize and distribute load at the knee. Currently, we cannot detect early changes in the meniscus that lead to OA, but Michelle’s research will use novel MRI techniques that are sensitive to meniscal changes and combine these results with biochemical and biomechanical testing of the meniscus. This could lead to methods for detecting early osteoarthritic changes non-invasively.

Kamina Wilkerson, Human Biology  
**Mentor: Carolyn Lee, Dermatology**  
Kamina is exploring the clinical and histological characteristics of Squamous Cell Carcinoma, the second most common cancer worldwide, that are most predictive of poor survival outcomes. Patients with metastasized tumors will be sequenced in the hopes of finding mutations that better predict clinical outcomes. Candidate mutations will then be further studied for impacts on cell growth, migration, and tumorigenesis.

Ashley Westerfield, undeclared  
**Mentor: Katja Weinacht, Pediatrics**  
Reticular Dysgenesis (RD) is one of the most serious forms of severe combined immunodeficiency (SCID) because it affects both innate and adaptive immunity. The disease is characterized by arrested neutrophil maturation, excess lymphocytes in the blood, and hearing loss. It disproportionately affects infants and children unless immune reconstitution is achieved by stem cell transplantation. Ashley will analyze how *in vitro* derived stem cells can model this disease and contribute toward possible treatment for the disease.
**Benjamin Yeh, Bioengineering**  
*Mentor: Justin Annes, Medicine (Endocrinology)*  
All forms of diabetes, whether Type I autoimmune diabetes or Type II obesity-associated diabetes, are caused by a loss of insulin-producing beta-cells. Ben is trying to determine the three-dimensional crystal structure of an enzymatic drug target bound to an inhibitory small molecule that has been shown in prior studies to have the potential to increase beta-cell replication. If successful, the structural information will be an invaluable tool in guiding synthetic strategies for increasing potency and selectivity for the drug target.

**Victoria Yuan, undeclared**  
*Mentor: Kim Butts Pauly, Radiology*  
Antibodies and immunotherapy show promise in shrinking malignant brain tumors. However, the blood brain barrier (BBB), a protective filtration system of blood vessels, only allows molecules of certain sizes to pass, and these antibodies are almost 400 times too large to pass through and attack the tumor. Victoria is exploring the application of focused ultrasound to open the BBB for antibody transport, then analyzing the activity of antibodies as they target brain tumors.

**Sophia Zhang, Biology**  
*Mentor: Joseph Wu, Medicine (Cardiovascular) and Radiology*  
One of the most common genetic heart diseases in the nation is familial hypertrophic cardiomyopathy (HCM), in which there is a thickening of the heart muscle. Sophie is studying the pathogenicity and molecular basis for functional defects of a mutation in a gene implicated in HCM causation. The project demonstrates the clinical significance of the mutation and the value of genome editing technology in disease modeling and personalized medicine, and may also lead to better diagnostic and therapeutic modalities for patients with HCM.

**Audrey Zhu, Chemical Engineering**  
*Mentor: Sarah Heilshorn, Materials Science & Engineering*  
Migration of cancer cells is known to correlate with extracellular matrix (ECM) stiffening; however, much of the research to date has not been able to monitor cancer progression in real time due to the use of destructive mechanical testing. Audrey is developing a novel approach that combines non-destructive soft-matter characterization with insights from polymer physics, cell biology, and mechanobiology to study the interplay between tumor progression and ECM dynamics.
Jonathan Mak, 2017 cohort, will complete his summer research training in Dr. Anson Lee's lab.

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