

# **Penn Undergraduate Research Mentoring Program Project Descriptions Summer 2019**

**Please read this before proceeding to project listings!**

Application and instructions at <https://tinyurl.com/PURM2019>

Unless otherwise noted, current freshmen and sophomores may apply for any listed project.

Students are encouraged to learn more about faculty interests by reviewing faculty webpages and recent publications to determine your interest level in particular projects.

You never know where you might find a project that interests you! While projects are listed by primary department, many of them are interdisciplinary in nature. **We suggest that you use keyword searches in this document to identify additional projects that would be of interest to you.**

Students should **NOT** contact faculty about their projects until contacted for an interview or the PURM selection process has been completed.

## Table of Contents

<a href="#"><u>Annenberg.....</u></a>	<a href="#"><u>6</u></a>
<a href="#"><u>COMMUNICATION.....</u></a>	<a href="#"><u>6</u></a>
<a href="#"><u>Arts and Sciences .....</u></a>	<a href="#"><u>7</u></a>
<a href="#"><u>AFRICANA STUDIES .....</u></a>	<a href="#"><u>7</u></a>
<a href="#"><u>ANTHROPOLOGY.....</u></a>	<a href="#"><u>8</u></a>
<a href="#"><u>ART HISTORY.....</u></a>	<a href="#"><u>9</u></a>
<a href="#"><u>BIOLOGY .....</u></a>	<a href="#"><u>10</u></a>
<a href="#"><u>CHEMISTRY.....</u></a>	<a href="#"><u>14</u></a>
<a href="#"><u>CLASSICAL STUDIES .....</u></a>	<a href="#"><u>16</u></a>
<a href="#"><u>EARTH AND ENVIRONMENTAL SCIENCE .....</u></a>	<a href="#"><u>17</u></a>
<a href="#"><u>EAST ASIAN LANGUAGES AND CIVILIZATIONS .....</u></a>	<a href="#"><u>18</u></a>
<a href="#"><u>ECONOMICS .....</u></a>	<a href="#"><u>18</u></a>
<a href="#"><u>ENGLISH .....</u></a>	<a href="#"><u>19</u></a>
<a href="#"><u>GERMAN .....</u></a>	<a href="#"><u>21</u></a>
<a href="#"><u>HISTORY .....</u></a>	<a href="#"><u>22</u></a>
<a href="#"><u>HISTORY &amp; SOCIOLOGY OF SCIENCE.....</u></a>	<a href="#"><u>24</u></a>
<a href="#"><u>LATIN AMERICAN AND LATINO STUDIES.....</u></a>	<a href="#"><u>25</u></a>
<a href="#"><u>LINGUISTICS .....</u></a>	<a href="#"><u>26</u></a>
<a href="#"><u>NEAR EASTERN LANGUAGES AND CIVILIZATIONS .....</u></a>	<a href="#"><u>28</u></a>
<a href="#"><u>PHILOSOPHY.....</u></a>	<a href="#"><u>29</u></a>
<a href="#"><u>PHYSICS AND ASTRONOMY .....</u></a>	<a href="#"><u>29</u></a>
<a href="#"><u>POLITICAL SCIENCE .....</u></a>	<a href="#"><u>35</u></a>
<a href="#"><u>PSYCHOLOGY .....</u></a>	<a href="#"><u>37</u></a>
<a href="#"><u>RELIGIOUS STUDIES.....</u></a>	<a href="#"><u>42</u></a>
<a href="#"><u>ROMANCE LANGUAGES .....</u></a>	<a href="#"><u>42</u></a>
<a href="#"><u>SOCIOLOGY.....</u></a>	<a href="#"><u>43</u></a>

<a href="#"><u>SOUTH ASIA STUDIES.....</u></a>	<a href="#"><u>44</u></a>
<a href="#"><u>Dental Medicine.....</u></a>	<a href="#"><u>47</u></a>
<a href="#"><u>ANATOMY AND CELL BIOLOGY.....</u></a>	<a href="#"><u>47</u></a>
<a href="#"><u>ORAL SURGERY AND PHARMACOLOGY.....</u></a>	<a href="#"><u>47</u></a>
<a href="#"><u>ORTHODONTICS.....</u></a>	<a href="#"><u>49</u></a>
<a href="#"><u>PATHOLOGY.....</u></a>	<a href="#"><u>49</u></a>
<a href="#"><u>PERIODONTOLOGY.....</u></a>	<a href="#"><u>50</u></a>
<a href="#"><u>PREVENTIVE AND RESTORATIVE DENTISTRY.....</u></a>	<a href="#"><u>51</u></a>
<a href="#"><u>Design.....</u></a>	<a href="#"><u>52</u></a>
<a href="#"><u>ARCHITECTURE.....</u></a>	<a href="#"><u>52</u></a>
<a href="#"><u>CITY PLANNING.....</u></a>	<a href="#"><u>56</u></a>
<a href="#"><u>FINE ARTS.....</u></a>	<a href="#"><u>57</u></a>
<a href="#"><u>Education.....</u></a>	<a href="#"><u>60</u></a>
<a href="#"><u>EDUCATION, CULTURE, &amp; SOCIETY.....</u></a>	<a href="#"><u>60</u></a>
<a href="#"><u>READING/WRITING/LITERACY.....</u></a>	<a href="#"><u>61</u></a>
<a href="#"><u>Engineering and Applied Sciences.....</u></a>	<a href="#"><u>62</u></a>
<a href="#"><u>BIOENGINEERING.....</u></a>	<a href="#"><u>62</u></a>
<a href="#"><u>CHEMICAL AND BIOMOLECULAR ENGINEERING.....</u></a>	<a href="#"><u>63</u></a>
<a href="#"><u>COMPUTER AND INFORMATION SCIENCE.....</u></a>	<a href="#"><u>64</u></a>
<a href="#"><u>ELECTRICAL &amp; SYSTEMS ENGINEERING.....</u></a>	<a href="#"><u>69</u></a>
<a href="#"><u>MATERIALS SCIENCE AND ENGINEERING.....</u></a>	<a href="#"><u>71</u></a>
<a href="#"><u>MECHANICAL ENGINEERING AND APPLIED MECHANICS.....</u></a>	<a href="#"><u>72</u></a>
<a href="#"><u>Law.....</u></a>	<a href="#"><u>76</u></a>
<a href="#"><u>LAW.....</u></a>	<a href="#"><u>76</u></a>
<a href="#"><u>Medicine.....</u></a>	<a href="#"><u>80</u></a>
<a href="#"><u>ADOLESCENT MEDICINE.....</u></a>	<a href="#"><u>80</u></a>
<a href="#"><u>ANESTHESIOLOGY AND CRITICAL CARE.....</u></a>	<a href="#"><u>80</u></a>
<a href="#"><u>BIOCHEMISTRY AND BIOPHYSICS.....</u></a>	<a href="#"><u>88</u></a>
<a href="#"><u>BIOSTATISTICS, EPIDEMIOLOGY, AND INFORMATICS.....</u></a>	<a href="#"><u>89</u></a>

<a href="#"><u>CANCER BIOLOGY .....</u></a>	<a href="#"><u>92</u></a>
<a href="#"><u>CARDIOVASCULAR MEDICINE .....</u></a>	<a href="#"><u>94</u></a>
<a href="#"><u>CELL AND DEVELOPMENTAL BIOLOGY .....</u></a>	<a href="#"><u>97</u></a>
<a href="#"><u>EMERGENCY MEDICINE .....</u></a>	<a href="#"><u>100</u></a>
<a href="#"><u>FAMILY &amp; COMMUNITY HEALTH .....</u></a>	<a href="#"><u>101</u></a>
<a href="#"><u>GASTROENTEROLOGY .....</u></a>	<a href="#"><u>102</u></a>
<a href="#"><u>GENETICS .....</u></a>	<a href="#"><u>104</u></a>
<a href="#"><u>GERIATRIC MEDICINE.....</u></a>	<a href="#"><u>107</u></a>
<a href="#"><u>HEMATOLOGY-ONCOLOGY .....</u></a>	<a href="#"><u>109</u></a>
<a href="#"><u>MEDICAL ETHICS AND HEALTH POLICY.....</u></a>	<a href="#"><u>110</u></a>
<a href="#"><u>MEDICINE.....</u></a>	<a href="#"><u>114</u></a>
<a href="#"><u>MICROBIOLOGY .....</u></a>	<a href="#"><u>124</u></a>
<a href="#"><u>NEONATOLOGY.....</u></a>	<a href="#"><u>127</u></a>
<a href="#"><u>NEUROLOGY .....</u></a>	<a href="#"><u>128</u></a>
<a href="#"><u>NEUROSCIENCE .....</u></a>	<a href="#"><u>136</u></a>
<a href="#"><u>NEUROSURGERY.....</u></a>	<a href="#"><u>140</u></a>
<a href="#"><u>OBSTETRICS AND GYNECOLOGY .....</u></a>	<a href="#"><u>143</u></a>
<a href="#"><u>OPHTHALMOLOGY .....</u></a>	<a href="#"><u>144</u></a>
<a href="#"><u>ORTHOPAEDIC SURGERY .....</u></a>	<a href="#"><u>145</u></a>
<a href="#"><u>OTORHINOLARYNGOLOGY .....</u></a>	<a href="#"><u>148</u></a>
<a href="#"><u>PATHOLOGY.....</u></a>	<a href="#"><u>150</u></a>
<a href="#"><u>PEDIATRICS .....</u></a>	<a href="#"><u>157</u></a>
<a href="#"><u>PHARMACOLOGY .....</u></a>	<a href="#"><u>173</u></a>
<a href="#"><u>PHYSIOLOGY .....</u></a>	<a href="#"><u>175</u></a>
<a href="#"><u>PSYCHIATRY .....</u></a>	<a href="#"><u>176</u></a>
<a href="#"><u>PSYCHOLOGY .....</u></a>	<a href="#"><u>186</u></a>
<a href="#"><u>RADIATION ONCOLOGY .....</u></a>	<a href="#"><u>188</u></a>
<a href="#"><u>RADIOLOGY .....</u></a>	<a href="#"><u>190</u></a>
<a href="#"><u>SURGERY .....</u></a>	<a href="#"><u>196</u></a>
<a href="#"><u>Nursing .....</u></a>	<a href="#"><u>199</u></a>
<a href="#"><u>    BIOBHAVIORAL HEALTH SCIENCES.....</u></a>	<a href="#"><u>199</u></a>

<a href="#"><u>FAMILY &amp; COMMUNITY HEALTH .....</u></a>	<a href="#"><u>200</u></a>
<a href="#"><u>Social Policy and Practice .....</u></a>	<a href="#"><u>203</u></a>
<a href="#"><u>NONPROFIT MANAGEMENT AND LEADERSHIP.....</u></a>	<a href="#"><u>203</u></a>
<a href="#"><u>SOCIAL WORK .....</u></a>	<a href="#"><u>204</u></a>
<a href="#"><u>SOCIOLOGY .....</u></a>	<a href="#"><u>206</u></a>
<a href="#"><u>Veterinary Medicine .....</u></a>	<a href="#"><u>208</u></a>
<a href="#"><u>BIOMEDICAL SCIENCES.....</u></a>	<a href="#"><u>208</u></a>
<a href="#"><u>CLINICAL STUDIES NEW BOLTON.....</u></a>	<a href="#"><u>209</u></a>
<a href="#"><u>CLINICAL STUDIES PHILADELPHIA.....</u></a>	<a href="#"><u>212</u></a>
<a href="#"><u>PATHOBIOLOGY .....</u></a>	<a href="#"><u>213</u></a>
<a href="#"><u>Wharton .....</u></a>	<a href="#"><u>218</u></a>
<a href="#"><u>ACCOUNTING.....</u></a>	<a href="#"><u>218</u></a>
<a href="#"><u>BUSINESS ECONOMICS &amp; PUBLIC POLICY .....</u></a>	<a href="#"><u>218</u></a>
<a href="#"><u>FINANCE .....</u></a>	<a href="#"><u>220</u></a>
<a href="#"><u>LEGAL STUDIES AND BUSINESS ETHICS .....</u></a>	<a href="#"><u>221</u></a>
<a href="#"><u>MANAGEMENT .....</u></a>	<a href="#"><u>222</u></a>
<a href="#"><u>MARKETING.....</u></a>	<a href="#"><u>223</u></a>
<a href="#"><u>OPERATIONS, INFORMATION AND DECISIONS.....</u></a>	<a href="#"><u>224</u></a>
<a href="#"><u>STATISTICS.....</u></a>	<a href="#"><u>227</u></a>

## **Annenberg**

### COMMUNICATION

*Joseph Cappella*

#### **Project: Tobacco Control Communication**

Students joining our research team will contribute to research focusing on selecting, designing, testing, and evaluating messages for cancer communication research, specifically tobacco related communication research. Students will help identify and archive tobacco control messages and manufacturer claims about modified risk tobacco products, including monitoring social media and established media for any new claims. Students will also participate in directed literature searches and summaries, directed searches for online materials, message coding, and preparing participant surveys.

Our research team is multifaceted and collaborative. Students who are inquisitive and detail oriented will thrive with our mentorship. Students with an interest in public health research and health communication would most benefit from this research experience. By participating in our research, students will gain experience in survey development and design, research methods, participant recruitment, data collection, and data management.

## **Arts and Sciences**

### **AFRICANA STUDIES**

*Michael Hanchard*

**Project: The relationship between fascism and racism in modern politics**

Prof. Michael Hanchard, Dept. Chair, Africana Studies  
Director, The Marginalized Populations Project

I am interested in working with two undergraduate students who would serve as my research assistants during the summer months to conduct research for a book manuscript I am developing on the relationship between fascism and racism, historically and in contemporary politics in various parts of the world. The main objective of this book is to educate a non-specialist audience about fascism's fundamental reliance on racial rule, whose existence in modern Western nation-states pre-dates the emergence of fascism in the late 1920's. Racial rule—conquest, colonialism, segregation and apartheid-- was central to the political imaginaries of fascism, fascist aesthetics, and the development of bureaucracies designed to categorize and control dominant and subordinate populations inhabiting the same territorial space.

Selected students will learn time-honored research skills--working in libraries and archives— in addition to their deployment of online research skills. Students will also learn qualitative methodological approaches to phenomena that persist across space and time (cross-spatial and cross temporal analysis). Students will become familiar with scholarship across the disciplines of history and the social sciences, social theory and cultural criticism about the empirical cases of fascist and neo-fascist popular mobilization, in addition to actual fascist governance in the 1920's and 1930's across Europe and the United States, as well as in contemporary Brazil, the United States, Greece, the Netherlands and Germany. With this knowledge, students will assist in the redesign of an undergraduate level course on race and racism in comparative perspective.

## ANTHROPOLOGY

*Morgan Hoke*

### **Project: Research Assistant for the Biocultural Anthropology Methods Laboratory**

The Biocultural Anthropology Methods Laboratory is a new lab on campus that uses mixed methods to examine health and wellbeing here at Penn and around the world. The laboratory includes a wet lab where we conduct immunoassay analyses of blood and saliva samples to examine various indicators of immune health, psychosocial stress, and intestinal health as well as hormones like testosterone. In addition to quantitative biological methods, we also use survey data to better understand health. We also employ cultural and ethnographic methods such as interviews and participant observation. For this position, we seek motivated undergraduates who are interested in learning all elements of anthropological data collection and analysis.

There are two roles that we are looking to fill. The first is for someone who has a working knowledge of Spanish. We have a significant amount of survey and interview data that needs to be processed and analyzed. Duties and responsibilities would include transcription of Spanish interviews, entry of survey data in Spanish, and some translation. The RA may also be asked to complete tasks including photocopying, scanning, and filing. This position comes with the possibility of serving as an RA on a data collection trip to our main field site in Nuñoa, Peru provided the student is willing and able to travel. In this case, the student would also learn the protocol for collection biomarker-based data including anthropometric measurement and dried blood spot sampling. This position will provide the students with a number of important skill-building opportunities including but not limited to: data collection (both ethnographic and biological), data entry and management, data analysis, transcription, translation, and the preparation of academic manuscripts. The student may also benefit from the opportunity to travel and undertake research in an international setting. There are also possibilities for learning wet labs technique if the student desires.

The second role is oriented toward wet lab analysis. This student would learn basic ELISA techniques and would be responsible for conducting laboratory analysis at the BAMLab at Penn. This would include managing samples, preparing samples for analysis, running assays, and examining results. This student may also be asked to participate in data entry, data cleaning, data analysis, manuscript preparation, and light cleaning work in the context of laboratory maintenance. This position also comes with the possibility of serving as an RA on a data collection trip to our main field site in Nuñoa, Peru provided the student is willing and able to travel and funding can be acquired. In this case, the student would also learn the protocol for collection biomarker-based data including anthropometric measurement and dried blood spot sampling. This opportunity also offers a number of benefits including wet lab skills in conducting immuno-based assays, laboratory management and maintenance skills, data



[Return to top of document](#)

management skills, and the preparation of academic manuscripts. The student may also benefit from the opportunity to travel and undertake research in an international setting.

*Lauren Ristvet*

**Project: Naxcivan Archaeological Project**

This summer the Naxcivan Archaeological Project will launch a series of excavations at Oglanqala, Azerbaijan. Situated on top of a hill in the midst of a fertile plain, Oglanqala witnessed over a millennium of occupation from 1000 BCE-200 CE. This summer's excavations will focus on excavating houses belonging to both elite and non-elite members of the population from ca. 200 BCE-200 CE, in a town situated on the frontiers of the Roman Empire and the Parthian Empire. We will investigate how different people negotiated a fraught imperial situation, focusing specifically on how violence, economic opportunities, and diverse cultural influence affected everyday life. Students will learn excavation skills, including surveying, digging, recording, and drawing. They will also learn how to process and analyze a range of materials (such as pottery, small finds, animal bones, and archaeobotanical samples); investigate research questions using archaeology; and collaborate with an international team of specialists. Students will be mentored by Professor Ristvet and the other project directors: Dr. Jennifer Swerida (Penn Museum), Dr. Hilary Gopnik (Monash University), and Dr. Veli Bakhshaliyev (Azerbaijani National Academy of Sciences). After four weeks in Azerbaijan, students will return to Penn and spend six weeks working with Professor Ristvet in the Penn Museum analyzing the excavation and preparing the final publication. They will learn how to use GIS and our project database, make digital maps and illustrations, and engage in library research. Students will thus have the opportunity to conduct several stages of research—from choosing an excavation site to excavating, analyzing, and publishing it.

## ART HISTORY

*Mantha Zarmakoupi*

**Project: Drawing archaeological finds on Paros (Greece)**

Paros is a Greek island in the central Aegean Sea and the centre of ancient marble trade in antiquity. The marble of Paros, quarried on the island since the 6th century BCE, is well-known for its clearness and translucence and famous sculptors - Praxiteles, Polykleitos and Skopas -

[Return to top of document](#)

[Return to top of document](#)

used it create some of their masterpieces. Underwater excavations in the harbor of Paros have recovered marble objects (sculptures and architectural parts), originating from shipwrecks as well as from the submerged cemetery of the port-city of Paros. I am preparing the publication of these objects, which will shed light on the history and marble trade of this important island. I seek an undergraduate student with drawing skills, who will draw the archaeological finds in situ. The marble objects are located in the storage area of the Archaeological Museum of Paros, which is open from 8am to 3pm. The student will spend two weeks on Paros during July preparing the final drawings of these objects in Illustrator.

## **BIOLOGY**

*Erol Akcay*

### **Project: Modeling the evolution of social and ecological interactions**

Research in my group is mainly theoretical and focuses on evolution of ecological and social interactions. Undergraduate researchers in my group develop their own independent projects. This involves critically reading and synthesizing primary literature, developing a mathematical or computational model of a biological or social phenomenon, analyzing the model, and/or conducting metaanalysis of publishing results. I closely mentor the students in all these steps, and there are also opportunities to collaborate with postdoctoral fellows in the lab.

A basic familiarity with mathematical modeling (including calculus) and some coding ability is preferable. Students can expect to gain experience in analyzing ecological and evolutionary dynamics, game theory, and network modeling. The goal of the projects is to produce publishable results and publish them. To that end, students are encouraged to continue the projects they initiate during the fellowship in the subsequent academic year for research credit.

Current areas of particular interest include (but are not limited to): cultural evolution, evolution of social behaviors on dynamic networks, mutualisms and the assembly of ecological networks, interactions between humans and ecological systems. Students are encouraged to read recent papers (including preprints) from the lab webpage:

<https://erolakcay.wordpress.com/publications/> to get a sense of the range of topics and approaches we use in the lab.

[Return to top of document](#)

*J Nicholas Betley*

**Project: Deconstructing the neural control of food intake**

In this project, students will perform research aimed at understanding how neural circuits in the brain influence food intake - both amounts of food consumed and the choice of food made. Experiments will be performed in rodent models, so students should be comfortable working with living animals. Experiments will involve behavioral assays designed to test how activity in distinct populations of neurons in the brain contribute to food intake. Over the course of these experiments, students will learn how behavioral tests are designed, how neurons in the brain can be controlled with optogenetics/chemogenetics, and will learn about neural anatomy and how feeding circuits in the brain are wired.

*Nancy Bonini*

**Project: Drosophila models of human disease**

The Bonini laboratory uses *Drosophila* as a research model to examine mechanisms of human neurodegenerative disease. We have several projects available for highly motivated students, to work with research scientists in the laboratory, to investigate mechanisms that contribute to toxicity of human disease proteins. Students will work with flies, performing genetics, as well as becoming involved in various other techniques to assess the effect on the animals, such as examining brain sections and assessing survival.

*Junhyong Kim*

**Project: Sub-cellular Genomics of Brain Cells**

Brain cells, especially neurons, are classic examples of complex cells whose central function involves highly distributed processes. As is well known, a neuron integrates and translates inputs from its synapses into electrical potentials. Along with its electrophysiological dynamics, the neuron also displays transcriptional regulation and response and dynamic remodeling of sub-cellular architectures such as synapses through translational responses. Long-term potentiation mediated by synaptic remodeling and translational response is especially well-studied. The requirement for novel protein synthesis for synaptic remodeling raised the question of how each synapse can be independently modulated when protein is centrally translated in the soma. This problem was resolved by the discovery of dendritic RNA localization and local protein

[Return to top of document](#)

translation in discrete “hot-spots” along the dendrite, leading to the still active study of RNA localization mechanisms and identification of local transcriptomes.

The project will involve using state-of-art single molecular visualization techniques to study the distribution of RNA along dendrites of mouse neurons and assay how the distribution might alter with external stimulation that elicit innate immune response in the cells. The student will work with a current PhD candidate student to measure RNA distribution using in situ hybridization and fluorescence microscopy. The results of this work is expected to have relevance for human neuropsychiatric diseases.

*Dejian Ren*

**Project: Genetic variations in neuronal excitability, intellectual disability and neurodegenerative diseases**

The brain uses electrical signals to control essentially every aspect of our life: from breathing and walking to speaking and intellectual reasoning. We study how ion channel proteins regulate the generation of electrical signals in the brain. Many genetic variations in the ion channel genes we study have been linked to hypotonia, lack of speech development, severe intellectual disability and neurodegenerative disorders such as Parkinson’s, but how the variations lead to human diseases is not understood. The summer project will study the functional consequences of the variations. Specifically, the student will generate mutant ion channel genes and compare their function with that of the wild-type. She/he will also have the opportunity to use animal (mouse) models to model the human diseases.

*Marc Schmidt*

**Project: Neurobiology of courtship behavior in songbirds**

Courtship is a complex behavior that is used to attract a mate. In songbirds, this behavior is accompanied by ritualized behaviors and complex vocalizations and is under the control of a dedicated "cortical" neural circuit known as the "song system". While much is known regarding the neurophysiological details of this circuit in males and its role in song production, much less is known about its role in females. An important aspect of courtship behavior in females is the production of a copulatory solicitation display (CSD) which females will produce in captivity when they are exposed to high quality male songs. Our laboratory has shown that targeted lesions to this neural circuit alters the highly selective nature of this behavior causing females to

[Return to top of document](#)

[\*Return to top of document\*](#)

produce CSD even to low quality songs. This loss of preference suggests a neural circuit in females that integrates information about song quality and transforms it into motor commands that drive copulatory behavior.

Our laboratory uses a variety of techniques including neurophysiology, computer vision based behavioral quantification in small behavior boxes as well as in a large outdoor aviary with ~ 20 birds, viral-mediated tract tracing and ablations, to study the role of this circuit in courtship behavior. Interested students may choose from a variety of potential projects that range from more neurophysiological to more behavioral in nature. Irrespective of the specific project that is chosen, the student will be exposed to the multi-faceted approach that our laboratory is taking to address these questions.

*Paul Schmidt*

**Project: Microbiome mediation of population and evolutionary dynamics**

Local adaptation is the process by which populations evolve in response to environmental conditions that are spatially and/or temporally restricted; understanding the mechanisms and dynamics of local adaptation remains one of the most fundamental goals in evolutionary biology. Until recently, this process was thought to only involve changes in the genetic composition of a single population. However, it is now clear that endosymbionts (e.g., *Wolbachia* in insects) and the gut microbiota may also change in response to local fitness landscapes and can also greatly affect host fitness. Our previous results demonstrate that 1) bacterial manipulations (the associated microbiota) can have robust and predictable effects on population growth, persistence, and maximum size; and 2) the manipulation of the microbiota results in rapid (within 3 generations) and predictable change in allele frequencies genome-wide.

We will use our field experimental facility at Pennovation and manipulate the *Drosophila* associated microbiota over a period of 10-15 generations. Population dynamics will be monitored, and comprehensive phenotyping over time will be used to examine what traits change in response to the manipulations; this includes metabolomics, patterns of gene expression using RNAseq, and a series of fitness-associated traits (body size, metabolic pools, stress tolerance, growth rate, etc.). Samples will also be taken from each experimental replicate at each time point for genome sequencing.

This project uses *Drosophila* as a model genetic and experimental system, and involves field work, laboratory culture, and genetics.

[\*Return to top of document\*](#)

*Michael Weisberg*

**Project: Community Science in the Galápagos Archipelago**

The Galápagos Archipelago is a series of 18 large volcanic islands located off the coast of Ecuador. Famously the inspiration for Darwin's ideas in *On the Origin of Species*, the islands remain an important focal point of biological work due to their relative isolation, their large number of endemic species, and their unique and fragile ecosystems. Unfortunately, due to the increasing popularity of ecotourism, the growing local population, and changes in global climate, these islands face many ecological challenges.

This project attempts to address some of these challenges. While other organizations are also attempting to save local species and habitats, our research group is focused on the community of galapageños. Despite living in one of the most biologically sensitive areas on the planet, the full-time residents are largely unaware of the environment in which they live. Prior attempts at environmental mitigation in the islands have taken the form of protocols imposed on the community, hence these attempts are often seen as annoying interferences with daily life. Research in our labs and elsewhere suggests that this is a mistake; the kind of scientific and ecological literacy required for action crucially involves an appreciation of the nature and character of the scientific research process. Even more importantly, community leaders have emphasized repeatedly to us that the most profound, ecologically positive changes have come when the youth of the Galápagos have been engaged in ecological matters. Besides the Penn team, you will work together with local leaders and community members in a series of projects that address pressing issues where ecology, climate change, poverty, and educational inequality intersect.

## CHEMISTRY

*Tobias Baumgart*

**Project: Using gene editing to engineer fluorescent proteins suitable for super-resolution imaging of cellular membrane trafficking**

Membrane trafficking is ubiquitously used by cells to transport molecules and information to and from the cell surface, as well as among intracellular membrane compartments. At the plasma membrane, this is largely accomplished by the processes of endo- and exocytosis, i.e. the internalization of the plasma membrane to form intracellular vesicles and the fusion of vesicles with the plasma membrane, respectively. Endocytosis involves the bending of close to flat membranes into highly curved, spherical membranes called vesicles. Since lipid bilayers resist

[Return to top of document](#)

bending, an important question is: what exactly are the mechanisms by which membrane curvature can be generated. The answer to this question is highly complex, but it is increasingly clear that proteins with crescent shaped membrane binding domains (called BAR domains) contribute to these processes. Our lab is elucidating mechanisms by which such BAR domains generate membrane curvature. Such studies are facilitated by the cellular expression of fluorescent protein chimera. However, overexpression of such proteins can produce artifacts. We are therefore developing gene editing approaches which allow controlled expression of BAR proteins fused with photoswitchable proteinaceous fluorophores. Photoswitching will ultimately allow us to image membrane bending processes with a spatial resolution that surpasses that of ordinary optical microscopy, and we will be able follow dynamic events in life cells. This project involves numerous techniques highly suited for undergraduate student involvement, ranging from molecular cloning over cell culture to imaging experiments.

*Karen Goldberg*

**Project: Synthesis and Reactivity of New Transition Metal Complexes**

This project will focus on synthesis of novel organometallic complexes and subsequent exploration of the reactivity of those complexes with hydrocarbons and oxygen. The broad goal of this project is to develop transition metal catalysts that will enable the synthesis of chemicals and fuels from more sustainable sources. A student working on this project will learn a variety of advanced synthetic techniques, including air-free methods (such as using glove boxes and vacuum lines) and also learn how to operate a wide range of laboratory instrumentation (including spectrometers and gas chromatographs). Additionally, the student will gain experience in presenting their science both orally and in writing, and hopefully contribute to a published scientific report.

*Marisa Kozlowski*

**Project: Reaction Optimization by Statistical Modeling**

Development of new computational models for reaction optimization based on statistical modeling. Electronic structure and quantitative structure activity relationship calculations are used. The results establish mechanistic pathways and the determinants for selectivity. This information in turn is used to predict the outcomes of modified systems with the aim of improving yield, selectivity, or scope.

[Return to top of document](#)

*Sergei Vinogradov*

**Project: Optical Molecular Probes for Physiological Analytes**

The project will entail organic synthesis and photophysical characterization of luminescent molecules that will be used in construction of luminescent probes for physiological analytes, such as pH, oxygen, metal ions. Once constructed the probes will be immediately used in imaging in live animals (in collaboration with different groups at Penn Medicine as well as outside Penn).

Alternatively, a project might be directed more towards microscopy/imaging itself, e.g. working on construction of a laser microscopy setup for new types of imaging.

## CLASSICAL STUDIES

*Peter Struck*

**Project: Study of Penn Undergraduate Career Exploration Programs**

The research question of this project is: what sorts of programs will help undergraduate students make the most of their undergraduate education and prepare them for a career that they are passionate about? Students interested in education research, or social science research more generally, are encouraged to apply. The project will start with exploration of existing social science studies on self-reflection activities and career exploration. The remainder of the project will involve structured interviewing and development of a survey to evaluate opportunities for program development at Penn. This research will not study what happens in Career Services and OCR. It will focus instead on what Penn is doing to help students decide what kind of careers they desire to pursue in the first place. Applicants should be able to critically evaluate social science research and have experience in survey development. The PURM student will work directly with both Dr. Peter Struck and Dr. Cathy Schrand of Wharton's Accounting Dept.



## EARTH AND ENVIRONMENTAL SCIENCE

*Alain Plante*

### **Project: Legacy of coal mining sediments in alluvial soils in central Pennsylvania**

Pennsylvania has a long legacy of coal mining, which can be seen through the presence of high concentrations of coal in legacy sediments found in floodplain and riparian soils along the Susquehanna and Schuylkill rivers. These sediments have been in place for up to 150 years and have undergone plant succession and other soil forming processes. This collaborative project seeks to determine the extent of these coal legacy deposits and the long-term environmental consequences of these materials. The summer research project would involve reconnaissance fieldwork to observe, map and sample sites, as well as laboratory-based chemical characterization of these soils to distinguish between neogenic soil organic carbon and coal-derived geogenic carbon. Additional experiments would test for microbial activity in coal-contaminated soils, and for concentrations of heavy metals.

*Lauren Sallan*

### **Project: How Have Ice Ages Impacted Fish Biodiversity in the Oceans?**

Earth has been in the grip of an Ice Age for most of the last 34 million years. While the current absence of mile-high-glaciers over Manhattan and mammoths over the last 10,000 years suggests relative warmth, the presence of polar ice caps shows we are still in one. For most of the history of life on Earth, there has been no ice what-so-ever, even in winter; the poles and tropics were indistinguishable. The evolution of current biodiversity was likely heavily influenced or even suppressed "Ice House" conditions. Indeed, recently studies suggest marine fishes at the frigid poles have been evolving much faster than those in the tropics, even as global diversity has declined. Yet, these limited studies routinely ignore the fossil record; we do not even know how many fish species lived 1 million years ago due to an absence of appropriate datasets. This prevents full understanding of where living species come from and predictions of what might happen in a warming, or ice-heavy (minus human intervention) future. This project will involve combing the literature and museum collections to assemble the first-ever database of fish biodiversity over the last 34 million years. This data will then be analyzed to determine if fishes diversify and evolve in predictable ways during maximum glaciation and warm "interglacials" such as the one which enabled human civilization to flourish over the last 10,000 years. Students will learn and apply important "Big data" approaches to paleontology and evolution, including databasing techniques, quantitative and statistical analyses, and programming in R and other

[Return to top of document](#)

languages. Students will also attend lab meetings, speak with collaborators, and have to opportunity to pursue efforts after the summer towards authorship on one or more scientific papers.

## EAST ASIAN LANGUAGES AND CIVILIZATIONS

*Paul Goldin*

### **Project: Bibliographies in Traditional Chinese Studies**

I maintain three online bibliographies in traditional Chinese studies: “Ancient Chinese Civilization: Bibliography of Materials in Western Languages” (more than 12,000 entries), “Gender and Sexuality in Pre-Modern China: Bibliography of Materials in Western Languages” (ca. 1,425 entries), and “Ancient Chinese Manuscripts: Bibliography of Materials in Western Languages” (ca. 500 entries). This has become an ongoing public service because the files get literally thousands of hits and are frequently cited in relevant scholarship, but keeping them up to date is difficult for one human being. Many items (especially very recent publications) have to be labeled "not seen," for example. A student interested in Chinese history and/or bibliographical methods could be very helpful in locating such items and helping to evaluate them for inclusion. To be sure, the project is highly academic, but this would be a hands-on experience for students to familiarize themselves with library work (both in the building and online) and the principles of assembling a useful research bibliography.

Since the bibliographies comprise works in Western languages only, knowledge of Chinese is by no means a prerequisite.

## ECONOMICS

*Petra Todd*

### **Project: Understanding Effects of Mexico's Prospera Program on Reducing Inequalities in Schooling and Academic Achievement**

Conditional cash transfer (CCT) programs were first introduced in Brazil and Mexico (Prospera aka PROGRESA/Oportunidades) in 1997. CCTs condition monetary transfers to poor families on children's school attendance. They aim to alleviate current poverty and future poverty by

[Return to top of document](#)

[Return to top of document](#)

augmenting poor children's human capital – and thereby reduce inequalities associated with parental socioeconomic status (SES), ethnicity, gender and urbanization.

This project will assemble data and use novel strategies to estimate long-term Prospera impacts on student learning and achievement, on which little is known despite its importance. The project will use administrative data from schools in Mexico to analyze how Prospera affects inequalities by 1) SES, 2) ethnicity, 3) gender and 4) urbanization, as well as other geographical dimensions including isolation and school quality. So far, there is one other graduate student (named Gabrielle Vasey) involved in the project.

## ENGLISH

*Jed Esty*

### **Project: Cold War Victorians: How the British Imagination Shaped American Power**

In this research project, tentatively entitled “Cold War Victorians: How the British Imagination Shaped American Power,” I compare two global dream factories that have shaped almost all of our contemporary modes of genre fiction: late-Victorian popular fiction and midcentury popular American film. Crucially, these two dream factories both spoke English. Together they describe the arc of what we might call Anglophone export fiction as it moves westward across the Atlantic and into the twentieth century. One might in fact observe that the explosive growth of genre fiction itself in the decades after 1880 in Britain anticipates America's robust popular-cultural machinery in the decades after 1930. I follow the symbolic baton pass from one hegemon to the other by digging in to the history of classic pop genres as they are modernized and Americanized in the decades stretching from the 1880s to the 1960s. This approach produces longitudinal case studies of key texts such as H.G. Wells's *War of the Worlds* (1897), which changes political shape into the notorious panic-inducing radio script of Orson Welles (1938) before landing as a rather bland Hollywood alien movie in the early 1950s. A long-rooted genealogical analysis of spy novels, detective fiction, alien invasion plots, and Victorian science fiction gives historical ballast for understanding the contemporary boom in genre fiction. From an even wider perspective, the generalized anxiety in post-Obama America about the end of our nation's centrality on the world stage makes it all the more pressing to find historical backgrounds and analogues for our shaping fantasies about global power. My goal is to renovate both British and US empire studies by combining them, and to open the entire conversation outward from literary to popular culture, from academic to general readers.

Table of Contents

1. Huck, Kim, and the Epic of National Innocence: Twain, Kipling and Cold War Criticism

[Return to top of document](#)

[Return to top of document](#)

2. Disney Victorians: The Trans-Atlantic Afterlives of Classic British Children's Literature
3. Imperial Light Opera from The Mikado to South Pacific
4. Blank Imperialism 1910/1960: From Polar Fever to the Space Race
5. Occidental Terrors: Conrad, Nabokov and the Fear of an Open Society
6. Aliens Attack!: The Fiction of Invasion from Imperial Britain to Cold War America
7. H.G. Wells, Orson Welles and the Americanization of War of the Worlds
8. The Plot of Paranoia: The Spy Novel as a North Atlantic Genre
9. Primitivism, American Style: What Saul Bellow Learned from D. H. Lawrence
10. The Frontiers of Film History: Classic Westerns and the Hollywood Raj

If I am assigned a PURM Research Assistant, I will ask the him/her to dig pretty deeply into chapter 3, 4, or 10, depending on research and academic interests/affinities.

*David Kazanjian*

**Project: Tepoztlán Institute for the Transnational History of the Americas**

This project seeks an undergraduate assistant to work with the Tepoztlán Institute for Transnational History of the Americas (see <https://www.tepoztlaninstitute.org/home.html>), on whose board I have served for 11 years and of which I am currently the co-director. Founded in 2004, the Institute's primary mission is to hold an annual, intensive, interdisciplinary, week-long conference (July 18-25) in the village of Tepoztlán, Mexico, devoted to the historical study of contemporary social and political dynamics that cut across national borders, transcend local contexts, and link multiple regions of the Americas. The theme of this year's conference is "Bodies of Water: Flows, Wars, Floods, Wakes" (see <https://www.tepoztlaninstitute.org/2019-conference.html>). The assistant would join me and two to four PhD students from Penn in a summer study group which would discuss the assigned conference theme readings and participant papers once weekly for nine weeks leading up to the conference. The assistant would then attend the conference in Mexico and participate in all the sessions, with faculty and graduate student attendees from throughout the Americas. The assistant would also assist me and my co-director in providing on-site logistical assistance during the conference, including for a few days prior to the conference start date. The ideal assistant would also help with occasional Spanish-English interpretation during the conference sessions.

[Return to top of document](#)

[Return to top of document](#)

*Jennifer Ponce de León*

**Project: Art and Politics across the Americas**

My research examines politically-engaged visual and performance art, theater, and literature within an interdisciplinary framework, aiming to analyze artistic productions in light of the social context in which they were produced and, in some cases, the social movements of which they form part. I focus on work that is experimental in its form and that often extends into areas not typically associated with the arts, including critical cartography, historiography, walking as an artistic practice, and direct-action protest. This summer, I will be doing research for a new interdisciplinary book project that focuses on recent work from art groups and individual artists and writers based in Argentina, Brazil and the U.S. I need a Research Assistant to help me gather, review, and take notes on scholarly and journalistic literature as we build annotated bibliographies on several topics related to this project (which can be tailored to a certain degree to best suit the Assistant's interests and strengths). Topics of research may include: creative and activist uses of cartography, racism and anti-racist movements in Brazil, the history of radical pedagogy, artists' use of historical archives, contemporary social movements organized to resist gentrification and the displacement of working-class communities, and artistic production in all mediums that addresses Latin American immigration to the U.S. and anti-immigrant politics. A Research Assistant will work with a broad range of scholarly sources from both the humanities and social sciences and will learn about interdisciplinary scholarship. Applicants do not need to have prior experience working on any of these topics. The ability to work with Spanish and/or Portuguese language texts is a plus, but not required.

## GERMAN

*Liliane Weissberg*

**Project: In Circulation: Modern Literature, Philosophy, Art, and the Medium of the Postcard**

While the first post card was sent in 1840, the so-called "Golden Age" of the postcard lasted from the late nineteenth century to the 1920s. During this time, the postcard changed from a mass-produced correspondence card to the more elaborate view card. The insistence on the brevity, the speed of communication, and the introduction of images were welcomed as modern progress, even though questions regarding privacy surfaced early on. After all, the postcard was not just a brief letter, it lacked an envelope.

[Return to top of document](#)

[Return to top of document](#)

Writers, philosophers, and artists adopted the use of postcards early on, and I would like to claim that this medium has left traces in their literary and artistic production at large. Let me call it the “postcard effect.” In my new book, I would like to study this “postcard effect” in a group of postcard writers (Walter Benjamin, Sigmund Freud, Franz Kafka, and others), as well as the historical and political context of the emergence of the new medium.

A PURM Fellow would aid me in my research: locating and organizing the visual material, helping me with obtaining library material, and discussing the material with me. This will introduce the student to the process of doing scholarly work, writing scholarly papers. The work/research will also be a good introduction to literary and visual and media studies and the period of modernism. I would be primarily interested in a person engaged in questions of culture, in early twentieth-century literature and perhaps philosophy, and in history of art and visual studies (whichever emphasis). It would be great if the student would be interested in German culture, but German would not be a necessary prerequisite.

## HISTORY

*Ann Farnsworth-Alvear*

### **Project: History of Mexican and Latin American Immigration to the United States**

History department faculty seek to develop a new course that will contextualize the current politics of immigration by providing students with an overview that looks back to the 19th century and includes in-depth discussions of the key turning points including the bracero program of the 1940s-50s, the arrival of refugees fleeing counter-insurgency violence in the early 1980s, and the 1994 roll-out of "Prevention through Deterrence" as a border policy. Interns will gain research skills and receive feedback on their writing as they develop an extensive bibliography for faculty use.

*Marc Flandreau*

### **Project: "Lame Ducks" in the London Stock Exchange 1780-1801**

As part of a book project on which I will work this Summer, I will need a student to work with the user friendly search engines of leading British historical newspapers database to organize information on the occurrence of the expression "Lame Ducks" (as people who committed fraud in the London stock exchange defaulters were known). A pilot study has suggested that the

[Return to top of document](#)

[\*Return to top of document\*](#)

expression surfaced in clusters, reflecting periods of market anxiety, and the ultimate goal will be to establish this rigorously. The task for the student will be to use the newspapers and their search engine to search systematically for the expression "lame duck" collating the context and information that was released at that point (not necessarily financial!!) to be used as correlate. The research does not require any skills in economics, though students with an economics background might find the project of interest to broaden their horizon. The key quality for the project is care, precision, and curiosity. (A willingness to cope with "quaint" 18th century British English should be also a plus). Finally, in order to put the information together the student will need to master the most basic commands of a simple software such as excel. All the required training will be provided by myself at the beginning of the Summer semester, after which the student is expected to show research autonomy (but I will remain available all along for questions etc.). I think of it as a wonderful opportunity for a highly motivated student with eclectic historical, linguistic and at least "mildly tech" interests and curiosities.

*Melissa Teixeira*

**Project: Everyday Economic Life in Hyperinflation Brazil**

This project explores the social, economic, and political experience of inflation and hyperinflation in Brazil under Military Dictatorship (1964-1984) and subsequent transition to democracy. The project – in its earliest stages – is the subject of my second book. Collaboration with a research assistant would allow me to complete preliminary research accessible at Penn, to in turn write a proposal for funding for travel to Brazil to conduct archival research. The student will be asked to pull, consult, and organize primary sources and economic data using library resources. Their first task will focus on materials on IMF and World Bank interventions in Brazil. They would also consult the institutional websites of these organizations to pull materials from the 1960s to the 1990s. Students will be asked to digitize and prepare brief summaries of materials, and to organize them into a digital research catalogue. The input of economic data into Excel will be another assignment, as well as making graphs/tables. Given the focus on IMF/World Bank, all sources will be in English. No prerequisites or prior experience necessary, but knowledge of Portuguese or Spanish would be a bonus to allow me to expand the types of sources the student accesses. Students will acquire: 1) experience using research catalogues/databases and digital resources; and 2) skills working with quantitative data and an introduction to Excel (including how to make graphs). The student will also engage with the practices and politics of economic policymaking and acquire familiarity with the institutions that still govern the global economy.

[\*Return to top of document\*](#)

## HISTORY & SOCIOLOGY OF SCIENCE

*David Barnes*

### **Project: The Legacy of Freedom and Servitude: One Family's Unusual Story**

In early August of 1800, two ships sailed into the Port of Philadelphia, their cargo holds stocked with contraband: 137 human beings from West Africa, shackled, unclothed, and underfed. The two ships had been transporting the Africans to Cuba in violation of U.S. law when they were captured off the coast of Cuba by the American warship *Ganges*. Captain John Mulloony of the *Ganges* put his own sailors in command of the two ships and sent them to Philadelphia, where a federal judge declared the Africans free and placed them in the custody of the Pennsylvania Abolition Society. The society gave them all the surname *Ganges* and indentured them as servants to local families for four years (or until adulthood in the case of children), with the proviso that they learn a trade and be taught to read and write.

Thus began the saga of an unusual African-American "family." Today African-American families named *Ganges* are scattered around the Philadelphia area and the rest of the U.S., along with many other descendants of the original 137. This project aims to reconstruct the lives and experiences of the original *Ganges* Africans and their descendants down to the present day. The student researcher will do extensive archival and genealogical research, using both original documents and online resources. Coursework and/or research experience in history is desirable but not required. Curiosity and a thirst for discovery are mandatory!

*Sebastián Gil-Riaño*

### **Project: Redeeming Race?: Anti-Racist Science and Postcolonial Development in the Twentieth Century**

This upcoming summer I will work on a book manuscript for Columbia University Press. My book tells the history of international efforts to end scientific racism after the Second World War. Existing accounts of this story have highlighted the role of scientists in the US and the UK. By contrast my book examines the role played by scientific experts in what is now increasingly referred to as the Global South. My book examines how social scientists and life scientists from diverse nations including Brazil, France, Argentina, Mexico, Peru, and New Zealand shaped international anti-racist projects such as the UNESCO Statements on Race, which typically denounced biological determinism and instead celebrated the economic potentiality of all human beings. Through these denunciations, my book argues, anti-racist scientists paradoxically paved the way for interventions in the "third world" that resembled earlier colonial civilizing missions,



[\*Return to top of document\*](#)

which drew on overtly racist ideas. My book is informed by critical perspectives from several fields including global histories of science, postcolonial studies of science and technology, indigenous studies, race and ethnicity studies, and Latin American studies.

I am looking for help with a variety of research, writing and editing tasks. This can include finding sources in local archives and libraries or online, translating quotes written in French, Portuguese, and Spanish, finding photographs and requesting permission for their use, copy-editing written work, and managing bibliographic information. Students can expect to gain valuable research skills and to learn more about the following fields: the history of race science, the history of international development, the history of international organizations and the United Nations System, Latin American history, and Indigenous Studies. Language skills in Spanish, French, or Portuguese are an asset but not a prerequisite.

## **LATIN AMERICAN AND LATINO STUDIES**

*Tulia Falletti*

### **Project: Global Citizenship and Indigenous Rights**

Project 1: Indigenous Rights and Demands around the World

Are you interested in learning about indigenous populations' rights and demands in countries around the world? Do you enjoy reading legal documents, such as constitutions, bill proposals, and legislation? Do you enjoy working with news and other types of archives? Are you fluent in a second or third language that you would like to put to use this summer? In this research project, you will gather information from legal documents about indigenous' populations rights in countries throughout the world and build a database of rights, particularly in reference to plurinationality, self-government or autonomy, territory, prior consultation, and intercultural education. Once this first task is complete, you will gather and organize information on indigenous populations' collective organization and demands around those and other issues. Fluency in Spanish is highly preferred, but not required.

Project 2: Educating for Global Citizens: The Penn Model OAS Program Research and Evaluation Project

How do we educate for global citizens? If you are interested in learning about global civic education and would like to assist with evaluating a new program being offered by the Latin American and Latino Studies (LALS) program, then this may be the research project for you.

[\*Return to top of document\*](#)

[Return to top of document](#)

This research project has multiple components. Working directly with LALS Associate Director Dr. Catherine Bartch, you will engage in a multi-method evaluation of the Penn Model Organization of the American States (MOAS) program.(\*). You will assist with aggregating and analyzing data from pre and post-surveys, gathering additional data through qualitative interviews of program participants, performing content analysis on written work, and engaging in an extensive literature review on themes related to educating for a global citizenry. In addition, you will have the opportunity to help with executing a participatory action research plan through focus groups of Penn MOAS participants and partners.

Another segment of the LALS - Penn MOAS Research involves researching how universities across the Americas are educating students for democracy, either through civic education curriculum or efforts to engage young adults politically and civically. Part of this research will focus on civic education programs being supported by Latin American and Latino Studies programs.

(\*) The Penn Model OAS program is a university-community partnership engaging Penn undergraduates with local public high school students in interactive, experiential learning about the OAS and social, economic, and political issues of the Americas. Penn undergraduates prepare high school students to serve as “diplomats” in the annual Model OAS simulation in Washington, D.C. in late November. During the semester, all students write policy papers, research OAS member countries and issues pertaining to the four pillars of the OAS – democracy, development, security, and human rights. They also engage in public speaking, and interact with policy experts, public officials, and leading scholars in the field. Overall, the student-centered Penn Model OAS program strives to activate and educate a global participatory citizenry. Additional information about the Penn MOAS program can be found at <https://lals.sas.upenn.edu/welcome-penn-model-oas>.

## LINGUISTICS

*Eugene Buckley*

### **Project: Kashaya Dictionary**

I am working on the completion of a comprehensive dictionary of Kashaya, an endangered Native American language of northern California. I seek a research assistant to help with various aspects of the editing of the database on which the dictionary is based, as well as the design of the dictionary itself in its various forms: an online dictionary; a printed scholarly dictionary; and practical wordlists. There are also web and smartphone implementations that feature audio files

[Return to top of document](#)

[Return to top of document](#)

for learning words and pronunciation: see <<http://www.ling.upenn.edu/~gene/kashaya.html>>. The focus of work will depend on the student's background and interests, and technical skills.

Tasks could include checking the English definitions for clarity and consistency; classifying entries according to their semantic category; analyzing example sentences by means of the lexical entries; verifying that the structure of the Kashaya words is correctly encoded, with links between roots and derived forms; and finding examples to illustrate the entries by looking in existing texts.

In assisting on this project, the student will learn the basic structure of a complex and fascinating language, and will gain experience in the documentation of languages in general. The collaboration could easily lead to a subsequent research project on any aspect of Kashaya that the student finds interesting.

Naturally, no previous knowledge of Kashaya is expected, but some knowledge of linguistics (from at least one course) is necessary. The student should understand basic aspects of phonetic transcription and morphological structure.

*Gareth Roberts*

### **Project: Laboratory language games**

In my lab participants take part in experiments in which they play games with each other using artificial languages. In some experiments they collaboratively construct novel communication systems from scratch, using colors or drawings instead of sounds or signs. In the past we have investigated how features of different dialects acquire social meaning, and how people learn it, or how phonemes becomes organized into well-dispersed sets, or how noise and time pressure affect the messages people send. Because some people reading this might become participants, and I don't want to give away the purpose of specific experiments, I won't say more here about the specific experiments we'll be running over the summer. However, if the sort of thing we do sounds fun and interesting, please get in touch.

If you work in my lab, you will get experience running experiments. You will get experience designing experiments. You will get experience reading relevant literature and discussing it. If you have programming skills you can put them to use designing software for games to run on, or in analyzing the data we get out. If you don't have programming skills, you can make the first steps to gaining some. We will have more than one project going at once, and I'll work to find you a role that best suits your skills and interests. Also, if you have a great idea for an experiment we may be able to design and run it together.

[Return to top of document](#)

## NEAR EASTERN LANGUAGES AND CIVILIZATIONS

*Talya Fishman*

### **Project: Curricular Redesign: "Jewish Political Thought and Action"**

Redesign of this twice-weekly undergraduate seminar will accomplish the following desiderata:

- (a) Fashion a new theme-based conceptualization that easily accommodates the juxtaposition of "pre-modern" (i.e., pre-18th century Emancipation) and "modern"/contemporary sources in as many class sessions as possible.
- (b) Ensure that course materials bring contemporary concerns into focus from the earliest class sessions. These concerns include; Jews in contemporary America; contemporary antisemitism, ideological and sociological tensions between liberal democracy and Jewish sovereignty in the contemporary State of Israel; contemporary theological perspectives that have bearing on group, state and international power relations.
- (c) Select and integrate additional audio-visual and artifactual materials into the curriculum.
- (d) Identify and integrate additional out-of-classroom learning experiences.

The student selected for this project will gain, or improve, these skills:

- (1) familiarity with the trajectory of Jewish history, from biblical times to the present, and an understanding of the ways in which developments in Jewish culture have always been historically and geographically contingent, that is, shaped by specific cross-cultural environments.
- 2) familiarity with primary sources, scholarship, journalism and other media that expose undergraduates to the constituent topics with maximum impact (and pithily).
- 3) an understanding of the ideals to be met in fashioning an undergraduate curriculum, and the strategies to be deployed.

While much of this work may be done remotely, the selected student researcher must be in regular (and frequent) contact with faculty mentor. The student must have access to an excellent academic library, superb web skills, and an intellectual appetite for the topics that fall within the course rubric.

## PHILOSOPHY

*Susan Meyer*

### **Project: Plato and Aristotle: Ethics and Politics**

I have two projects on Classical Greek philosophy on which I would welcome research assistance from undergraduates who have (a) taken at least one Philosophy course at Penn and (b) enjoy philosophical writing and careful textual study. Knowledge of ancient Greek language or history is not required (although it is an asset), and for the second project strong reading competence in German is very desirable. Both projects involve studying primary texts (in English translation) as well as scholarly literature, writing up analytical summaries, and meeting regularly with me to discuss results.

Project 1:

Aristotle's conception of virtue in the NICOMACHEAN ETHICS. (Researching and writing a paper for publication, with special attention to bibliography).

Project 2:

Plato's LAWS, books 3, 4, and 5. (A translation and commentary on Plato's last and longest dialogue, which rethinks the positions taken in the REPUBLIC. Here Plato's Athenian considers the origins and purpose of legislation, the structure of a stable constitution, and the history of the Peloponnese, Athens, and Persia.) A research assistant with strong reading skills in German would spend time studying a recent commentary in German on this material.

## PHYSICS AND ASTRONOMY

*Marija Drndic*

### **Project: Two-dimensional materials: growth, device fabrication, electrical measurements, data analysis**

Under this broad umbrella theme of two-dimensional materials, we will have up to 5 focused projects on two-dimensional materials, devices and advanced data analysis within the field of nanoscience and nanotechnology. The first project entails the growth of new two-dimensional materials using chemical vapor deposition processes in the Drndic lab. The second project is focused on related characterization and device fabrication in the Singh Center to study the

[Return to top of document](#)

electrical and optical properties of these materials. In particular, these PURM students will help make single-atom thin membranes of new two-dimensional materials using several techniques in the cleanroom including lithography and etching and will help characterize them with optical and electron microscope techniques. Both students will work in close collaboration with Drndic lab graduate students and postdocs to improve the growth of materials to minimize and control the defects in these materials and to study how the structural properties (atomic content and arrangement) play a role in the optical and electrical features of these new materials. For a student particularly interested in the applications of these basic studies, we will offer them an opportunity to work on the application (device) side, which includes applications in biomarker detection, DNA sequencing and efficient water desalination with two-dimensional membranes. Finally, we employ advanced data analysis techniques and a theoretically-inclined student will have a chance to work on machine learning and similar data analysis tools in Matlab and Python (in collaboration also with Prof. Masao Sako at Penn Physics).

Drndic lab has pioneered several device studies and applications in this field and the PURM students will have the opportunity to work with a dynamic, internationally-recognized team, at the frontiers of the latest nano-science and applications. For ambitious students who are particularly hard working and successful, we offer opportunities for them to go with the lab to present at conferences during the academic year and other exciting opportunities when they join our team and show longer term commitment as well. For example, in the Summer 2018, Drndic lab hosted 5 PURM students (four were funded from Drndic NSF funds), and two of them will be presenting at an NSF conference in February 2019 in Washington DC.

The students will be trained by the Drndic lab and within the world class Singh nano fabrication facility. We expect the students to be self driven and motivated with good interpersonal and communication skills as team work and collaboration is required to pursue successful projects. Self-drive and persistence are the most important prerequisites. No other particular prerequisites are required besides a strong interest in physics and related fields and a strong self-motivation and work discipline and persistence in research. Graduate students in Drndic lab, including Paul Masih Das (MRSEC student), Priyanka Thiruraman (VIEST fellow), Sarah Friedensen (NSF fellow)

and Killian Chou (who performs his PhD on a collaborative project with CHOP), will be assigned as mentors depending on the particular angle of the project including the specific materials, materials growth or device measurements, for example. We can accept up to five undergraduate students to work in our lab during the summer on these aspects. Drndic lab has a strong record of mentoring high school and undergraduate students and keeping in touch with them after they move to graduate school or other successful career paths. Please also visit our Webpage, Facebook page, Twitter page for various lab activities. Undergraduate students will have opportunities to author papers.

[Return to top of document](#)

[Return to top of document](#)

*Jonathan Heckman*

**Project: Popularize a topic in particle physics**

Popularize a topic in particle physics. This could include the physics of the Higgs boson, the hierarchy problem, the cosmological constant problem, etc. Possibilities include production of videos, a website, etc.

*Elliot Lipeles*

**Project: Particle Physics Track Processing Hardware**

The Penn group is involved in designing the next generation of electronics for particle physics. This project is to be involved in the development and testing of prototypes for a very high volume pattern recognition system. The component we are developing is a circuit board (PCB) with an advanced processor called an FPGA on it (similar to a CPU). The project has several aspects including coding for the FPGA, developing software testing infrastructure the FPGA code, and coding a variety of hardware monitoring systems include the "IPMC" interface used in the "ATCA" telecom standard for high throughput processing.

The pre-requisites are familiarity with coding in general (Python preferred). Experience with Linux is a plus. The student will learn about hardware to software interfaces as well as significant additional coding. The student will be mentored by a combination of myself, team engineers, and graduates students.

*Christopher Mauger*

**Project: Experimental Particle Physics - Operating Detectors in a Neutron Beam at Los Alamos National Laboratory**

Near-term neutrino experiments will search for leptonic CP violation by precision measurements of neutrino oscillations. A key requirement is properly reconstructing the total energy of neutrino interactions. This summer, we will operate a cutting-edge scintillation detector designed for 3D reconstruction of events in a neutron beam at Los Alamos National Laboratory in New Mexico.

Using time-of-flight techniques, the data we collect will allow us to determine the detector's response to neutrons of specific kinetic energies. Neutron response is the most challenging and

[Return to top of document](#)

most impactful factor for determining the neutrino energy in neutrino experiments. Students will spend significant time in New Mexico commissioning the detector and running the experiment. They will also have the opportunity to participate in the subsequent data analysis. Students will learn all aspects of detector commissioning and operation - crucial for anyone contemplating a career in experimental particle or nuclear physics. Students will acquire significant hardware and software skills in order to conduct this work. Exposure to the rich scientific environment of the premier national laboratory is an unparalleled opportunity.

***Robyn Sanderson***

**Project: Exploring the Milky Way's dynamics with Gaia**

Galactic dynamics---the study of the orbits of stars in our Galaxy, the Milky Way---can reveal much about the Galaxy's contents and history. In April 2018 a new window opened on Galactic dynamics with the public release of data from the Gaia satellite, which has accurately measured the positions and velocities of 1.7 billion Milky Way stars. This new data, literally a thousand times better than our previous map of the Milky Way, is matched by advances in our ability to simulate the formation of Milky-Way-mass galaxies, from the initial conditions set by the Big Bang up to the present day. The high resolution of these simulations, which require tens of millions of CPU-hours to complete, lets us turn them into simulated maps like the one Gaia has made of the real Milky Way and directly compare predictions to observations.

Participating students will use simulated and real Gaia data to ask and answer new questions about the dynamical state of our Galaxy. Examples: can we tell where and when Milky Way stars formed by classifying their orbits? Can we estimate the amount of dark matter in the Milky Way or learn about its distribution? How many stars should we expect find at the very edge of the Galaxy, and what could we learn from them? Individual projects will be tailored to the student's interests.

Depending on their specific project, students will gain the following sorts of skills: coding in the Python programming language and the Jupyter notebook interface, accessing the Gaia archive, using the Linux operating system and bash shell, using a computing cluster and batch job management system, making and interpreting plots and images, and fitting models to data using an optimizer.



*Ravi Sheth*

**Project: A better ruler for making cosmological maps**

Baryon Acoustic Oscillations, measured in the spatial distribution of galaxies, are used as a standard ruler with which to measure the expansion history of the Universe. They are the primary science driver of a number of ongoing and planned large sky surveys. Over the course of the summer, you will develop a simpler, more robust way to use this ruler. The day-to-day work will involve a mix of guided reading (to learn the relevant bits of astrophysics and cosmology), computer programming, and data analysis (tricks associated with fitting polynomials to noisy data).

*Evelyn Thomson*

**Project: Data analysis of proton collisions at the CERN LHC**

The ATLAS experiment at CERN (<http://atlas.cern/>) is searching for new particles in the highest energy proton-proton collisions ever detected. Professor Thomson's group is exploring several new searches for particles in Minimal Supersymmetric Standard Model with an additional B-L symmetry, motivated by close collaboration with theorists at Penn. Undergraduate students will benefit from research experience on one of the world's largest science experiments, and gain highly transferable advanced data analysis and programming skills.

Three possible research projects are (1) investigating new selections to separate signal from background from other processes (eg <https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PAPERS/SUSY-2016-29/>), (2) improvements to the reconstruction and calibration of jets that are important for many searches (<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/JetEtmissPublicResults>); (3) data analysis and testing of advanced electronics chips for an upgrade of the detector (<https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/UPGRADE/CERN-LHCC-2017-005/>).

Prerequisites are Physics 150/151 or Physics 170/171. Previous knowledge of computer programming is helpful but not required. The main programming language used will be Python, with some C++. We have several copies in the lab of "A Student's Guide to Python for Physical Modeling" by Prof Phil Nelson and Jesse as a primer (<https://www.amazon.com/Students-Guide-Python-Physical-Modeling/dp/0691170509>).

Here are the links to the research summaries from students in summer 2018:  
<https://www.curf.upenn.edu/project/iyer-pranav-punch-through-uncertainties-atlas-detector>  
<https://www.curf.upenn.edu/project/panitch-samuel-truth-level-studies-b-l-rpv-chargino-decays>

*Liang Wu*

**Project: Searching for a new generation of bulk photovoltaics**

Nonlinear optical responses are fundamental to sum and difference frequency generation used in technical applications and provide a natural and sensitive probe of inversion symmetry-breaking at surfaces and in bulk materials. This project is motivated by a recent conceptual breakthrough that suggests a deep connection exists between strong nonlinearities in the optical responses of crystals and their momentum space band topology. Topological semimetals with broken inversion symmetry are ideal candidates since their band structures embed point degeneracies within strongly dispersing bands which are precisely the favorable ingredients for supporting strong topological characteristics in its response functions. In the proposed work we are aiming to search for new topological semimetals that provide even larger optical nonlinearities with possible uses in applications ranging from energy-efficient infrared detectors to topological bulk photovoltaics.

*Arjun Yodh*

**Project: Optics for Tissue Monitoring and Soft Matter Physics**

The reader should note that I am offering projects in two different subject areas: Biomedical Optics and Soft Condensed Matter Physics. Also, I am willing to take more than one student (in either project, or across projects).

Project 1: Non-invasive Optical Monitoring of Brain Hemodynamics with Diffuse Light

Undergraduate students will join on-going projects that utilize diffusing light to probe tissue physiology of the brain. The exact project will depend on the latest developments in our lab. Briefly, this biomedical research is oriented towards optical monitoring of deep tissue physiology, i.e., millimeters to centimeters below the tissue surface. The diffusion (random walk) model for light transport permits experimenters to quantitatively separate tissue scattering from tissue absorption, to accurately incorporate the influence of tissue boundaries and interfaces, and to use light at different wavelengths to carry out tissue spectroscopy and imaging. Further, dynamic diffuse optical methods monitor the speckle fluctuations of scattered light, which in turn are sensitive to blood flow. Collectively this work makes possible construction of novel instrumentation for non-invasive extraction of regional information about tissue blood flow, total hemoglobin concentration, and blood oxygenation, among other factors. The research in this project will measure and understand cerebral blood flow, oxygen dynamics, and oxygen metabolism during functional activation in healthy adults, during management of brain injury, especially stroke, and during surgical procedures. Students will use/develop state-of-the-art

[Return to top of document](#)

electro-optical instrumentation for these purposes; they will learn to analyze the optical signals, and opportunistically, they apply these tools in the clinic along with my graduate students and post-docs.

#### Project 2: Physics of Soft Materials: Colloids, Liquid Crystals, Membranes, and Emulsions

Undergraduate students will join on-going experimental projects that utilize optical microscopy, laser spectroscopy and micro-manipulation, wet chemistry and more, in order to understand the phases, dynamical properties, and mechanics of various soft materials. The exact project will depend on the latest developments in our lab. Briefly, one possible set of experiments seeks to understand how local structure drives assembly, rearrangement and deformation in disordered colloidal particle packings like glasses. This research utilizes novel particle systems with unique “knobs” for experimental control, including microgel particles whose diameter can be tuned with temperature. In disordered and partially ordered colloidal solids we will carry out experiments to elucidate the parameters which make a material “soft”. Another (different) project will study liquids with exotic elasticity: liquid crystals (LCs). Chromonic liquid crystals are new. They exist in water, and compared to traditional LCs, used in displays, they twist extremely easily. This leads to formation of chiral (helical) structures. Our experiments will probe fundamental properties and self-assembly of these LCs confined in drops, capillaries, etc. We also have projects that investigate the behaviors of magnetic nanoparticles in LCs, and which study reconfiguration of thin films due to swelling.

## POLITICAL SCIENCE

*Julia Gray*

#### **Project: How Do International Organizations Work? Credible Commitments, Backsliding, and Investment**

Some say the global order is in crisis -- but international organizations have always faced crises. Which organizations die off, and which ones thrive? What aspects of international organizations -- including their staffing, their budgets, and the member states involved -- make them resilient to crises and able to implement their mandates? Political scientists and economists have long theorized about the different ways in which countries can signal their credibility to investors. International commitments are one such mechanism through which countries can inspire confidence and attract investment. But after the financial crisis and in a world where countries backslide on their commitments, which of these commitments hold up? Students working on this project will research 120 different economic organizations around the world, gathering information on their activities, staff structure, decisionmaking, and financing. Students will gain

[Return to top of document](#)

[Return to top of document](#)

a deep understanding of the forces that allow countries to cooperate across borders, as well as why so many efforts at international cooperation face challenges. Students will also gather data on the degree to which countries uphold the commitments they make and track market reactions to those commitments. Area interests in emerging markets and developing countries is helpful; French or Spanish language skills requested. Knowledge of Python or R is a plus.

*Rudra Sil*

**Project: Is Putin's Russia truly "revisionist"? Continuity and Change in Russian Foreign Policy**

International Relations theory discusses emerging powers in terms of whether they are "revisionist" (seeking to transform the international order and become its most dominant state) or "status quo" (maximizing gains within the existing order). Russia under Putin has often been explicitly or implicitly treated as a "revisionist" power, especially over the past decade. This project is intended to explore just how much of a "revisionist" power Russia has been under Putin, at least when Russia's motivations and worldviews are traced over a longer arc dating back to the break-up of the USSR at the end of 1991. A thorough analysis of Putin's speeches and writing shows that (a) they have not changed fundamentally since he came to power at the end of 1999; and (b) they are not radically different from the views of his predecessor, Boris Yeltsin, whom many still see as having been more friendly to the West and even willing to follow the leadership of the West. Putin did lament in 2005 that the USSR's break-up was the "greatest geopolitical catastrophe" of the 20th century. But, a careful look at a major 2007 speech clarifies that he meant suggests that this was more about the unfortunate situation that resulted from the break-up in terms of the global balance of power and the emergence of national boundaries in 1992 that left millions of Russians within new sovereign states. These were not the statements of an empire builder but of someone seeking to reestablish Russia as a serious global player which required, at a minimum, the ability to respond to disputes close to its own borders, particularly given the constant push for NATO expansion and the explicit efforts to keep Russia at arms' length even during the Yeltsin years. Indeed, Putin's views, are hardly idiosyncratic among a broader Russian elite, are not all that distinct from those of Yeltsin, who was also annoyed by NATO expansion, also worried about the fate of Russians in the "near abroad," and also frustrated by Russia's inability to influence even its own backyard, let alone draw serious respect from other global powers. Seen through this wider lens, neither the 2008 conflict with Georgia, nor Russia's involvement in Ukraine, nor the effort to create a Eurasian Union are throwbacks to the Cold War as much as the behavior of a realist state fears NATO expansion and sees itself as needing to establish its credibility at least as a serious power, starting with being able to thwart the influence of the U.S. in the "near abroad." Such an interpretation is not intended as a justification of every course of action taken by Russia, but it does point to the need

[Return to top of document](#)

[Return to top of document](#)

for treating Russian foreign policy less in black-and-white terms and more as a matter of shades of gray. In other words, Putin is not a friend of the West, but nor is he out to resurrect what Ronald Reagan once called “the evil empire.” Russia has been reacting and improvising under both Yeltsin and Putin for quite some time, and it's efforts have simply become more assertive as the chaotic economic, political, and demographic crises of the 1990s have receded further into the past.

The PURM mentee selected to work on this project will be reviewing the content of some of Yeltsin's and Putin's most prominent foreign policy speeches and statements, as well as speeches and articles by key members of the Russian foreign policy establishment and books and articles by Western scholars who have been writing on Russian foreign policy.

## PSYCHOLOGY

*Sudeep Bhatia*

### **Project: Data science methods for studying human behavior**

Recent advances in machine learning, combined with the increased availability of large online datasets, have opened up new opportunities for understanding human behavior. With these new methods, it is now possible to observe what people read and talk about, and thus think and feel about, a wide range of common objects and events. The goal of this project is to study how these novel methods and datasets can be combined with existing psychological theory to predict and understand human behavior, with applications to health policy, political psychology, marketing, and social cognition. Students will contribute by performing literature reviews, programming and implementing studies, and analyzing data. Data analysis will involve natural language processing, simple machine learning, and psychological hypothesis testing, in Python. Prior programming experience is desirable.

*Elizabeth Brannon*

### **Project: Numbers and the brain**

The Brannon lab conducts research on preverbal number sense and its neural bases. Projects include fMRI studies that explore how children's and adult's brain process number and school-based studies that explore how we can harness children's primitive number sense to teach math. In the first, you will work directly with children and adult participants to conduct brain imaging

[Return to top of document](#)

research. In the second, you will work directly with children to explore the relationship between children's symbolic math abilities and their preverbal ability to make non symbolic mathematical computations. For both types of projects, students will join a team of postdoctoral, graduate and undergraduate students and be trained in all aspects of the research.

## *Delphine Dahan*

### **Project: Coordination meaning and understanding in conversations**

Language enables people to talk about entities in the world, but speakers must choose how to refer to them. For instance, people may talk about Jim Kenney by saying ‘the mayor’, ‘the man at the podium’, ‘my neighbor’, or ‘Jim’, or ‘Philadelphia's current mayor’. Importantly, the choice is not arbitrary: Each expression reflects the speaker's experience or perspective as well as their beliefs about what their addressees know and do not know. How accurate are people at estimating such beliefs, and are people better than others? Can we explain why some people fail to make themselves understood? The project examines how different people adopt different strategies and which, if any, demographic variables (e.g., age, sex, level of education, personality traits, cognitive abilities) may predict people’s behaviors.

This project examines these questions by collecting and analyzing conversations in a laboratory setting. Participants are invited to take part in a communication task that resembles a matching game: Two people sit on either side of a table separated by a barrier that blocks access to each other’s face and workspace. Each participant is given an identical set of cards; one participant is assigned the role of director and instructs the other, the matcher, about which cards to select from their set in order to reproduce a series of sequences printed on a booklet that only the director can see. The game continues for several rounds, with participants exchanging roles along the way. Each card appears in multiple sequences. A video-recording of the participants’ workspace allows the experimenter to assess whether or not the matcher chose the intended card and thus, provides an objective measure of communication success. The verbal exchanges between the participants are recorded and later coded and analyzed.

Students working on this research project will be involved in all stages of the research: They will schedule participants, recruited from the community, and be responsible for recording the conversations. They will work on the conversations themselves, applying coding protocol and validating inter-coder reliability. Along the way, they will learn to write simple scripts to automatize the coding and analysis. Students will work closely with the Principal Investigator and will meet with the research team regularly to discuss progress, results from analyzes of collected conversations, as well as possible follow-up studies.

*Adrianna Jenkins*

**Project: Contextual flexibility in human thought and behavior**

Project 1: Multi-tasking and Default-Mode Network of the brain

Research in cognitive neuroscience has identified a network in the brain that behaves in a very interesting way: its activity tends to be high when individuals are not engaged in any particular task and to de-activate when they direct their attention to tasks like mental arithmetic or holding in mind a string of numbers. Intriguingly, activity in this network also remains high when people engage in activities like imagining themselves in the future and making inferences about what's going on inside other people's minds, suggesting that it might play a role in mental simulation. This research project examines the functional profile of this network, the Default-Mode Network (DMN), with a particular focus on its consequences for human multi-tasking across social and non-social domains. This project will provide the student in-depth exposure to research in social cognitive neuroscience, with opportunities to develop technical skills ranging from programming and statistical analysis to literature digestion, hypothesis development, experimental design, and scientific communication. Specific responsibilities will be tailored to the student's skills and interests and may include assistance with literature reviews, stimulus development, experiment programming, data collection in the lab and/or online, and analysis of behavioral and/or fMRI data. Coursework in Psychology, Neuroscience, or Cognitive Science and programming experience (especially in R, Python, and/or MATLAB) is beneficial but not required.

Project 2: Mechanisms of uncertainty reduction in human social decision-making

Humans frequently need to fill in gaps in information in order to make decisions, relying on associations from past experience or logical inferences to constrain their predictions about the likely outcomes of different courses of action. This is particularly true in the social world, where much of the information that might be critical to a decision – for example, information about what another person believes, intends, or desires – cannot be perceived directly but must instead be inferred from an array of indirect cues. This research project examines how the human brain fills in the informational gaps that permeate our social world in order to guide decision-making and behavior. We use a combination of behavioral and neuroimaging (fMRI) experiments to investigate the cognitive processes through which people make social inferences given varying sources and amounts of uncertainty and how the outputs of those processes affect behavior. This project will provide the student in-depth exposure to research in social cognition, decision-making, and cognitive neuroscience, with opportunities to develop skills ranging from programming and statistical analysis to literature digestion, hypothesis development, experimental design, and scientific communication. Specific responsibilities will be tailored to the student's skills and interests and may include assistance with literature reviews, stimulus development, experiment programming, data collection in the lab and/or online, and analysis of behavioral and/or fMRI data. Coursework in Psychology, Neuroscience, or Cognitive Science

[Return to top of document](#)

and programming experience (especially in R, Python, and/or MATLAB) is beneficial but not required.

*Allyson Mackey*

**Project: Environmental influences on early childhood brain development**

We are interested in how experiences in early childhood shape the development of brain structure and function, and ultimately influence cognition and academic performance. We are studying both negative experiences, such as poverty and stress, and positive experiences, such as cognitive enrichment and social support. Do such experiences speed up or slow down brain development, and are the effects global or specific to particular neural circuits? What are the effects of developmental timing on plasticity?

We are looking for undergraduates to help with child recruitment, administering neurocognitive assessments (in the lab, and in schools and museums), acquiring magnetic resonance imaging data, and data analysis. Experience working with children is required. Experience in computer programming languages such as Matlab and Python is helpful but not required. Coursework in the Biological Basis of Behavior or Psychology is also helpful.

Students will be mentored by Allyson Mackey (PI), Julia Leonard (Postdoctoral Fellow), Ursula Tooley (Graduate student), Anne Park (Graduate student), and Austin Boroshok (Graduate student). Previously, students in the lab have started by contributing to a large-scale project, and then have developed independent projects that synergize with ongoing lab efforts.

*Alan Stocker*

**Project: Learning to compensate perceptual biases**

Human visual perception is often biased. Recent studies suggest that these biases might not represent a deficit of the visual system but rather represent the visual system's attempt to optimally infer the stimulus using prior belief information (top-down). We have previously run psychophysical experiments that allowed us to characterize these priors. The goal of this project is to test whether humans are able to overcome these biases by feedback, and to establish how such potential learning might change their prior beliefs over time. The project involves the adjustment of the existing visual psychophysical experimental setup to incorporate feedback, recruiting subjects and running the experiment, and finally processing and analyzing the data. The project is best for students who want to gain experience in setting up and running

[Return to top of document](#)



[\*Return to top of document\*](#)

psychophysical experiments. Knowledge of the programming language 'Matlab' is an advantage but not required. The student will have the opportunity to learn more about Bayesian models of perception.

*Daniel Swingley*

**Project: How mothers teach infants language**

Children learn languages "from scratch", without formal instruction, in a process that starts when they are babies. How do babies do it? To understand what infants get out of language, we need to look carefully at the speech they hear. This project is all about characterizing early infant language learning. A good part of this will be about listening carefully to infant-directed maternal speech, annotating examples of this speech, and running computational models of speech similarity and categorization. Experience in linguistics, psychology, or computer science would be helpful, but is not required.

*Rebecca Waller*

**Project: Affiliation, parenting, and callous-unemotional traits**

This interdisciplinary project will examine affiliation within parent-child relationships (i.e., feelings of reward from emotional and physical closeness with others) and links between affiliation and callous-unemotional traits. It represents an ideal project for undergraduate students interested in advancing knowledge and gaining data collection experience in clinical psychology, developmental psychology, and neuroscience. Children with callous-unemotional traits show deficits in empathy and guilt, and reduced sensitivity to others' emotions, putting them at high risk for chronic and severe aggression and violence. Advancing our knowledge how low affiliation is related to callous-unemotional traits will help to propel treatment research towards more tailored and specialized treatments to prevent further development of harmful outcomes like violence and aggression. Beginning in late spring of 2019, we will collect data from 150 children aged 8-10 years old. Parents and children will take part in a half-day protocol at the Emotion Development Environment and Neurogenetics (EDEN) Lab in the Department of Psychology. We will collect parent and child reports of callous-unemotional traits and affiliation, use observational coding of structured tasks in the laboratory to assess observed parent-child affiliation during social interactions, and use a novel neuroimaging paradigm with naturalistic stimuli to assess neural sensitivity to affiliation cues. Undergraduate research assistants will be directly involved in all aspects of data collection. For example, undergraduate research assistants

[\*Return to top of document\*](#)

[Return to top of document](#)

will help to administer questionnaires to families on iPad Tablets, set up observational paradigms, and accompany the lead examiner and family to the imaging facility for the scan.

## RELIGIOUS STUDIES

*Jolyon Thomas*

### **Project: Religion and Public School Education in Japan and the United States, 1945–2020**

Students will perform background research for a book about religion and public schools in contemporary Japan and the United States. Simply put, the project asks not whether religion should be allowed in schools by law, but rather how various stakeholders use terms like “morality,” “patriotism,” and “security” to envision the proper relationship between religion and education. Relevant topics include attempts to introduce Bible curricula or religious literacy courses into public schools, changes to school social studies and history curricula after 9/11, and debates over whether yoga and mindfulness meditation are permissible in public schools. For more on the primary investigator and the project, see details at [jolyon.thomasresearch.org](http://jolyon.thomasresearch.org).

Research tasks include reading and coding articles in newspapers and special-interest magazines; collecting relevant primary sources at local and regional archives; and interviewing stakeholders such as teachers, administrators, and activists. Research assistants will receive training in basic religious studies approaches as well as archival research and interview methods; they may have the opportunity to do short research trips to regional archives if funding permits. Required skills: Curiosity and an open mind, plus ability to read and make sense of large volumes of text. Basic skills in standard word processing and spreadsheet software a must. Ability to read Japanese (all jōyō kanji) is a plus, but is not required for this phase of the project. Feel free to contact Prof. Thomas by email for details: [jolyon@sas.upenn.edu](mailto:jolyon@sas.upenn.edu).

## ROMANCE LANGUAGES

*Ericka Beckman*

### **Project: Capitalism, Indigeneity and Literature in 20th-Century Peru**

As part of a book I am writing on Latin American literature and capitalist transitions in rural Latin America, I am seeking a research assistant to help me with my research on the Peruvian

[Return to top of document](#)

[Return to top of document](#)

writer José María Arguedas (1911-1969). Arguedas is a towering figure in 20th-century Peruvian and Latin American literature and culture. In addition to being the author credited with incorporating Quechua language and world-views into the Latin American novel, he was a prolific ethnologist and public intellectual. Indeed, it is no exaggeration to say that Arguedas' literary and ethnographic works are key to any understanding of the massive cultural and economic changes faced by indigenous peoples in 20th-century Peru.

I am seeking a research assistant who will help me identify, collate and analyze documents and images pertaining to Arguedas' literary works, photography and ethnographic studies. I am seeking an intellectually agile and curious student, with a love for delving into historical archives. Reading knowledge of Spanish is required.

*Michael Solomon*

**Project: Cinema Minimo: Micro-Short Filmmaking in Spain 2000-2019**

During the first years of the 21st century, internet sites in Spain began encouraging young filmmakers to submit their short films for dissemination on online festivals. The submission rules limited the length of these films to less than 4 minutes. Some festivals required even shorter works, accepting only films less than 30 seconds, 20 seconds and in one case, films of one second or 24 frames. The response to these online festivals has been astounding. Today more than 10,000 short films have appeared online for public viewing. These micro-shorts represent almost all genres (drama, comedy, horror, documentary, thrillers, animation) and touch on a vast array of contemporary topics and social and political concerns. Students interested in participating in this project will assist me in archiving these short films and in cataloging, tagging, and analyzing their content. A knowledge of Spanish is required.

## SOCIOLOGY

*Melissa Wilde*

**Project: Sociological Research on American Religious Denominations**

Undergraduate research assistants are needed to conduct research about the issues facing American religious groups between 1945-65, and the groups' responses to those issues. Research assistants can choose the issues they are interested in researching. Potential topics for which I already have data include: segregation, World War II, the cold war, civil rights,

[Return to top of document](#)

[Return to top of document](#)

feminism, the Vietnam War, global missions, race, eugenics and the population explosion. The work will include coding and transcribing articles from denominational periodicals which have already been gathered. The most advanced assistants will have the opportunity to assist with analysis and writing. While much of the work can be done remotely, frequent and regular communication with Dr. Wilde will be required. Assistants will learn a great deal about the research process, including how one codes, analyzes and writes-up sociological findings. Co-authorship is a possibility.

## SOUTH ASIA STUDIES

*Deven Patel*

### **Project: Drama, Poetry, and Literary Theory in Early India**

There are two large research projects that students can assist during the summer. The first is a study of drama and dramatic theory in Sanskrit literature. Students would read several plays with me, in English translation, along with excerpts from theoretical works (again, in translation), to identify patterns of composition and thematic elaboration. There is quite a bit of research required to contextualize the social, historical, and aesthetic worlds of these plays and students would be working with different types of secondary sources and perhaps even original paper or palm-leaf manuscripts of the plays from the sixteenth to eighteenth centuries.

The second project, related to the first, is the study of a single illustrated Sanskrit scroll manuscript of a 15th-century poem in three languages. The multicolored and multilingual manuscript is made of cloth and, when unfurled, is 11 meters (33 feet) long. It is currently held in the Freer Gallery of the Smithsonian, in Washington D.C. The interested student would be able to actually handle this rare manuscript in Washington DC and also to work with digital editions that were specifically made for my exclusive use on this project. My collaborator at the University of Michigan and I are working on a book on this manuscript's literary, artistic, and historical significance.

*Teren Sevea*

### **Project: Unearthing the Archives of Forgotten Saints, Shrines and Religious Economies**

The Penn Undergraduate Research Mentoring Program will provide me an opportunity to incorporate one undergraduate research assistant into my research project on the Islamic and

[Return to top of document](#)

[\*Return to top of document\*](#)

Sikh saints and shrines of Southeast Asia. A research assistant would assist me with data collection, data analysis and a literature review of English-language sources on the Islamic and Sikh saints and shrines of Southeast Asia. I am convinced that it would be mutually beneficial for the student and me to collaborate on this research project devoted to a topic that has not drawn sufficient scholarly attention.

This project could be significantly supported by the services of one undergraduate research assistant. A research assistant would assist me with surveying English-language sources pertaining to Islamic and Sikh saints and devotional cults in port cities of nineteenth- and early twentieth- century Southeast Asia. The undergraduate research assistant would be provided full access to the digitalized newspapers of nineteenth- and early twentieth-century Southeast Asian port cities, and colonial documents that now available through online resources like Adam Matthew Digital (for which, I have already requested access for the summer). I plan to collaborate with and mentor the research assistant and look forward to working with him/her to study English sources that I have compiled and digitalized after my research trips to libraries and colonial archival collections of the United Kingdom, Netherlands, Singapore, Malaysia, Indonesia and Myanmar.

I look forward to this opportunity to collaborate with an undergraduate research assistant primarily because I understand the need for faculty members to cultivate a continuing research mentoring relationship with undergraduate students at Penn, and also because this project will give them the opportunity to acquire and develop transferable skills for their future careers.

***Ramya Sreenivasan***

**Project: Mapping kin and migrations in northern India**

I am working on a history of the household in northern India, over a vast geographical space (a thousand miles east to west) but within a single linguistic - cultural - political zone. Within this zone, I track individuals, kin, and clan groups across generations, as they migrated or moved around.

Second, this socio-economic history also shows how migrations triggered the emergence and decline of settlements — through grants of land rights, revenue rights, and water rights. I am tracking such shifts in the agrarian frontier, and shifts in population densities at particular settlements in northern India, between 1400 and 1800.

As I explore strategies to present this material digitally, I seek a research assistant who can help with both the mapping and the digital presentation ends of this project.

[\*Return to top of document\*](#)

[\*Return to top of document\*](#)

No prior familiarity with digital humanities tools is required, nor prior familiarity with South Asian languages. The research assistant will emerge from this project having acquired skills in data plotting, data visualization, mapping, and other digital humanities tools relevant to social scientists and humanists. (S)he will also develop an understanding of historical method and of the nature of historical evidence, as well as an understanding of the behavior of kin groups over time and space.

[\*Return to top of document\*](#)

## **Dental Medicine**

### **ANATOMY AND CELL BIOLOGY**

*Claire Mitchell*

#### **Project: Substrate stiffness and astrocyte ATP release**

This project is a collaboration with Paul Janmey of the Bioengineering Dept. The hypothesis is that stiffer gels lead to greater ATP release in response to mechanical strain. The student will learn to make the gels in Dr. Janmey's lab, plate astrocytes on them, apply mechanical strain and measure the ATP released.

*Shuying Yang*

#### **Project: Stem cell and gene mediated bone regeneration and repair**

Developing bone graft substitutes for bone regeneration and repair for large size bone defect is a major clinical need. However, to date, mechanically competent osteoconductive/inductive constructs have not been well documented. A major barrier to breakthroughs in this field is the lack of sufficient integration of biomaterial design, growth factors, antimicrobial peptides and stem cells. Therefore, the goal of this project is to develop new bone graft substitutes for accelerating neovascularization and bone regeneration and inhibiting inflammation in large bone defects, bone fracture model, and other bone loss disease models.

### **ORAL SURGERY AND PHARMACOLOGY**

*Chider Chen*

#### **Project: Extracellular Micro-vesicles from Mesenchymal Stem Cells Accelerate Wound Healing**

Reconstruction of critical gingival/mucosal defects has always been challenging due to the complex structure, activated inflammation, and fibrotic scar formation during regeneration of damaged tissues. Several previous studies reported the beneficial effects of mesenchymal stem

cells (MSCs) on wound healing by promoting M2 macrophage polarization, collagen synthesis and angiogenesis. Recently, we showed that MSC-derived exosomes are capable of transporting active proteins and microRNAs to communicate with the surrounding cells. Our preliminary data suggests that exosomes from Gingiva-derived MSCs (GMSCs) contain a lot of cytokines, which may participate in wound healing process through increasing angiogenesis by enhancing epithelial cell migration. In this project, a student researcher will have the opportunity to learn cellular and molecular techniques including tissue culture, immunohistostains, immunoblotting, and microscopy, as well as data collection and analysis. The student will work in a team of senior scientists, postdoctoral fellows, and graduate students.

### ***Elliot Hersh***

#### **Project: Toward Predicting the Analgesic Response to Ibuprofen Following Third Molar Extraction**

The dramatic increase in opioid prescriptions over the recent years has been linked to the concomitant rise in opioid addiction, transition to heroin and death. Young adults' initial exposure to opioid analgesics is often following impacted third molar surgery, with 5,000,000 cases performed in the USA per year. While non-addicting NSAIDs like ibuprofen (Advil®) 400mg provide substantial post-surgical pain relief in about 80% of subjects we don't know before surgery who those 80% will be or the 20% who legitimately need a short course of acetaminophen (Tylenol®) plus an opioid added to the ibuprofen. Our previous double-blind, placebo-controlled pilot study (n=29) suggested that individuals producing the greatest amount of urinary prostaglandin metabolites and expression of inflammatory pathways on RNA of peripheral blood mononuclear cells, experience the best response to ibuprofen.

In the current proposal, urine and blood samples will be taken prior to surgery and at various intervals after dosing with ibuprofen (n=60) or placebo (n=20). With this larger patient sample, we can also evaluate the effect of other variables such as gender and the oral microbiome on analgesic responsiveness. After initial dosing, everyone will be placed on a 48-hour regimen of ibuprofen 400 mg plus acetaminophen 500 mg.

The student under the guidance of Drs. Hersh, Grosser, Theken and Farrar will gain experience evaluating radiographs of the jaw, interpreting urine samples for pregnancy and illicit drugs, assisting in surgery and analyzing urine and blood samples for inflammatory biomarkers. The student will be included in any publication.



## ORTHODONTICS

*Hyeran Helen Jeon*

**Project: The Effect of Intraflagellar Transport Protein IFT80 in Mesenchymal Stem Cells during Maxillary Expansion**

Cleft lip and palate (CLP) is the most common congenital defect involving the severely underdeveloped upper jaw with an incidence of 1 in 700 births. Maxillary expansion is a common procedure for CLP patients to correct maxillary width deficiencies. Sutural mechanical strains during maxillary expansion triggers a biologic chain of events leading to new bone deposition in the suture. Mesenchymal Stem Cells (MSCs) in the suture are known to proliferate and differentiate into osteoblasts during expansion. However, to date, the mechanism by which stem cells sense and transduce a mechanical stimulus into a biochemical response remains undetermined. Intraflagellar transport protein (IFT) proteins are required for the biogenesis of primary cilia, which function as a mechanical sensor. In particular, IFT80 is predominantly expressed in bone. The objective of this study is to examine if IFT80 deletion in mesenchymal stem cells significantly affects new bone formation during maxillary expansion through the regulation of osteogenic differentiation. We will examine the role of IFT80 in MSCs during maxillary expansion using transgenic Gli1CreERT2. IFT80<sup>f/f</sup> mice. We will investigate new bone formation using micro-CT, hematoxylin and eosin (H&E), alkaline phosphatase (AP) stain, histomorphometry analysis and immunofluorescence stain.

Students will be responsible for performing genotyping, Histology and Immunohistochemistry stain and analyzing data under close supervision by the mentor. It is expected that the data will be presented at a national meeting and produce a publication in a peer-reviewed journal. This project is suitable for not only premedical/dental students, but also all students who are interested in bioengineering.

## PATHOLOGY

*Kelly Jordan-Sciutto*

**Project: Understanding white matter deficits in HIV positive children and adolescents**

Children infected with HIV develop a spectrum of cognitive, neurologic and psychiatric disorders despite effective viral control using antiretroviral therapy. Brain imaging studies demonstrate abnormal and reduced white matter and ventricular enlargement suggesting impact

on the cells that produce myeline, the oligodendrocytes. Our preliminary data suggest that the HIV-infection and a subset of the antiretroviral drugs used to treat infection prevent development of the oligodendrocyte precursor cells into mature, myelinating oligodendrocytes. Since children are actively myelinating their central nervous system until early adulthood, we hypothesize that HIV positive children may be developing neurologic and psychiatric disorders due to white matter loss. Identifying the mechanism underlying the impact of HIV and antiretroviral therapy on myelin sheath will help design more rational drug therapies as well as adjunct therapies to improve the cognitive state of HIV+ pediatric and adolescents. Students on this project will learn basic cell and molecular techniques including tissue culture, immunohistochemistry, immunoblotting, and microscopy, as well as how basic research laboratories function and collaborate with each other. They will be part of campus initiatives to understand, treat and eliminate HIV.

## PERIODONTOLOGY

*Dana Graves*

### **Project: Oral wound healing, periodontitis and the impact of diabetes**

The ability to heal oral wounds and the susceptibility to periodontal disease is an important aspect of an individual's health and is negatively affected by diabetes. Our recently published studies demonstrate that activation of the transcription factor forkhead box O1 (Foxo1) plays important but surprisingly, opposite roles in diabetic and normoglycemic animals. The goal of this project is to unravel the molecular mechanisms through which FOXO1 differentially activates a healing response or periodontal disease susceptibility in normoglycemic or diabetic conditions. These studies will focus on the impact of FOXO1 in organizing the expression of factors that stimulate cells in normal conditions to maintain homeostasis but fail to do this in diabetic conditions. This is significant since our recent findings indicate that the ability of FOXO1 to bind to inflammatory factors is increased by high levels of glucose and its ability to bind to factors that stimulate repair is decreased by high glucose. Thus, periodontal disease and wound healing have in common that diabetes causes a shift in gene expression that promotes healing to one that promotes inflammation. Students will learn how to do quantitative immunofluorescence, microscopy, histostains, image analysis, cell identification, gene expression in vivo and data collection and analysis. The project is well suited to a student interested in a career in medicine or dentistry with a background in biology. It is expected that the project will involve participation during the summer and potentially independent study.

## PREVENTIVE AND RESTORATIVE DENTISTRY

*Francis Mante*

### **Project: Remineralization of Dental Enamel and Dentin after Radiation Treatment.**

Exposure of the oral cavity to radiation during head and neck cancer treatment increases the susceptibility of teeth to demineralization and radiation related caries (RRC). Xerostomia induced by destruction of salivary glands by radiation as well as alterations in the physical properties of enamel and dentin are implicated in the etiology of RRC.

The purpose of our investigations is to determine the structural changes in dentin and enamel that accompany head and neck radiation treatment and to devise approaches to restore the affected physical properties.

The student's tasks will include dental materials literature review, learning the basics of laboratory research practices, sample fabrication, data collection and application of basic statistics in hypothesis testing. The student will make presentations to the research team and produce a report under guidance of team members. Students who are considering careers in biomaterials science and dentistry are encouraged to apply.

## **Design**

### **ARCHITECTURE**

*Masoud Akbarzadeh*

#### **Project: Interactive, web-based library of efficient structural forms**

This research project intends to develop the first interactive library of efficient structural forms and their force equilibrium for students, researchers, engineers and architects around the world. This library will represent a wide range of non-conventional structural forms designed by using a novel method of structural design called 3D Graphic Statics at the Polyhedral Structures Laboratory, School of Design, University of Pennsylvania. 3DGS is a state-of-the-art structural design method and is the foundation of the research at PSL. Many researchers around the world follow the progress of this new field of science, and the completion of this project will represent UPenn as the first institute to provide a taxonomy of efficient structural forms for educational and research purposes. The current and limited version of this library is available in the following link: <https://psl.design.upenn.edu/webtool/>

In the current version of this library, the examples do not allow any direct transformation on their geometries which significantly limits the interactivity. Moreover, the extents of the library including the number of models and typologies of the structures are quite limited.

The primary objective of this project is to:

- I. extend the existing library to include variety of different examples; and,
- II. develop interactive models allowing direct user manipulations.

This research is highly relevant for students who would like to contribute to interdisciplinary research at the intersection of design, engineering, and computer science. Specifically, the students from Digital Media Design program at Upenn is highly encouraged to apply. We are looking for a researcher with experience in JavaScript, three.js library, and WebGL/OpenGL. Besides, the project has essential learning values for the participant:

- a. the student will develop an intuitive understanding of the behavior of complex structural systems using geometric diagrams;
- b. S/he learns a lot about data structures and the topological relationships among the components of complex spatial graphs; and,
- c. their contribution will be accessible online from everywhere and can serve as an outstanding portfolio and representing them as being part of a team that contributed to this research.

*Daniel Barber*

**Project: Architecture and Energy Transitions: Past, Present and Future**

Architecture and Energy Transitions: Past, Present and Future explores how the cultural dynamics of architecture can facilitate new relationships between energy use and social patterns, especially relative to policies of urban growth. The project brings together policy, humanities, and design to examine energy and buildings, and to propose near-term changes to the built environment.

The design of the built environment is essential to the current energy transition. Buildings are widely understood to produce between 40-60% of carbon emissions. Architecture plays a role in both the technological intensification of energy efficiency; design is also crucial to fostering a culture of low-carbon living, and to encouraging discussion about policy, life-styles, and urban transformation.

Discussions of the relationship between energy and culture have proliferated in the past decade, as scholars have sought to emphasize how energy has played a role in cultural, economic, and political developments over the centuries. This has especially been the case relative to the processes of industrialization - to be modern, many scholars have argued, is to depend on the capacities and abilities generated by fossil fuel energy. The capacity for increased energy use has been essential to the expansion of democracy and freedom around the globe in the 20th century; the dynamics of energy, economic growth, and democratic governance are of significant concern in the face of increasing environmental pressures and the rapid global increase in economic inequities of the past few decades.

Architecture is a valuable site for exploring cultural relations to energy –in the context of innovative policies and technologies, changes to professional practice, and low carbon lifestyles. Buildings are widely understood to produce between 40-60% of carbon emissions; architecture contributes to the patterns and contours of social life, and also to adjusting these patterns as new contingencies emerge in relationship to energy systems. Design is an essential component of how cultures will persist in the face of massive reduction of carbon, and the turn to responsive and responsible living in the near future.

Given the tight connection between energy and modernity in general, it is striking that so little attention has been paid to the history of modern architecture and energy. Histories of the environment in general have, until recently, been in the background of architectural discussions. Energy transitions were essential to the development of modern architecture on both cultural and technological terms. Each chapter examines an innovative modern building in the context of the specific energy conditions of the building's urban and regional environment, and in the context

[Return to top of document](#)

of global changes to energy production and policies. Examples include the Bauhaus in Dessau, Germany (1925); the British Petroleum Headquarters in Lagos, Nigeria (1960), and the Shenzhen Energy Headquarters in Shenzhen, China (2017), among others.

Student research would involve extensive reading into the historical dimensions of energy transitions since about 1850 - including summaries of central texts, timelines and other visual aids, as well as general assistance in image scanning, retouching, and other production.

*Sophie Hochhaeusl*

**Project: Memories of the Resistance: Women, Dissent, and the Forgotten Work of Architect Margarete Schütte-Lihotzky, 1938-1989**

Memories of the Resistance is an interdisciplinary architectural history that makes Austrian architect Margarete Schütte-Lihotzky's (1897-2000) German-language book *Erinnerungen aus dem Widerstand* (1985) available to English-speaking audiences. Alongside an in-depth discussion of Schütte-Lihotzky's design work, the critical English edition focuses on the architect's engagement in the resistance against the Nazi Regime, excavating fragile spaces of dissent that were built with and by fellow activists. The edition also examines why resistance work led to the ostracization of the important modern architect in Austria after 1945, leaving a glaring hole in the field's literature in which Schütte-Lihotzky's post-war work remains almost forgotten.

The book project would benefit from research participation of an undergraduate student in Germanic Literatures and Languages, History, or Art History, who has substantial German skills. With this research partner, I would like to complete archival research and establish short biographies of Schütte-Lihotzky's fellow resistance fighters. For this purpose, we will be mainly working with two online databases on campus, that of the Documentary Archives of the Austrian Resistance and the German historical database system De Gruyter. This task requires advanced German reading skills, and it would introduce the qualified undergraduate student to detailed archival research and work. In addition, the same, or a second undergraduate student, would assist in helping to select visuals as well as clearing their copyrights. The student aiding in this visual work, would develop critical organization skills in cataloging, writing captions, and clearing copyrights, which is critical to any work in museums. These tasks are both organizational and creative; some of the work may require making lists and cataloging images, others may entail looking carefully at visual archival documents and creating the visual narrative of the book overall.

[Return to top of document](#)

*Andrew Saunders*

**Project: Baroque Topologies: Novel Spatial Analysis and Representation of the Sacred Interiors of Italian Baroque Architecture**

The term Baroque is the subject of many debates ranging from its etymological origin to disputes on the emergence of an aesthetic “style” by historians such as Heinrich Wölfflin to more contemporary applications of the term, such as philosopher Gilles Deleuze’s positioning of the Baroque as a recursive philosophical concept that ‘folds’ through time and space. While the term is as illusive and dynamic as the artistic endeavors associated with it, the characteristics, attitudes and effects attributed to the Baroque are embodied clearly in Italian Baroque Architecture. The Baroque Topologies research project reveals those architectural works, and their spatial effects, in an entirely new way through emerging technology.

The Baroque period was informed by the Council of Trent (1545-1563) that outlined new principles for the Catholic Counter-Reformation in response to the Protestant Reformation. The new rules included the rejection of the pure centrally planned church of the Renaissance to re-emphasize the directional ceremony of the liturgy of the mass. Rather than reject completely the static centrally planned type, Baroque architects deformed it by adding multiple centers to create churches with dynamic polycentricity. Topology is a mathematical field dedicated to identifying spatial and formal relationships that are maintained through transformation. In this light, the primary Baroque works selected for analysis can be deciphered as topological variants of the centrally planned church of the Renaissance. Architectural masterpieces from the most innovative Italian Baroque architects including Francesco Borromini, Gian Lorenzo Bernini, Carlo Rainaldi, Pietro da Cortona, Guarino Guarini and Bernardo Vittone are examined through a novel form of representation developed with LiDAR (Light Detection And Ranging) surveying technology.

Throughout history, surveying instruments from inside and outside of the discipline have directly influenced the way architecture is designed and realized. The era of “big data” has fostered the need for new approaches to analysis and representation in all fields of design. The ability to capture, record and simulate increasingly larger sets of data coupled with remote access to cloud computing and progressively more affordable additive fabrication technology provides new opportunities and methods for understanding and assessing complexity and representation in architecture.

Baroque Topologies examines the potential of these new methods to redefine and enhance knowledge of the full spectrum of formal and spatial complexity of Baroque architecture. The unprecedented survey reintroduces the most famous Italian Baroque architecture through explicit high-definition images of geometry, space, material and light. Inherent in this process is a reexamination of the value-laden tools of contemporary representation and their impact on current architectural production.

Students' duties and responsibilities:

- General research on Italian Baroque Architecture including locating, contacting and corresponding with archive institutions with original architecture documentation and drawings.
- Working with, processing and manipulating LiDAR survey data.
- Comparative analysis of previous representation and documentation with new laser scan surveys.
- Architectural drawings and modeling.
- 3D printing architectural models both MakerBot Replicator and FormLabs 2 Resin printer.
- Graphic layout for exhibition and publication.
- Helpful skillsets, but not required:
  - General Knowledge of the Baroque in Art and Architecture History
  - Desire to acquire advanced digital skillsets
  - Travel experience to Rome and or Torino
  - Fluent in Italian
  - Graphic and design experience
  - Web design
- Academic and professional skills, experiences and benefits for students:
  - Intensive understanding of Italian Baroque Architecture including complex geometry, figuration, lighting, dome structures and spatial concepts.
  - Advanced analytical skillsets to work with LiDAR, 3D printing and digital modeling.
  - Advanced understanding of architectural representation.
  - Experience working with archives and other important institutions to acquire and support research.
  - Experience planning, curating and executing exhibitions.
  - Experience working on publications and future book on the research.

## CITY PLANNING

*Francesca Ammon*

### **Project: Urban Digital Humanities**

Student(s) will assist in the development of 1-2 urban digital humanities projects. The goal of each project is to aggregate, spatialize, and analyze multiple layers of historical data in order to better understand post-World War II change in the American city. Strong organizational skills and attention to detail are critical. The positions should particularly appeal to students interested in public history, digital humanities, and the history of architecture and city planning.

Specific tasks may include: 1) scanning photographs and geotagging buildings depicted within them; 2) conducting archival research (e.g., census, city directories, building permits, deeds) to populate a database of social, economic, and architectural history by address; and 3) website



[Return to top of document](#)

development. While existing skills in Geographic Information Systems (GIS) and web design are particularly welcome, they are not necessary. The position will provide training in basic skills related to urban and architectural historical research.

Project 1: Ed Ruscha's Streets of Los Angeles

This new web project takes an urban history perspective on Los Angeles's Sunset Boulevard, which Ed Ruscha photographed repeatedly from the 1960s to today. The aim is to layer multiple sources of historical data (both artistic and bureaucratic) by parcel to visualize the small-scale, everyday forms of postwar redevelopment.

Project 2: Preserving Society Hill (<http://pennds.org/societyhill/>)

This existing web project documents the urban renewal of Philadelphia's Society Hill neighborhood during the 1950s-70s, focusing particularly on the relationship between demolition and historic preservation. There may be opportunities to conduct oral histories as part of this project.

## FINE ARTS

*David Hartt*

### **Project: The Histories (Le Mancenillier)**

This year and into the summer I will be working on a Pew funded exhibition that opens in September 2019 at the historic Frank Lloyd Wright designed Beth Sholom Synagogue in Elkins Park, PA.

The Beth Sholom Synagogue Preservation Foundation has commissioned me to produce a site-responsive, multi-part installation. Comprising video, music, performance, and other elements, the project will provide new ways to experience the synagogue and push the boundaries of the building's interpretation in ways that are deeply resonant with broader social and cultural histories. Additionally, the Preservation Foundation will present related public programming to engage multiple constituencies. The project will advance the idea that historic buildings are significant cultural assets ripe for use by artists to create new and highly engaging interpretations and experiences for contemporary audiences.

While the production of the project is fully funded, there's an opportunity for an undergraduate student studying history or anthropology to participate in providing research for the catalogue.

[Return to top of document](#)

[\*Return to top of document\*](#)

The research will focus on the historical movement of both Black and Jewish diasporic communities.

Eugene Lew, the Director of Sound & Music Technology In the Music Department is currently consulting on both the recording of the score and the technical infrastructure for the installation. Additional external experts in film production and sculpture fabrication will join the team at different points. This is a great opportunity for a student to work with and contribute to a multi-disciplinary team on an ambitious experimental project.

*Michelle Lopez*

**Project: Wrecking Ball: Solo Sculpture Exhibition ICA Philadelphia**

Fall 2019 will be an exciting moment: my Fine Arts sculpture research will culminate in two public exhibitions:

1. Wrecking Ball (working title): a solo sculptural/architectural installation at the Institute of Contemporary Art (ICA), Philadelphia (curated by Alex Klein of the ICA); September 2019
2. Joplin Project: a multi-disciplinary animation/sound performance piece at the Franklin Institute, Philadelphia (curated by Cole Akers of The Glass House Foundation); November 2019

The project focuses specifically on the installation at the ICA and will require sculptural fabrication in metal welding, wood-bending, and the construction of a scaffolding. My studio assistants and I will be working one-on-one with the students as they learn how to map out a large-scale architectural installation along with contemporary sculptural theories and techniques.

While I expect to draw most of the students from Fine Arts (with sculpture background), Engineering, Architecture, or Theater, I am open to any smart, tool-savvy individual willing to get his/her hands dirty and with an interest in contemporary art.

In a preview note for the ICA exhibition, Alex Klein describes the work as follows:

“For her exhibition at ICA, Michelle Lopez will expand on her sculptural installation, House of Cards, in which a city is reduced to rubble and the suggestion of barricades, borders, scaffolding, and the remains of street protests are all meticulously crafted by hand. It is an urban landscape that one imagines has been fabricated out of real estate speculation and political discord, causing it to precariously teeter on the brink of collapse.... This tension between specificity and evocation is evident in Lopez's lexicon that often deconstructs symbols of nationalism, power, and identity through a process of formal reduction, alchemy, and violence.”

[\*Return to top of document\*](#)

[\*Return to top of document\*](#)

*Orkan Telhan*

**Project: Exhibition on the Future of Food & Human Diet**

During Summer 2019, we will be working towards and upcoming exhibition at the Philadelphia Museum of Art called “Design for Alternative Futures.” Our part will be mainly focused on an installation that will feature different types of food and beverages (i.e., lab-grown burgers, GMO organisms, probiotic chocolate, food computers, etc.) that intend to make the audience think about the future of food and the human diet. The installation will showcase products, machines, and a publication that will explain the stories behind the products in relation to major challenges such as climate change, biodiversity loss, food security, labor exploitation and so on. We would like to work with one or two undergraduates to help us with different parts of the exhibition such as designing infographics, visualizations, and product explanations. We prefer that the students have been exposed to design foundations, have drawing skills or capable of doing independent research.

[\*Return to top of document\*](#)

## **Education**

### **EDUCATION, CULTURE, & SOCIETY**

*Krystal Strong*

#### **Project: Tracking Social Change in Philadelphia and Africa**

“Re/Member Black Philadelphia” and “Tracking a New Generation of Leaders” are two distinct research projects. PURM Fellows are encouraged to apply to contribute to one or both of these projects, described below:

Re/Member Black Philadelphia

“Re/member Black Philadelphia” investigates the fraught past, present, and future of Black Philadelphia and the increasingly “endangered spaces” of Black social and cultural practice against the backdrop of the systematic displacement of longtime Black residents.

This multimodal project has four components, which utilize traditional ethnographic and oral history fieldwork, geospatial mapping and technologies, archive making, and filmmaking. They are: (1) an immersive, interactive map which layers 2D and 3D representations of sites and events that constitute the spatiality of “Black Philadelphia”; (2) a web series that captures the lived experiences of Black Philadelphians as they negotiate processes of urban change through filmmaking; (3) an oral history collection of individual and collective memory that will combine oral testimony with 3D visualization; (4) a public archive which supports the creation and preservation of unexplored or endangered community-based archives. Together, these components demonstrates how the tools of the participatory qualitative research and the digital and spatial humanities can help us more fully understand and teach the lived realities of marginalized populations and spaces.

The PURM student researcher will join a project team of ethnographers, media makers, and historians, and learn to utilize geospatial and 3D immersive technologies, filmmaking, and oral history techniques while exploring important social and cultural sites around the city of Philadelphia.

Tracking a New Generation of Leaders

“Tracking A New Generation of Leaders” is a multinational qualitative project that explores the role of educational development in the production of a new political leadership class in Africa. The leadership programs targeting African youth that are the focus of this study have an explicit mission of developing the capacity of African youth to play a leadership role in their societies and provide some form of academic and professional training or support. In the first phase of our

[Return to top of document](#)

research, we developed a web-based database and mapping platform that aggregates and visualizes data on global educational programs targeting African youth for leadership. Thus far, we have catalogued over 200 programs in 45 countries. We are now beginning the second, qualitative phase of our research, which seeks to understand the leadership experiences of trajectories of African youth who identify as rising leaders.

The PURM student researcher will join a team of undergraduate and graduate students in recruiting and interviewing young African leaders around the world, while learning important techniques in survey research, interviewing, data analysis, and database management.

## **READING/WRITING/LITERACY**

*Ebony Thomas*

### **Project: Race, Storying and Restorying: A Digital Humanities Study of Black Fans and Fandoms**

The proposed study will investigate how youth and young adult fans of African descent inscribe their racialized selves into legible existence through digital age counternarrative and counterstorytelling. Contributors will be invited to submit video, audio, and text about their experiences in online fandom as audience members being interpellated by and through speculative text, and as fan creators of fanfiction, fanart, fanvideos, and essays speaking back to science fiction, fantasy, and comics. A tracing of storying traditions from historic roots within Black cultures to their roles within contemporary narrative landscapes will be analyzed via genealogical, intersectional, and critical race approaches in order to seek understanding how young Black fans write themselves into narratives as a way of writing people of color in to the metanarratives of fandom and popular culture. Exploring the ways that today's Black fans are using their fan work to engage in restorying connects this agentive work to current projects on the vanguard of reader response theory, race in digital literacies, and Black/Africana studies. If funded, the project will yield a rich archive of Black fan narratives for future research.

[Return to top of document](#)

## **Engineering and Applied Sciences**

### **BIOENGINEERING**

*Jennifer Cremins*

#### **Project: The 3D genome and Alzheimer's Disease**

The Cremins lab studies the higher-order folding of the 3D genome and how it is linked to development and disease in the human brain. We map neural epigenomes in three-dimensions using quantitative, systems level, genome-wide technologies. We also perturb 3-D epigenomes by developing and applying state-of-the art genetic engineering (CRISPR/Cas9, 3D optoepigenetic) technologies. We use human induced pluripotent stem cell differentiation and organoids as our model system(s) to understand the brain. We have multiple computational and/or wet lab rotation projects available, including, but not limited to:

- (1) Computationally identifying loops, subTADs, TADs in human neuronal subtypes and how they change genome-wide due to genetic mutations causing familial Alzheimer's,
- (2) Generating and computationally analyzing Hi-C maps in model systems of Friedreich's Ataxia, Fragile X Syndrome, Amyloid lateral sclerosis, and Huntington's disease
- (3) dCas9-YY1 loop engineering
- (4) Compare ion channel mutations in disease to 5'-3' gene loops

*Michael Mitchell*

#### **Project: Polymer-Lipid Nanoparticles for In Vivo mRNA Delivery to Immune Cells for Potent Cancer Immunotherapy**

The induction of a strong cytotoxic T cell response is an important prerequisite for successful immunotherapy against many viral diseases and tumors. Nucleotide vaccines, including mRNA vaccines with their intracellular antigen synthesis, have been shown to be potent activators of a cytotoxic immune response. The intracellular delivery of mRNA vaccines to the cytosol of antigen presenting immune cells is still not sufficiently well understood. In this project, we will engineer and implement a polymer-lipid nanoparticle formulation for the delivery of mRNA vaccines to induce a cytotoxic T-cell response. We will develop nanoparticles encapsulating mRNA coding for various tumor-associated antigens for the transfection of immune cells in vitro

and in vivo. The efficacy of the vaccine will be tested in an aggressive mouse model of melanoma. We will also investigate if the immune response can be further increased by the incorporation of various adjuvants. The resulting polymer-lipid nanoparticle formulations developed in this study will serve as promising vectors for mRNA delivery, ones that are capable of inducing a strong cytotoxic T-cell response required for cancer immunotherapy. Prerequisites: coursework in molecular/cell biology and organic chemistry lecture and labs are highly recommended but not required. Prior research experience in cell culture, molecular biology, and organic chemistry are highly recommended but not required. Students will be mentored by the PI as well as postdoctoral fellows and PhD students within the lab.

## CHEMICAL AND BIOMOLECULAR ENGINEERING

*Bomyi Lim*

### **Project: Characterization of Pol II elongation rate in living *Drosophila* embryos**

My lab has an expertise in using live-imaging based assays and quantitative analysis to examine one of the most exciting problems in modern biology: the nature of transcriptional regulation. The undergraduate students joining my lab will use a combination of molecular cloning, live-imaging, and quantitative analysis tools to test the hypothesis that RNA polymerase II (Pol II) elongation rate is a key parameter in dynamic gene control.

I propose to study how elongation rate and its cell-to-cell variability changes in various molecular backgrounds, such as in different gene length, intron density, and type of enhancers and promoters. Each molecular background would require designing three or more transgenic constructs (e.g. 1kb, 5kb, and 10kb gene length), and subsequent live-imaging and quantitative image analysis of multiple biological replicates. I expect undergraduate students to take responsibility of testing one variable (e.g. gene length), from designing experiments to analyzing the data.

As a start, students will learn molecular cloning, such as traditional DNA recombination techniques as well as more recent CRISPR/cas9-based genome editing approaches.

Concurrently, they will get a chance to collect live imaging data of transcriptional dynamics, using a cutting-edge confocal microscope in the lab. Finally, the students will learn how to write custom-built Matlab codes to perform quantitative image analysis. This whole process will give students a chance to experience various aspects of conducting a research project in the lab. Since the project involves both traditional biological experiments and quantitative analysis, students will obtain insights from multiple disciplines as well.

## COMPUTER AND INFORMATION SCIENCE

*Sebastian Angel*

### **Project: Paxos through the lens of concurrency**

Background:

-----

Have you ever wondered how large scale services (Google, Microsoft, etc.) stay online (without losing your data!) even when their machines fail all the time? The secret is using fault-tolerant protocols. The most general is the replicate state machine approach: an application is expressed as a state machine and is replicated on multiple servers. Using a consensus algorithm, replicas agree on which commands to execute. Since replicas execute the same commands in the same order, they transition through the same states. If a replica fails, simply use another replica! There are several consensus protocols, but the most influential is Paxos.

Project:

-----

This project is about making Paxos faster. This is no easy task, as there are dozens of Paxos variants already! But which variant should one use for a given application? Some variants achieve higher throughput but have high latency; some variants achieve low latency but only in some settings; some variants require additional hardware. In other words, this ecosystem is a mess!

We need a better understanding of which variants of Paxos should be used in different situations. One way to explore this is through the lens of concurrency: how many operations (agreement decisions) does a particular variant of Paxos allow? Under what conditions? We think this is a good start, since concurrency is a good proxy for throughput.

Requirements:

-----

Good understanding of distributed systems, though it can be picked up.

Benefits:

-----

After this project you will be a fault-tolerance expert! You will master core concepts in distributed systems that will prepare you for grad school. Companies will want you to keep those pesky failures at arm's length. We will also collaborate with people at Microsoft Research.



*Norman Badler*

**Project: SPACES - Spatialized Performance And Ceremonial Event Simulations**

SPACES is to be a parameterized, spatially and temporally situated, Augmented Reality simulation of large-scale public ceremonies. In prehistoric contexts these activities must be hypothesized from artifacts, architectural, and geophysical remains, documentary sources, and cultural context. SPACES should create plausible variations that may be both visually (qualitatively) and quantitatively assessed. This approach is fundamentally different from one-off “reconstructions”, as explorations of variations may be essential to determine which performance possibility is more compatible with evidence. Computer programming, graphics, and 3D modeling experience necessary.

Although computerized crowd simulations exist, most effort has been directed toward low-level navigation, collision avoidance, and trajectory realism. “Higher-level” organization is left to user discretion, artistic decisions, or creative goals. Crowds are often behaviorally homogeneous with only vague overall purpose.

SPACES will center on AR participation in processional environments: what activities occur where, about how long they last, what objects agents carry, use, or play, sound and motion coordination, and interpersonal interactions. We will develop a user interface to control such parameters. SPACES will use Magic Leap AR through Unreal via Blueprint procedures.

The SPACES AR app will allow a user to embed herself as a crowd participant and active performer. AR requires highly realistic graphic environments, and responsive behaviors in the other characters to cement the sense of cultural presence: “the feeling of being and making sense there together.” What better way to experience the ethos of a bygone culture than by being embedded in its public ceremonial practices?

*Chris Callison-Burch*

**Project: Help computers better understand human languages with multimodal representations of words and images**

Language is used to describe the visual world around us, and as such, both images and text can be used to represent it. However, some concepts (e.g. cat) are represented well visually, while others (e.g. jealousy) are better represented semantically. Recent work in natural language processing and computer vision uses vectors to represent words and images. These allow the similarity of two words or two images to be measured by comparing their vector representations (often called their 'embeddings'). In this summer research project, you will help to create

[Return to top of document](#)

multimodal embeddings that combine visual and textual information. You will learn about natural language processing, and you will apply artificial intelligence algorithms like neural networks to help learn a mapping from a textual representation of a word onto a visual representation.

Over the summer we will discuss how multimodal embeddings can be used for cross-modal retrieval tasks, including caption generation and image retrieval. Additionally, they can be used for semantic tasks that text-trained embeddings are more typically used for, including language modeling, synonym generation, and machine translation.

*Chenfanfu Jiang*

**Project: Realistic animation of lifelike natural phenomena**

"Multi-physics" physical phenomena require the simulation of solids, fluids, through their different phases, scales, and interactions. We desire to hybrid strengths of different methods to enable animating complex material interactions. The summer projects will target at several aspects of multi-physics simulation using state-of-the-art physics-based animation techniques. The detailed investigation topic could come from the following (but not necessarily limited to): (1) High-performance GPU or Multi-thread optimization of existing schemes. (2) Novel numerical interrogators for efficient numerical simulation of complex phenomena. (3) Coupled, spatial and temporal adaptive hybrid simulation of various materials: such as foam and water, snow and air. The student works with state-of-the-art solid/fluid animation C++ code and develops new features and experiments with research ideas. The student will also work with 3D software such as Houdini or Maya for modeling and rendering simulation geometry. C++ background and basic knowledge of computer graphics are required. Research accomplishments lead to publications and collaborations with animation/visual effect industry on state-of-art simulation techniques. Students will work under the supervision of Prof. Chenfanfu Jiang and his Postdoctoral scholar Dr. Ming Gao of Penn Computer Graphics group.

*Insup Lee*

**Project: High-fidelity wearable activity monitors**

Wearable activity monitors provide an unprecedented amount of data -- however, accessing this data for real-time data analysis can be challenging. While manufactures allow for remote access of downsampled data through standardized interfaces (e.g., web applications) no system

[Return to top of document](#)

currently collects the high-fidelity waveforms can only be accessed through manufacturer-unique APIs. In this project, we aim to develop a standardized framework providing: (i) access to high-fidelity wearable device data (e.g., 100Hz accelerometer and photoplethysmography data); (ii) fault tolerant transmission of data to a remote server; (iii) secure storage in a remote database. The platform will be integrated onto existing system hardware in the PRECISE lab (for Samsung Gear Fit smart watch/google Pixel 1 smart phone and/or iWatch/iPhone) and will utilize our existing java-based device interoperability framework OpenICE-lite. Once a prototype is completed, the system will be tested by performing data collection and monitoring of medical conditions (e.g., hypovolemia/postpartum hemorrhage at the Hospital of the University of Pennsylvania and/or Postural Orthostatic Tachycardia Syndrome (POTS) in remote subjects.

*Mayur Naik*

### **Project: Adapting Smartphone Applications for the Developing World**

In 2018, Google started an initiative named Build for Billions [1] with the intent of encouraging programmers to create content for the next wave of smartphone users. To accomplish this goal, programmers are encouraged to limit their app's resource consumption. Over the past year, our research team has designed ChiselDroid, a learning framework by which programmers can better understand where they can reduce their applications without sacrificing the significant elements of their user interface.

Going forward, we would like to conduct further research into both the resource savings that can be generated by different reductions and the potential for designing a portal for developers to generate reduced applications. Ideally, we would have a student primarily research each of these threads with the understanding that there will be much overlap between them.

- Participating in the first initiative will introduce students to the intersection of hardware and software as they investigate resource consumption within the Android Studio development framework. This work will introduce students to program analysis skills that will help them in high level program design and analysis courses. Such software analysis fundamentals will be invaluable in any workplace that prioritizes quality software development.
- Participating in the second thread will introduce students to full stack development as they create a tool where programmers can submit an application and have an optimal reduced version returned. Students will have the opportunity to work with graduate and post-graduate students who have experience developing similar tools. We expect a student pursuing this thread to learn the essential skill of product design and development which will set them up for success in a future software engineering position.

[\*Return to top of document\*](#)

We believe that ChiselDroid is in a stage where students with limited exposure to research can make real contributions to a project with great potential, and develop an appreciation for research in the process.

[1] Google's Build for Billions Initiative Website: <https://developers.google.com/billions/>

***Dan Roth***

### **Project: Language Processing for Low Resource Languages**

While many of the world's languages are in wide use and have a plethora of resources that can be used to learn or translate them, and to identify features and patterns, there are many other languages that have comparatively few written or online resources -- so that if you find text you don't understand, you can't just go look it up or drop it into a translator. In the field of Natural Language Processing (NLP), these are known as low resource languages.

This project involves preparing for and participating in a ten-day timed exercise applying a number of NLP techniques such as Named Entity Recognition (identifying the names of people or places, etc., in running text), Entity Linking (connecting such entities with their entries in a knowledge base such as Wikipedia), and text classification (assigning labels to sections of text) to two surprise low resource languages, whose identities will be revealed only at the start of the exercise. The student(s) will work closely with graduate students in the group and will help with preparing infrastructure and with running experiments.

The following types of experience are preferred but not required:

- Experience with unix systems
- Experience writing Python and Java
- Experience with NLP: preparing data, training models, evaluating and comparing results of different runs

***Cynthia Sung***

### **Project: Design Algorithms for Printable Robots**

Our group works on algorithms and systems for designing custom robots. One large challenge during the design process is to ensure that the design is both functional and fabricable. Different

[\*Return to top of document\*](#)

[Return to top of document](#)

fabrication approaches such as 3D printing, origami-inspired assembly, and machining each result in parts with different mechanical properties but also impose different geometric constraints. This project will explore algorithms for breaking down a full design into individual components with the goal of producing a design that is optimized for particular motions and is also physically realizable. It will incorporate ideas from computational geometry and topology optimization. Previous experience with rapid prototyping methods is a plus but not required.

Students involved in the project will have the opportunity to work in an interdisciplinary lab and interact with other students from multiple engineering disciplines. They will learn about computational geometry and how computer-aided design tools store and represent 3D objects. They will develop new algorithms for processing and manipulating geometric data, program these algorithms, and test them in 3D printed prototypes.

*Lyle Ungar*

**Project: Cultural and platform variations in positivity in language**

All cultures and writing forms, from Twitter to novels tend to have more positive words than negative ones, and all cultures seem to exhibit a 'social desirability bias' such that people present themselves to others as they think others wish them to appear. There are, however, cultural and platform differences in much positive language is encouraged. This project will look at some mix of Twitter, Facebook, transcribed spoken language and perhaps Sina Weibo (the Chinese equivalent of twitter) to look at variations in positivity across platforms and cultures.

Familiarity with python and programming at the level of CIS121 required.

## **ELECTRICAL & SYSTEMS ENGINEERING**

*Lee Bassett*

**Project: Engineering Quantum Biosensors**

Quantum-mechanical systems are exquisitely sensitive to their environment. Usually this sensitivity prevents their use in biological applications, since ambient noise tends to destroy quantum effects, but a recently-discovered class of optically-addressable “impurity spins” in semiconductors circumvent these limitations, exhibiting quantum-mechanical effects at room temperature and above. Using these spins, we aim to realize a new class of multifunctional

[Return to top of document](#)

[\*Return to top of document\*](#)

biosensors that respond to electrical and chemical signals through quantum physics and that can be probed using light. The sensors are based on atom-scale defects in diamond nanoparticles, which are nontoxic, stable fluorophores that respond to nanoscale electromagnetic fields.

Working with Prof. Bassett and researchers in the Quantum Engineering Laboratory, a PURM student will investigate the properties of nanodiamonds functionalized with varied surface chemistries using a combination of optical, electron beam, and scanning probe techniques. Specifically, the student will develop methods to attach molecules to the diamond surface, characterize the efficiency of the attachment process, and study the effect on the nanoparticles' quantum properties. The student will gain a wide variety of experimental skills and have the opportunity to work as part of an interdisciplinary team involving physicists, biochemists, electrical engineers, and neuroscientists. The research will ideally lead to published paper.

The work requires a knowledge of introductory physics and chemistry and a motivation for hands-on lab work. Training on all experimental equipment (e.g., confocal, electron beam, and scanning microscopes) will be provided. This project could appeal to students majoring in physics, biophysics, chemistry, biochemistry, bioengineering, and materials science and engineering, among other areas.

*Deep Jariwala*

### **Project: Heat-Scavenging Photovoltaic Cells**

The proposed project is a low-cost, easy to manufacture heat harvesting device. The device is analogous to a solar cell or photovoltaic cell except it converts heat instead of sunlight into useful electricity. As compared to conventional fluid based heat exchangers and other direct heat to electricity converting devices such as thermoelectric generators this is a thin film device that is convenient for deployment, cheap to manufacture and much more efficient in comparison. It uses the property of heat transfer by infra-red (IR) radiation which are electromagnetic waves similar to visible light. The key innovation here is that this device tailors the color of emitted heat to exactly match the color that the active semiconductor material can absorb most efficiently such that maximum emitted heat is converted into electrical power. Achieving this requires careful choice of materials and innovative optical design. This invention has the potential of transforming the energy-efficiency landscape of all vehicular engines, exhausts and high-temperature heavy machinery. We are open to two students, each of whom would have independent roles.

[\*Return to top of document\*](#)

[Return to top of document](#)

***Rahul Mangharam***

**Project: Self-driving cars: Build one yourself**

We have a Toyota Prius which we are making into a fully-autonomous vehicle. We'd like to get you involved in learning how to put together the sensors for perception, the software for planning the vehicle's next move and the actuators for the control. This is both hands-on and also involves learning a good bit of theory on the robotics and decision making in autonomous vehicles.

A related project is on building, driving and racing F1/10 Autonomous Racecars - these are 1/10th the scale of real Formula 1 cars, but 10x the fun! Learn more at <http://f1tenth.org>

More details on other Autonomous Vehicle projects are here -

<https://www.dropbox.com/s/mp9ycv7yajshyi2/10%20Autonomous%20Systems%20Research%20Projects.pdf?dl=0>

Interested students should have some background in python, must be hands-on and not have fear of working on hardware, software and mechanical systems. This will help you get a job in the exciting world of autonomous vehicles.

## **MATERIALS SCIENCE AND ENGINEERING**

***Ritesh Agarwal***

**Project: Chiral Photodetectors for Quantum computing**

Quantum information science is radically revolutionizing our technologies in computing, communication, and sensing. Common quantum information technologies rely on qubits that can each adopt two possible states. For example, with single photons, two orthogonal polarization states of each photon (two spin states) form a qubit. Although the superpositions of qubits can dramatically enlarge information density compared to classical bits, it is challenging to produce on-chip single photon emission with controlled polarization state, route them into designed waveguides followed by their on-chip detection without the use of any external optical elements.

Recent advances in metamaterials and quantum 2D materials promise a new dimension with the controlled generation, manipulation and detection of photons that carry unique chirality. We will utilize the unique geometry, symmetry and properties of 2D materials to rationally design chiral optical photoresponse for reading out chiral states of single photons in photodetectors. The work will involve synthesis of 2D materials, fabrication of devices followed by their optical

[Return to top of document](#)

[Return to top of document](#)

characterization to study their photoresponse to different chiral optical excitation. If successful, these devices can enable increased information processing capabilities of future quantum computers.

*Liang Feng*

**Project: On-chip Photonic Circuits to Guide, Sort, and Direct Twisted Light**

Light typically consists of a stream of linearly polarized photons, traveling in a straight line and carrying a linear momentum. However, light carrying an orbital angular momentum (OAM) propagates in a twisted helical way with a corkscrew-shaped wavefront. Such twisted light is characterized by an integer quantum number corresponding to its OAM. It has been recognized that this twisted light can be used as great information carriers since the degree of freedom of OAM is unbounded. The combined use of twisted light with other multiplexing/demultiplexing techniques is expected to enable the entirely new high-speed secure optical communication and quantum teleportation systems in a multidimensional space.

The goal of this project is to experimentally demonstrate an on-chip photonic structure to guide, sort and direct twisted light of different OAM quantum numbers within chip-based photonic circuits. This will involve nanophotonics designs, novel nanomanufacturing schemes, and optoelectronic characterizations.

## **MECHANICAL ENGINEERING AND APPLIED MECHANICS**

*Jennifer Lukes*

**Project: Antibacterial Properties of Magnetically Heated Nanoparticles**

Bacterial pathogens such as Escherichia coli and Staphylococcus aureus are a serious health concern, leading to millions of deaths per year worldwide. One potential strategy to address this problem is the use of magnetically heated nanoparticles, which have recently demonstrated efficacy in killing bacteria and disrupting bacterial biofilms. The purpose of this project is to do research into the current state of the art on this topic. In this project, the student will perform an in-depth literature review, summarize important research advances, and identify key directions for future work on the antibacterial properties of magnetically heated nanoparticles. The project will culminate in a review article and a research presentation.

[Return to top of document](#)



*James Pikul*

**Project: Energy storage and mechanics of robots made from soft, stretchable materials**

There are two projects that students can work on. The first project is developing energy storage for soft robotic applications. The goal of this project will be to develop new technologies for storing energy in robots that are intrinsically soft, and therefore can be bent, stretched or deformed without failure, in contrast to current energy storage which is rigid. The second project will be to build and study the mechanics of soft stretchable membranes as they are deformed and interact with objects. The goal will be to develop a system that can detect when the membrane touches an object and with what magnitude of force. This is a critical knowledge gap for soft robotics and will lead towards a collaborative project on the control of soft robots. Students should have interest and enthusiasm for either of these projects.

*Michael Posa*

**Project: Modeling and learning dynamic robot models**

The field of robotics has made tremendous strides in recent years, with improvements resulting in strong and accurate hardware and advances in artificial intelligence. However, when these robots interact with their environment, they do so with far less skill and surety as their human counterparts. The quickness and accuracy that robots display in static or structured settings quickly disappears when faced with the presence of unknown people or objects. A critical challenge facing the field lies in modeling, planning, and control of robots in contact with their environments. This project will be composed of two parts.

Part 1: System identification of the Cassie bipedal robot

To best control a robot like the Cassie biped, in the Dynamic Autonomy and Intelligent Robotics (DAIR) lab, we must first determine an accurate model of the robot, mapping from motor control torques to motion. The Cassie robot design makes notable use of large springs within the leg joints, and modeling the motion of these springs poses significant challenges. By performing experiments on the real robot, one result of this project will be a dynamic simulation of the robot that closely matches the robot itself. The student will gain significant experience programming a state-of-the-art bipedal robot, with a focus on the practical aspects of modeling, estimation, and control. As conducting experiments on robots like the Cassie can be difficult, students will work

[\*Return to top of document\*](#)

closely with graduate students and will also assist in the development and testing of walking control strategies.

The part will involve significant programming, and so Python/MATLAB experience is required and C++ experience is recommended. Undergraduate dynamics is required.

Part 2: Structured learning of non-smooth dynamics

A critical challenge in interaction between robot and world lies in the non-smooth dynamics of contact, including impact and frictional forces. Current approaches to machine learning use smooth algorithms to match these non-smooth effects. This inevitably leads to numerical difficulties and reduced learning rates. Furthermore, smooth approximations fundamentally cannot capture behavior like the stick-slip transitions due to friction, and are therefore inherently limited in their predictive power. This project will develop differentiable optimization problems that, by leveraging structure in the contact dynamics, can describe non-smooth motion. Accurate predictive models will be an enabling technology for when a robot attempts to grasp and manipulate a tool, or assemble a small-parts project. This project will include physical experimentation using a robotic arm, experimentation in simulation, and modern machine learning.

The part will involve significant programming, including Python and/or C++. Introductory knowledge of machine learning is highly recommended.

*Jordan Raney*

**Project: Geometry, design, and dynamics of deployable, reconfigurable structures**

3D printing and other advanced manufacturing techniques have greatly expanded the design space available to engineers. Whereas traditional manufacturing focused on the external shape of an object and its material properties, it is now possible to control the internal geometry of structures to affect the bulk mechanical properties over a very large range. Inspired by origami and new structural designs, we are interested in exploring how a structure's internal geometry affects its ability to change shape (e.g., for deployable space structures) and its nonlinear dynamic properties. The work is primarily experimental, involving fabrication, 3D printing, characterization with a high speed camera, etc.

[\*Return to top of document\*](#)

*Kevin Turner*

**Project: Enhancing Mechanical Properties of 3D Printed Materials through Control of Geometry**

Additive manufacturing, also known as 3D printing, is unique among manufacturing processes in that it allows geometry to be controlled across multiple length scales. Fine-scale control of geometry in additive manufacturing presents a unique opportunity to control the mechanical behavior of printed materials through geometry rather than composition. In this research project, strategies to enhance the fracture toughness (i.e. resistance to crack propagation) of interfaces via geometric control will be investigated. Over the course of this project, the student will design, fabricate, and test 3D-printed components with structured interfaces to establish the role of geometry on interface toughness. The specific geometries and structures to be investigated will be designed based on analytical and computational mechanics (i.e. finite element) analyses and will likely be done in collaboration with other researchers.

The project is best-suited for a student majoring in Mechanical Engineering and Applied Mechanics. Experience with CAD, Matlab, and basic mechanics of materials (e.g. MEAM 210) is preferred. The project will involve significant hands-on experimental work in the lab.

## **Law**

### **LAW**

*Cary Coglianese*

#### **Project: Estimating the Benefits of Regulation**

Professor Cary Coglianese is working on a book manuscript on the economic costs and benefits stemming from regulations. Excessive regulation has long been something of a national obsession. Politicians and businesspeople love to decry “red tape,” and the majority of Americans believe that regulatory burdens are too high. In recent years, several Washington think tanks have bolstered these views by attempting to quantify the economic burdens of regulations, with one widely-cited estimate claiming that regulations cost \$2 trillion annually. President Trump has in turn touted the impact that his administration’s deregulatory initiatives have had on the economy, and his administration has introduced a slew of initiatives aimed at eliminating existing regulations or making it more difficult for agencies to issue new regulations.

However, while there has been tremendous focus on the economic costs of regulations, there has been relatively little empirical research and attention focused on the benefits stemming from regulations. This project aims to fill this gap. It will critically examine and test the hypothesis that businesses exert a substantial negative impact on the economy by attempting to quantify the overall benefits of regulations across a number of different areas, and comparing these benefits to the costs of regulation.

Students will be involved in conducting reviews of the academic literature, empirically examining regulations, and assisting with drafting and revising manuscripts. It is recommended that students have some coursework in statistics or economics and have completed at least one course focused on American government. Priority will be given to rising juniors but all students will be considered.

*Claire Finkelstein*

#### **Project: Advancing the Rule of Law in the Areas of Grey Zone Warfare and Women in National Security**

The Center for Ethics and the Rule of Law (CERL) is an academic center that unites preeminent scholars and practitioners from around the world to engage in multi-disciplinary conversations

and issue policy recommendations on the legal, ethical, and political issues of national security and contemporary conflict. CERL offers the opportunity for an undergraduate to join the CERL team during summer 2019 and engage in activities that will advance both his/her research skills and subject matter knowledge and CERL's mission to promote and preserve the rule of law. The student will work in the two areas below.

#### Challenging the Grey Zone: The Changing Character of Warfare and the Application of International Law

The United States Special Operations Command (USSOCOM) defines grey zone challenges as “competitive interactions among and within state and non-state actors that fall between the traditional war and peace duality.” Providing structure to the grey zone, whether through the application of existing international legal regimes or through a novel construct, would serve the interests of global stability and justice. International legal frameworks would allow states to better predict when their actions are a breach of another state's sovereignty and will equip target states and the international community with accepted proportional methods to respond to such violations.

The student will research the topic and identify important issues and experts as potential participants in a one-day conference. He/she will write a paper on a topic related to grey zone warfare, which may help inform a CERL policy paper to be drafted later for external distribution. The student will also be given the opportunity to write one or more posts for The Rule of Law Post, CERL's blog. He/she will work at the direction of Professor Claire Finkelstein and participate in CERL activities (e.g., participate in CERL program planning meetings, attend presentations by industry guest speakers) to augment his/her research skills and knowledge with a real-world perspective. The project offers the unique opportunity to make important professional contacts, which may open doors to future job opportunities.

The student will also be mentored by Christopher Walsh, CERL's executive director.

#### Women, Peace and Security: “When Women Do Better, Countries Do Better”

A growing body of evidence shows that women offer distinctive contributions to making and keeping peace: inclusion of women in peace negotiations makes a resulting agreement far less likely to fail, and higher levels of gender equality are associated with a lower propensity for conflict, both between and within states. Despite this evidence women only make up a small percentage of national security leadership, cybersecurity experts, and combat forces. How does this disparity affect U.S. national security, and what steps can be taken to bridge this gender gap?

The student will research the topic and identify important issues and experts as potential participants in a one-day interdisciplinary conference. He/she will conduct follow-up outreach to experts and do media searches for articles and other public writings that will help inform the content of the symposium. The student will also be given the opportunity to write one or more

[Return to top of document](#)

posts for The Rule of Law Post, CERL's blog. He/she will work at the direction of Professor Claire Finkelstein and participate in CERL activities (e.g., participate in CERL program planning meetings, attend presentations by industry guest speakers) to augment his/her research skills and knowledge with a real-world perspective. The project offers the unique opportunity to make important professional contacts, which may open doors to future job opportunities.

The student will also be mentored by Christopher Walsh, CERL's executive director.

*Jean Galbraith*

**Project: The Separation of Power between Congress and the President: Tools of Presidential Control**

Our constitutional system divides power between Congress and the President. But these two branches do not always agree on what powers fall on either side of the line. I am working on several projects exploring these disagreements. One project -- the one I expect my research assistant to focus on this summer -- will look at statutes passed by Congress to which the executive branch has objected on constitutional grounds during the drafting process. The research assistant will contribute to a database of executive branch objections and conduct historical research on how (if at all) these objections have changed over time. The research assistant may also help me with research and/or writing for other ongoing projects. I am looking for a highly motivated and capable research assistant with an interest in law or government. There are no other prerequisites.

*Christopher Yoo*

**Project: 1 World Connected**

1 World Connected is a research project of the Center for Technology, Innovation and Competition at the University of Pennsylvania. Governments, civil society organizations, and businesses around the world have initiated a wide range of efforts to improve broadband adoption around the world, but no systematic analysis of these myriad efforts currently exists. 1 World Connected represents a comprehensive effort to consolidate, systematically analyze and disseminate information about these efforts, as well as understand their effects on development outcomes in education, health, financial inclusion and gender development. A systematic compilation and analysis of all initiatives to connect the unconnected is useful to governments, development banks, and other organizations who are interested in implementing or funding such

[Return to top of document](#)

[\*Return to top of document\*](#)

initiatives Spotlighting efforts made by various stakeholders and evaluating them for their cost effectiveness, funnels investment in the right directions, leading to enhanced outcomes for the investment that is being made across the world in Internet deployment.

PURM students will be assisting in the development and maintenance of a comprehensive initiatives database and enable the ongoing dissemination efforts with a wide variety of stakeholders from governments, international development organizations, private sector, and civil society. Students will be introduced to elements of data validation, coding and analysis using statistical software, as well as engaged in creation of briefs, presentations and position papers. They will be actively involved in reaching out to a diverse international and multistakeholder community that engages in Internet deployment for dissemination of research outputs.

[\*Return to top of document\*](#)

## **Medicine**

### **ADOLESCENT MEDICINE**

*Rebecka Peebles*

#### **Project: Medical Complications and Outcomes in Adolescents with Eating Disorders**

Selected student(s) would work with the PI and research team to collect data about medical complications and long-term outcomes occurring in children and adolescents with eating disorders. Students will be involved in many parts of the research project including, reviewing medical records, data entry, IRB proposals, background research, literature reviews, and data analysis. Students will become familiar with statistical software SPSS, as well as data entry using REDCap. Students will also have the opportunity to work with the CHOP Eating Disorder database, this includes data entry, cleaning, and checking data, as well as data analysis. Students will attend weekly lab meetings with the team, attend educational seminars and lectures within the Division of Adolescent Medicine, as well as the opportunity to shadow physicians within the Division of Adolescent Medicine at CHOP. Students also welcome to develop longitudinal research experiences as desired, and if this is pursued these often lead to presentations, honors projects, and/or publication opportunities.

Experience with pediatric research environment is preferable. Proficient in Microsoft office. Excellent communication and interpersonal skills to interact with staff, adolescents, and community partners. Ability to be discreet with confidential materials and sensitive topics. Ability to handle multiple, time dependent tasks in a fast paced, complex work environment. Must be highly motivated, with strong work ethic, excellent organizational skills, and ability to pay strict attention to detail. All CHOP hires must complete FBI fingerprinting clearance and child abuse history.

### **ANESTHESIOLOGY AND CRITICAL CARE**

*Seema Bhatnagar*

#### **Project: Identifying neural substrates of resilience to stress**

Students will assist in projects examining brain circuits and substrates that are important in an individual's resilience or vulnerability to the effects of repeated stress. Our lab uses rodent models to examine resilience or vulnerability to social stress, manipulates brain structures and



[Return to top of document](#)

substrates to determine the impact on behavior and physiology. Students will assist in all aspects of studies, from surgical procedures, stress administration to examination of brain structures and behavior. Students will be involved in experimental designs, data acquisition and statistical analyses as well as presentations of results to lab members. Our lab has considerable experience in training undergraduate students and we value their contributions.

*Maurizio Cereda*

**Project: An imaging approach to predict and contain lung injury**

Acute lung injury results from the propagation of an inflammatory insult in the lung; it causes respiratory failure in almost 200,000 patients annually, and 60% of these will be dead within two years. Our goal is to design strategies to contain lung injury and to reduce its impact in patients. Our research focuses on the early mechanisms leading to acute lung injury. Dr. Cereda's group studies how the distribution of local mechanical properties in the lungs governs the regional progression of pulmonary inflammation. They use a multifaceted quantitative approach that incorporates various techniques of morphologic, functional, and metabolic imaging (CT and MRI) in conjunction with standard measurements of tissue and systemic inflammation. With the support of a recent NIH grant, Dr. Cereda investigates new strategies of personalized care in a large animal model undergoing prolonged mechanical ventilation. Students will learn animal preparation and surgery techniques, help run the biological experiments associated with the project, and perform tissue analysis to measure regional inflammation in the lung. For those interested, students can learn 3D image reconstruction and analysis techniques. There are no particular prerequisites for students. The involvement will depend on the student's experience, availability, and most importantly interests. Importantly, the students will be exposed to a research environment where the focus is to rapidly narrow the gap between basic research and clinical investigation in critical care. Dr. Cereda has extensive experience in mentoring undergraduate students. He has recently supervised Rachleff Scholarship and PURM recipients and has been involved with the BE 400 preceptorship since 2006.

*Nabil Elkassabany*

**Project: The effect of using liposomal Bupivacaine on the quality of recovery in patients using shoulder arthroscopy**

Shoulder arthroscopy is one of the most commonly performed ambulatory orthopedic procedures in the United States. However, despite advances in arthroscopic technique, significant

[Return to top of document](#)

[Return to top of document](#)

postoperative pain remains a major challenge in the perioperative period. Regional anesthesia has played a key part in alleviating postoperative pain, particularly the use of single-shot interscalene nerve blocks. However, single-shot blocks are limited by their relatively short duration of action. The use of continuous peripheral nerve catheters is often limited by institutional resources.

As such, adjuvants can be added to the local anesthetic solution to help prolong the single-shot block. Whereas a long-acting local anesthetic such as Bupivacaine HCl can provide analgesia for 8-12 hours when deposited perineurally, the addition of adjuvants such as 4 mg preservative-free dexamethasone has been shown to prolong blocks for up to 24 hours.

Liposomal Bupivacaine (Exparel®, Pacira Pharmaceuticals, Parsippany, NJ) is a novel formulation of Bupivacaine that was approved for interscalene nerve blocks in April 2018.<sup>8</sup> By incorporating Bupivacaine within a multivesicular liposomal suspension (DepoFoam®) that causes a slow release of the drug, it is purported to extend a nerve block's analgesic effect to at least 72 hours.<sup>9</sup> 10 ml of Liposomal Bupivacaine 1.3% (133 mg) is recommended for interscalene blocks; this solution is also often mixed with Bupivacaine HCl to complement early analgesia.

Given the well-known postoperative pain and functional limitations of shoulder arthroscopy, the postoperative Quality of Recovery (QoR) scale is an appropriate tool to capture these outcomes. This scale assesses patient recovery in multiple domains, including physiological, nociceptive, activities of daily living, cognition and patient satisfaction.

Study Objectives:

We seek to determine if Liposomal Bupivacaine 1.3% will improve the quality of recovery, as measured by QoR-15 scores, in patients undergoing shoulder arthroscopy for rotator cuff repair when compared to Bupivacaine HCl 0.5% with 4 mg of preservative-free dexamethasone as an additive.

Student Roles:

Recruit patients, collect data, enter data into a web-based database

*John Fiadjoe*

### **Project: Emergency Intubation and Airway Management in a Children's Hospital**

This project aims to use simulation to study errors in operating rooms. A simulation scenario will be administered to anesthesiology residents in order to determine the primary outcome of the

[Return to top of document](#)

study. Students will participate in creating the study data collection tool using Redcap software, Collect data during simulations and collate data to generate basic reports after each session. Students will learn the basics of how to design a prospective randomized study. During downtime from study activities students will have the opportunity to observe in the operating room and attend clinical departmental lectures.

## ***Meghan Lane-Fall***

### **Project: HATRICC Sustainability**

Post-surgical handoffs of patients requiring intensive care threaten patient safety. These patients are transferred from one site and team of care to another, and they are often incapacitated and thus unable to participate in their care. Loss of critical information occurring in the transition process predisposes to error and preventable harm. The Handoffs and Transitions in Critical Care (HATRICC) project is employing qualitative and quantitative methods to improve and measure the postoperative handoff process in two Penn surgical intensive care units. This project has been ongoing since 2014, and we have successfully created and implemented a standardized operating room to intensive care unit handoff process in two Penn surgical ICUs. Students joining the project over the summer will participate in data collection that will help us determine the sustainability of this improvement effort. Responsibilities will include in-person observation of handoffs, surveys of clinicians, attendance at team meetings, and contributing to data analysis and writing. Students will join a multidisciplinary research team, learn about qualitative and quantitative research methods, collect data in a clinical environment, and will have opportunities to shadow clinicians (physicians, nurses, and others involved in patient care) from intensive care, anesthesia, surgery, and trauma. This opportunity is ideal for students with some clinical experience (e.g. EMT, medical scribe, hospital volunteer), but we will consider all interested students. Interested students will be able to continue participation in the project after the summer. Previous students involved in this project have gone on to medical school and nursing school and have published research abstracts and publications. For more information about this project, please visit our website at <http://www.hatricc.com>.

*Aaron Masino*

**Project: Machine learning methods and analysis of unstructured electronic health record data**

The Masino Lab conducts research on the application and development of machine learning methods to address challenges in the biomedical domain. Our primary focus areas include: 1) natural language processing (NLP) methods to extract information from electronic health record (EHR) text data; 2) deep learning methods to analyze streaming physiological data; 3) methods to facilitate machine learning analysis of large EHR datasets; and 4) application of machine learning methods for predictive analytics in pediatric medicine.

In all projects, the student will participate in data acquisition and pre-processing, model development, and model performance evaluation. If the specific project is successful, and the results are publishable, the student would be listed as a coauthor on relevant papers.

Project 1: Machine learning analysis of physiological data for adverse event prediction

The objective of this project is to incorporate physiological data (e.g. heart rate) measured every few seconds in operating room (OR) and intensive care unit (ICU) settings into machine learning models that predict specified adverse events (e.g. cardiac arrest, sepsis, airway distress). Model development and analysis will involve many aspects of applied machine learning research including feature engineering, feature selection, and design of evaluation for model comparison.

Project 2: Natural language processing for clinical text analysis

The objective of this project is to develop novel NLP methods using recent advances in word embedding representations and neural attention mechanisms for deep learning models to automatically extract discrete information from EHR text for use in research and clinical applications.

Project 3: Health diagnosis prediction using deep learning

The objective of this project is to develop deep learning models for prediction of a patient's future health diagnoses based on their medical history and environmental exposures. The project involves a large dataset consisting of several hundred thousand patients and thousands of input features. Model development and analysis will involve many aspects of applied machine learning and research including feature engineering, feature selection, and design of evaluation for model comparison.

Prerequisite: Students should have competency in Python programming for all projects. A background in machine learning is helpful, but not required.

*Prakash Patel*

**Project: Patient Satisfaction with the Use of Sedation in Transcatheter Aortic Valve Replacement**

Transcatheter aortic valve replacement (TAVR) for aortic stenosis continues to expand with a greater emphasis on minimalist approaches. This includes the use of sedation rather than general anesthesia. Penn, like many TAVR centers, has been avoiding general anesthesia in select TAVR patients since 2014. Avoidance of general anesthesia has demonstrated improved patient outcomes, including decreased length of stay, decreased need for vasopressors, and decreased mortality. However, not much is known about how patients feel about this transition to sedation and away from general anesthesia. Currently, the anesthetic approach in TAVR is not the decision of the patient, but rather the TAVR clinical team. We have previously conducted and presented an IRB-approved pilot study (33 patients) that investigated patient satisfaction with their anesthetic. The current proposed research project for an undergraduate student would expand on this prior work, given that sedation is now used for over 90% of transfemoral TAVR cases (allowing for a higher sampling population). After IRB approval, the potential student would be involved in direct patient interactions before the TAVR procedure to consent for postoperative survey participation. The student would also be able to observe the TAVR procedure in the OR to learn about the different aspects of the case (from induction to incision to valve positioning to sheath removal). This intraoperative participation will allow the student to understand what aspects of the procedure may be uncomfortable or unexpected to a patient. One day after the TAVR, the student will meet the patient again to perform a satisfaction survey that will include questions about the patient's overall experience with the anesthetic (was it explained prior to day of procedure, was an alternate anesthetic plan described to you the day of surgery, was the consent process thorough in describing the plan, was the intraoperative experience what you expected, what aspects of the anesthetic were unexpected (not explained)). After all data collection, the student will also assist with analysis of the survey questions for scientific presentation.

Benefits to the student in this proposed project would include clinical research with direct patient interaction, the opportunity to shadow in a hybrid operating room during a TAVR procedure, as well as participation in creating an abstract for presentation at a national meeting and likely a journal publication. Along with myself, other faculty involved will include members of the CT Anesthesia group at HUP.

*Alexander Proekt*

**Project: Understanding how general anesthesia causes unconsciousness**

Anesthesia has been hailed as a great discovery in modern medicine. These drugs allows physicians to perform lifesaving surgeries, aid pain, and allow for adequate recovery time in millions of patients worldwide. However, even with its widespread use, we still do not understand how general anesthetic agents lead to loss of consciousness.

One hypothesis is that anesthetics selectively alter sensory processing within the brain. In our lab, we test this hypothesis by giving mice multiple sensory stimuli and recording their brain activity using in vivo electrophysiology. We alter level of consciousness of our mice by giving them different anesthetic agents.

We are excited to take on diligent and motivated undergraduate students to help with this project! We have a few different avenues that students can help with.

- 1) Visual and Tactile Stimulation Paradigm: We use the matlab based psychophysics program PsychToolbox, to deliver a variety of visual stimuli. We will also start using a motorized system to move mouse whiskers. We would love to have an undergraduate student help us create sensory stimulation paradigms and build the whisker stimulation set up. Undergraduates who are interested/ have a background in coding/bioengineering are likely to find this project interesting. Students who choose to work on this project will better learn how to code in matlab, and create psychophysical experiments.
- 2) Histological Imaging: We record neural activity with electrodes that we implant into the brains of mice. We would appreciate help in looking through microscope slides mounted with mouse brains in order to find the precise location of these electrodes. Students who are interested in this project will gain a knowledge base in neuroanatomy, as well as learn how to collect and analyze microscopy images.

In addition to the skills noted above, students will gain a knowledge set in general neurobiology and learn how to formulate testable hypotheses. Moreover, students are welcome to observe mouse neurosurgeries and electrophysiological recording sessions. Very interested and dedicated students can also be taught how to perform these experiments independently.

*Rajeev Subramanyam*

**Project: Pediatric Anesthesia Outcomes Research/Quality Improvement**

1. Children exposed to secondhand smoke presenting for anesthesia

CHOP anesthesia has recently introduced a standardized assessment tool on EPIC to collect data on children exposed to Secondhand smoke. A study will be performed to assess the implementation of this standardization. The students will be exposed to the IRB submission process, data collection from EPIC, working with statistician on performing analysis and submitting an abstract for presentation at a meeting along with a peer-reviewed manuscript.

## 2. Quality improvement

Trainees will be exposed to the CHOP quality improvement framework, be a part of ongoing projects, be a part of abstract writing for a national or international conference and be exposed to the science of writing a quality improvement project (which is very different from writing an original research article).

## ***Robert Sutton***

### **Project: Resuscitating Pediatric Resuscitation**

Drs. Sutton and Kilbaugh, Co-Directors of the Resuscitation Science Research Program CHOP have developed a true bench-to-bedside-to-bench high-fidelity platform of pediatric cardiac arrest and resuscitation. Dr. Kilbaugh oversees the basic and translational arms of the program, while Dr. Sutton oversees the clinical arm. As such, prospective students have the opportunity to participate in a multitude of projects related to the field of pediatric resuscitation science. A few specific areas of research focus include physiologic-directed cardiopulmonary resuscitation, neuroprotection, neurotherapeutics, and mitochondrial bioenergetics. The program benefits from large animal models of cardiac arrest and extracorporeal life support, with corresponding clinical projects in each domain. Prospective students can expect to gain experience in their chosen area of research. For bench related projects, they can gain experience in such techniques as tissue extraction and fixation, mitochondrial bioenergetics and biogenesis analyses, ELISA and western blots, mRNA and cfDNA analyses, neuroimaging, and immunohistochemistry / biomarker analyses. For large animal translational projects, they can gain experience in large animal anesthetic management, resuscitation techniques, surgical procedures including invasive hemodynamic and neuromonitor placement, and neurobehavioral testing. Should a student desire a clinical project, instruction in study design, database development, and statistical methods for large databases can be expected. Overarching areas of instruction will include waveform analytics in collaboration with our engineering team, and manuscript writing. Students can expect to be a named a co-author on manuscripts related to projects on which they invest measureable effort. Weekly meetings will be scheduled during the summer to monitor progress and for feedback.

[Return to top of document](#)

*Huafeng Wei*

**Project: Mechanisms of neuropathology in Alzheimer's disease**

We will study the role of calcium dysregulation, especially the excessive calcium release from the endoplasmic reticulum (ER) and the transfer into mitochondria, on impairment of neurogenesis and synaptogenesis in induced pluripotent stem cells (iPSC) from Alzheimer's disease patients. Therapy options based on the mechanisms study will be proposed and investigated. The student will take part in part of the research project and will be trained for experimental design, tissue cultures and other basic biological and molecular experimental techniques, calcium measurement, data collection and analysis and manuscript drafting. The student will under direct supervision of Dr. Ge Liang (ge.liang@uphs.upenn.edu).

## BIOCHEMISTRY AND BIOPHYSICS

*Kathy Liu*

**Project: RNA Epigenetics and Human Disease**

To characterize the role of an enzyme complex of Trmt10A and FTO in adipocyte development. And to characterize the influence of the patient-derived mutations on these two enzymes above by using a combination of genetics, structural biology, biochemistry, and high-throughput sequencing tools.

*James Shorter*

**Project: Countering aberrant phase transitions connected to neurodegenerative disease**

We have two projects available for multiple undergraduates, which focus on countering aberrant phase transitions connected to neurodegenerative diseases such as amyotrophic lateral sclerosis (ALS) and frontotemporal dementia (FTD). Using pure component biochemistry, CRISPR gene editing, and yeast model systems we seek to:

1. Uncover RNA disaggregases to reverse formation of toxic RNA inclusions that accumulate in ALS/FTD.
2. Engineer enhanced protein disaggregases to reverse aberrant phase transitions of important neurodegenerative disease proteins, including TDP-43, FUS, and alpha-synuclein.

[Return to top of document](#)



## BIOSTATISTICS, EPIDEMIOLOGY, AND INFORMATICS

*John Holmes*

### **Project: Agent-Based Models of Human Behavior in Urban Traffic**

This project seeks to develop agent-based models (ABMs) to simulate human behavior in urban traffic settings. We are interested especially in intersections and sidewalks, where pedestrians, bicycles, and motor vehicle drivers can come into conflict that may or may not necessarily result in injury. Our goal is to explore: 1. characteristics of human behavior that can be encoded in software agents from qualitative and video data we have obtained at intersections around Penn's campus and in Center City; 2. the effects of possible interventions on such behavior. We will use a well-known ABM platform (NetLogo) in conjunction with geographic information to model faithfully the environments.

While some programming experience will be helpful, it is not required; NetLogo's language is simple and easy to learn. Rather than just programming, the student will learn about complex systems, injury epidemiology, and how to design possible public health, behavioral, equipment, and environmental interventions to reduce traffic-related conflict and injury. We will present our work at a monthly meeting of the Penn Injury Science Center, and plan and co-author a manuscript for submission to an epidemiology journal by the end of the summer.

*Jason Moore*

### **Project: Automated machine learning**

Machine learning (ML) can be a challenge due to the many different algorithms and parameters to choose from. We have developed an automated approach to ML that builds an entire analysis pipeline for you using components from the open-source scikit learn library. Our tree-based pipeline optimization tool (TPOT) approach is programmed in Python and available on Github as open-source. Research projects include extending TPOT, evaluation of TPOT, or application to biomedical data. Some Python programming experience is needed.

*Li Shen*

**Project: Bioinformatics Strategies for Multidimensional Brain Imaging Genetics**

The central theme of my lab is focused on developing computational and informatics methods for integrative analysis of multimodal imaging data, high throughput "omics" data, cognitive and other biomarker data, electronic health record data, and rich biological knowledge such as pathways and networks, with applications to various complex disorders. Our research interests include medical image computing, bioinformatics, machine learning, network science, visual analytics, and big data science in biomedicine. I am open to multiple students. The following are two specific projects designed for two PURM students, respectively.

Project 1: Genetics of the Brain Connectome

Human brain connectomics and imaging genetics are two emerging research fields enabled by recent advances in multi-modal neuroimaging and high throughput genotyping technologies. Integrating brain imaging genetics and connectomics holds great promise for a systematic characterization of both the human brain connectivity and the connectivity-based neurobiological pathway from its genetic architecture to its influences on cognition and behavior. We are working on developing computational methods for profiling structural brain connectome optimized for imaging genetics and for identifying genetic basis of interesting connectomic features. The student is expected to work with myself and my team members to perform integrative analysis of brain network data and genetic data available from landmark studies such as the NIH Human Connectome Project and Alzheimer's Disease Neuroimaging Initiative. Participating in the project will give the student experience with brain image computing, network science and imaging genetics. Basic knowledge of neuroscience and genetics and basic experience with quantitative analysis and programming would be helpful.

Project 2: Subtyping analysis using multimodal brain imaging data in Alzheimer's disease

One strategy for enabling precision medicine for Alzheimer's Disease (AD) is to detect patient subgroups with distinct endophenotype structures. Brain imaging is a powerful tool to study AD. For example, multimodal neuroimaging data have been studied as endophenotype to characterize brain structure and function and to serve as intermediate traits linking genetics to phenotypic outcomes. In this project, we will perform data-driven subtyping analysis for AD using multiple brain imaging modalities. Specifically, we will perform and compare a set of subtyping analyses using each single modality independently or via combining multiple modalities jointly. Subtyping results will be evaluated via genetic association study and/or biomarker analysis to identify subtypes with strong genetic basis and/or distinct progressive biomarker outcomes. The student will work with Dr. Xiaohui Yao and myself to perform the above analyses using imaging, biomarker and genetic data from the Alzheimer's Disease Neuroimaging Initiative. Participating in the project will give the student experience with brain image computing,

machine learning, genetics and AD research. Basic knowledge of statistics and computer science and basic experience with quantitative analysis and programming would be helpful.

***Ryan Urbanowicz***

**Project: Machine Learning Strategies for Mining Complex Patterns from Biomedical Data**

Developing and applying smarter machine learning (ML) is critical to biomedical data mining and many other real world applications. The URBS-lab is focused on investigating ML methods that can select features and generate predictive/interpretable models, in the presence of complex associations. Tackling these challenges can improve: our understanding of disease etiology, risk prediction, and personalized medicine.

Pre-requisites: Experience with programming in Python/R (mastery of basics preferred, but commitment to learn welcome). Interest and/or experience in machine learning, informatics, and/or statistics encouraged.

Expectations: Student(s) will gain experience in ML development, statistical analysis, data visualization, and/or working with clinical/genetic data. The goal is to publish a peer-reviewed publication. Student(s) will be listed as a co-author assuming project is successful and publishable.

Project-1: Implement/evaluate novel feature selection strategy. Expand on our previous work towards better performance in ‘big data’, while accommodating different data types, noise, and complex patterns. Focus will be on strategies that adopt ensemble and iterative algorithm concepts.

Project-2: Implement/evaluate a novel rule-based machine learning (RBML) algorithm. RBMLs are uniquely interpretable and sensitive to complex patterns. Focus here on unique challenges of analyzing electronic health records (EHR): (1) adapting risk predictions as data becomes available over time, (2) boosting performance in data with high dimensionality (i.e. very large numbers of features and/or subjects).

Project-3: Develop/apply ML pipeline for biomedical data analysis (genetic and/or EHR). Collaborate on analysis of one or more investigations of clinical/disease outcomes (e.g. graft rejection, pancreatic cancer, obstructive sleep apnea, congenital heart disease, pulmonary hypertension, and post-operative complications).

## CANCER BIOLOGY

*Lewis Chodosh*

### **Project: Survival and Recurrence of Dormant Cancer Cells**

Breast cancer is the leading cause of cancer mortality in women, mainly due to incurable metastatic recurrence arising after initial treatment. Recurrent tumors arise from a presumptive pool of residual tumor cells (RTCs) that persist in a dormant state after treatment. The mechanisms enabling dormant tumor cell survival and recurrence are poorly understood. Hence, identifying the pathways underlying tumor dormancy and recurrence is critical to reduce breast cancer recurrence and mortality.

Our laboratory has developed genetically modified mouse models for human breast cancer that recapitulate key steps during breast cancer progression. Transgenic mice that conditionally express the HER2/neu oncogene (MTB/TAN mice), develop mammary tumors upon oncogene induction, and conversely, tumors regress following oncogene down-regulation. However, a small number of RTCs survive oncogene inhibition and persist in a dormant state, and ultimately seed spontaneous recurrent tumors.

To explore potential pathways that may be required for RTCs survival, our lab generated gene expression data sets from MTB/TAN derived tumor cells in dormancy. Interested students will have a critical role in validating candidate pathways mediating RTC survival. We are interested in recruiting two students that will be mentored separately by postdoctoral fellows Dr. Sreekumar and Dr. Escobar-Aguirre. Students will learn the basics of cell culture (to perform in vitro dormancy assays), flow cytometry (to quantify the proliferating tumor cells), and fluorescence microscopy (to define the activation status of signaling pathways in dormancy). Previous lab experience is not a prerequisite; we can adapt the project to the student's skill set and interest.

*Roger Greenberg*

### **Project: DNA Damage Responses and Cancer**

Altered DNA damage responses are perhaps the most common cause of cancer. Indeed, germline mutations to DNA repair genes result in hereditary breast, ovarian, colon, and pancreatic cancers. Exaggerated use of noncanonical DNA repair mechanisms also contributes to cancers. To understand the molecular basis underlying altered DNA repair in human cancer, we have developed methodologies to directly monitor homologous recombination at telomeres, a first for

any genomic location in mammalian cells. This enabled our discovery of a novel form of homology directed repair that is responsible for alternative telomere length maintenance mechanisms in approximately 15% of human cancers (Cho et al. Cell 2014; Dilley et al. Nature 2016). Projects will involve molecular studies into the DNA repair networks that become active in cancers that utilize noncanonical DNA repair mechanisms. This includes cancers with BRCA mutations and those that rely on alternative telomere maintenance.

*Sandra Ryeom*

**Project: Understanding mechanisms contributing to the Pre-metastatic niche**

Metastatic disease is the primary cause of cancer-related mortalities with the lung being the most common site of metastases. Many studies are focused on understanding how tumor cells acquire the ability to metastasize to distant organs and escape from their primary location. However much less is known about the mechanisms underlying the ability of normal organs to permit metastatic tumor cell seeding and expansion. In this proposal, we are investigating the contribution of endothelial cells and fibroblasts towards generating pre-metastatic niches (Pre-MN) in the normal lung. The Pre-MN has been defined as a future metastatic site in a normal organ generated by tumor-derived factors to promote a permissive microenvironment for metastatic tumor cell colonization or seeding. Fibroblast activation is known to be an important aspect of primary tumorigenesis but less is understood about the requirement for fibroblast activation or the ‘stromagenic switch’ in metastases or in formation of the Pre-MN. Our published studies and preliminary data suggest that lung endothelial cells (ECs) and fibroblasts are activated prior to the arrival of tumor cells in an experimental model of spontaneous lung metastases. Our data also indicate that the anti-angiogenic protein thrombospondin-1 (TSP1) plays an important role in regulating EC activation and that loss of endothelial specific TSP1 promotes EC activation at baseline, fibroblast activation and enhances lung metastases. We will investigate how TSP1 regulates EC activation, determine how Tsp1-null ECs promote fibroblast activation and investigate how nutrient deprivation and type I interferon receptor expression regulate TSP1 expression and EC activation, respectively. Identifying key pathways in the normal lung microenvironment that are critical for the formation of the Pre-MN may offer new therapeutic targets for metastatic progression.

*Xiaolu Yang*

**Project: The molecular and cellular mechanisms that protect against cancer and neurodegeneration**

Our lab studies the molecular and cellular mechanisms that protect against major diseases, including cancer and neurodegeneration. Our current projects are focused on two areas: 1) the tumor suppressor p53, and 2) the cellular systems that degrade misfolded proteins. Our experimental strategies include molecular and cell biology techniques, biochemical techniques, metabolic analysis, cell culture, genomics, mouse disease models, and human patient samples.

p53 plays a preeminent role in blocking tumor formation and is the single most frequently mutated gene in human tumors. p53 is activated by various tumor-promoting stresses and effectuates a range of anti-proliferative and repair responses. We are investigating the regulation and functions of p53. We previously identified a complex that stabilizes the principal p53 antagonist Mdm2 and are now examining how this complex controls p53 activation. We also revealed a role for p53 family proteins in modulating cellular metabolism, particularly the production of NADPH, the reducing equivalent required for biosynthesis and anti-oxidant defense. We are further studying how p53 acts as both a sentinel and a regulator for metabolism, coordinating metabolism with cell fate decision, and how these functions may be compromised in tumor cells.

Proteins are the most abundant macromolecules in the cell and are critical to virtually all physiological processes. However, proteins are prone to misfolding, and accumulation of misfolded proteins is genetically and pathologically linked to neurodegenerative diseases and cancer. Cells ultimately rely on degradative systems to maintain protein quality. We recently identified a cellular system that selectively degrades misfolded proteins through sequential SUMOylation and ubiquitination, and protects against neurodegeneration. We are further defining the mechanism of this novel protein quality control system, as well as its dysregulation in human diseases.

## CARDIOVASCULAR MEDICINE

*Yuchi Han*

**Project: Deep learning in cardiac imaging combined with genetic information**

In this exploratory study, we will apply deep learning neural network to existing cardiac MRI and echocardiography information (size, systolic function, diastolic function, tissue

[Return to top of document](#)

characteristics) and linked genetic information to look at separation of groups. We will examine these groups and try to understand the relationship between traditional classifications and deep learning generated classifications. A further analysis will also link outcomes of these patients.

Student qualifications: Inclined for quantitative science and engineering with programming skills. Interested in imaging.

Student duties/responsibilities: Student will handle large amount of imaging data and patient genetic information. Data labeling will be a necessary part of this work.

Student will be trained in good clinical research practice, data preparation, data analysis, data interpretation, and abstract/manuscript drafting.

*Marielle Scherrer-Crosbie*

**Project: Cardioprotective effect of a brown adipose tissue adipokine**

Approximately every 38 seconds, an American will experience a myocardial infarction (MI). The prognosis after MI depends on the amount of myocardial death, therefore, finding cardioprotective therapies is an important field of research. Our laboratory has been investigating the interactions of brown adipose tissue (BAT), a type of adipose tissue involved in body temperature control, and the heart. We reported that BAT has cardioprotective effects in mice in a myocardial damage model. Recent preliminary results show that a protein secreted by BAT protects mice hearts during myocardial infarction.

To mimic human MI, our laboratory is studying the effect of this protein in isolated human pluripotent stem cells (iPSC) differentiated into cardiomyocytes. The student will evaluate the pro-survival effects of this protein in iPSC in the presence or absence of inhibitors.

This will be an opportunity for an undergraduate student to be part of our team and to learn the importance of research. The student will work directly with a research technician and a post-doctoral fellow to learn the different techniques in cell culture and molecular biology required to develop the project and achieve the results. Furthermore, he/she will participate in the weekly research meetings and have the ability to present and discuss their results. We expect the student to write a short presentation of the full experiment at the end of the summer. That exciting experience will provide to the student with a skill set that will help them to develop their career in science.

[Return to top of document](#)

*Victoria Vetter*

**Project: Prevention of Sudden Cardiac Death in Youth**

Sudden cardiac arrest (SCA) occurs when the heart suddenly and unexpectedly stops. Without intervention, sudden cardiac death (SCD) occurs. SCA is the third leading cause of death in the United States (US), with over 395,000 out-of-hospital sudden cardiac arrest/year, one every two minutes. In addition, SCD claims the lives of approximately 7000 US children and adolescents yearly. Sudden cardiac death can be prevented by using cardiopulmonary resuscitation (CPR) and automated external defibrillators (AEDs), small portable computerized devices that deliver an electric shock (current) to the heart to restore the normal heart rhythm. While survival in the community is only 10-12% after a SCA, survival in a school with an AED and emergency response plan can be over 85%.

Youth Heart Watch (YHW) is a sudden cardiac arrest and sudden cardiac death prevention program at the Children's Hospital of Philadelphia (CHOP) whose aim is to prevent sudden cardiac death among children and adolescents by serving as a resource to help schools develop AED programs and save lives.

In Philadelphia, all public high schools, middle schools and elementary schools have AEDs but many do not have AED programs with the necessary procedures, policies, and training to make their schools heart safe. Pennsylvania State Law (ACT 35: 2014) mandates that schools report the presence and status of their AEDs, but many have not complied with this mandate resulting in an incomplete understanding of AEDs in our schools. We are compiling a list of AED placements in schools in southeastern Pennsylvania. We have developed a REDCap (scientific database) survey for schools in Pennsylvania with data from hundreds of schools entered, but with hundreds not yet reported or entered. The student will participate in contacting schools, collecting and entering additional data, and evaluating the data. The student will help with implementation of the Youth Heart Watch School AED Program in these schools as we use these data to determine best practices for our program. Under our supervision, the student will interact directly with the schools to determine the current status of the AED and AED programs to determine the specifics of the school's AED: Are batteries working? Are electrode pads active or expired? Is the AED in an accessible location? Are trained personnel aware of its location and on site at all time? Does the school have a Cardiac Emergency Response Team and Plan (CERP)? This is an ongoing activity and the student could participate in visits to the schools to see how an AED based Emergency Medical Program in the schools is implemented. This year, we are focusing on having the schools comply with a set of criteria that would include a CERP in their AED program. The student will learn CPR and AED use and assist in instruction in the schools. In addition, the student would have the opportunity to shadow pediatric cardiologists in their clinics at CHOP, learn how to read electrocardiograms, and learn about cardiac conditions for which AEDs may be needed.



## CELL AND DEVELOPMENTAL BIOLOGY

*Erfei Bi*

### **Project: Regulation of septin architecture and function by conserved kinases**

Many human diseases such as cancer arise from abnormal growth and division of cells within the body. During neural development, nonmitotic neurons must adopt a very unique shape to facilitate the formation of many axon-dendrite synapses that become part of the central nervous system. The septin family of proteins has gained interest in recent decades given that mutations and misregulation of their expression have been implicated in neurodegenerative diseases. Our lab studies the septin proteins in the budding yeast *Saccharomyces cerevisiae* due to the ease of genetic manipulation and fewer septin subunits (only 7 septins compared to 13 in humans), while maintaining the conserved functionality of being important for polarized cell growth and cell division. The particular project focuses on septin regulation at the post-translational level, namely by phosphorylation. Previous data from our lab and others has shown that the conserved kinase Elm1 is required for the proper localization and function of septins in yeast. However, the regulation of Elm1 itself has still largely been unexplored. Based on preliminary evidence, we believe that a related kinase Gin4, which arrives at the bud neck prior to Elm1, is critical for Elm1 localization and function. The exact mechanism for this regulation (by activating Elm1 or simply recruiting to the bud neck) remains to be seen and will be investigated by the interested student.

*Stephen DiNardo*

### **Project: Cellular Dynamics of Tissue Formation & Stem Cell Biology**

We study two major questions, with both taking advantage of genomic and genetic approaches, and relying on advanced live-imaging microscopy on living tissue.

1) How do our tissues and organs first form, and how do the specific shapes of those organs arise? To address these questions, we investigate how signaling pathways control cell shape. This involves examining the cytoskeletal changes that occur in real-time. We combine that with molecular manipulation of proteins, such as small GTPases, polarity, adhesion proteins and cytoskeletal components. The pathways are quite conserved, and we expect that conceptual advances will apply to mammalian tissue organogenesis.

[Return to top of document](#)

<https://sites.google.com/site/sdinardolab/home/epithelial-morphogenesis>

2) How do Stem cells work? Stem cells are essential in replenishing cells in your organs throughout life. These adult stem cells reside in special microenvironments in our tissues, called “niches”. The mechanisms that establish a niche, and the ways the niche controls the behavior of its resident stem cells are poorly understood. To address these questions we use state-of-the-art genetic, genomic and live-imaging techniques to ask how a niche forms, and characterize factors that control stem cell self-renewal.

<https://sites.google.com/site/sdinardolab/home/stem-cell-niche-interactions>

Students will conduct 1). Genetic screens to identify new mutations affecting embryos or stem cells. 2). Ask how those new genes work by state-of-the-art DNA cloning, transgenesis and live-imaging to test function.

*Shawn Little*

**Project: Uncovering genes that promote precision and robustness in cell fate determination during early development**

Early embryos exhibit single-cell-level precision in establishing specific gene expression programs at precisely defined locations. This precise positioning is reproducible across embryos and is highly robust to fluctuations in environmental conditions such as temperature and nutrients. How do embryos generate robustness and precision in their gene expression patterns? This project will explore the molecular genetic basis of precise patterning in embryos of the fruitfly *Drosophila*, one of the best studied embryonic patterning systems. Students will use a straightforward genetic screening approach to discover genes that alter the precise positioning of cell fates. The students will set up genetic crosses between strains of different sensitized genetic backgrounds, then use microscopy to look for defects in embryonic patterning and cell fate determination. Ordinarily, embryos from these sensitized backgrounds develop normally. However, embryonic patterning is disrupted when these organisms are challenged by additional genetic perturbation. Further genetic crosses will be used to determine the factor(s) that alter precise patterning. When new factors are identified, the student will assess their effects on gene expression using high resolution single molecule microscopy. The student will receive practical, hands-on experience with *Drosophila* genetics, embryonic patterning, and high resolution microscopy. These studies will lead to a greater understanding of the molecular basis for gene regulation.

[Return to top of document](#)

*Patrick Seale*

**Project: Metabolic control of fat cell differentiation**

Fat tissue plays a central role in regulating metabolism and energy levels. In obesity, fat tissue expands through increases in fat cell number (hyperplasia) and/or size (hypertrophy). Hyperplastic fat expansion, which involves the differentiation of precursor cells into new fat cells, is critical for preserving fat function and protecting against metabolic disease. We recently identified a pathway through which mature fat cells regulate the conversion of precursor cells into new fat cells through producing specific small molecule metabolites. Developing strategies to enhance this pathway may ameliorate the metabolic complications of obesity, including insulin-resistance and fatty liver disease. Projects are available in the lab to study this pathway, including determining the molecular pathways involved using candidate-driven and unbiased approaches in cell culture models. Additional work using mouse genetic models will seek to determine the importance of this pathway under normal physiological conditions and in response to obesity. The student will be responsible for assisting with experiments under the supervision of a senior PhD student or postdoctoral researcher in the lab. The student will learn a variety of techniques, including gene expression and western blot analyses, Crispr-technology to modify gene function, and metabolic analyses of mice. The student will also learn how to analyze experimental results and design experiments. The student will attend weekly lab meetings and have the opportunity to present his/her research findings to the group at the end of the research period.

*John Weisel*

**Project: Biophysical studies of blood clotting and clinical implications**

This research project focuses on the molecular and cellular mechanisms of blood clotting. Blood clots are necessary to stem bleeding in the case of injuries, but thrombi, or clots that block the flow of blood are the cause of heart attacks, strokes and venous thrombosis, some of the most common causes of death. We use various biophysical and structural techniques, including visualization of molecules and supramolecular aggregates and measurements of mechanical properties of blood clots and thrombi. The interactions of cell membrane integrins with adhesive proteins and with the cytoskeleton is also a focus of this research, especially their roles in platelet aggregation. Relationships between clot structure and mechanical properties are also an important part of this work, since clotting is basically a mechanical function. We are also studying the structure and composition of thrombi taken from heart attack patients, stroke patients and others. Biology or chemistry students might help to image clotting proteins or various types of clots or thrombi by light or electron microscopy or atomic force microscopy.

Engineering or physics or mathematics students might analyze the mechanical properties of clots or help with quantitative image analysis. Students will learn the basics of hemostasis and thrombosis and various techniques, as described above. The results of these studies have implications for basic mechanisms of protein-protein and protein-cell interactions as well as for clinical aspects of hemostasis, thrombosis and atherosclerosis.

## **EMERGENCY MEDICINE**

*Benjamin Abella*

### **Project: Studies in CPR, cardiac arrest and post-arrest care**

Our team, the Center for Resuscitation Science, is a dynamic and multidisciplinary group of physicians, nurses, and paramedics who study cardiac arrest, including CPR training, CPR delivery, and post-arrest care. We have a number of projects that would be suitable for student engagement and leadership; two are described here:

1. Mobile CPR Project and layperson training in CPR. We have managed a successful community-oriented project for several years known as the Mobile CPR project (<https://themobilecprproject.com/>), which seeks to promote CPR and AED training among disadvantaged communities in the Philadelphia region. We propose a project to evaluate several different approaches to CPR and AED training in this community, to improve our outreach and increase CPR training saturation to save lives. Advantages for a student are that the program is stable, up and running, and has excellent coordinators - so this would be "plug and play" with relatively straightforward engagement.
2. Post arrest care. Our team has helped develop hospital protocols for post arrest care, including the use of whole-body cooling (targeted temperature management) and other techniques. A key question that we now seek to answer is the role of oxygen delivery in the post-arrest state; there is some evidence from our team and others that too much oxygen may increase brain damage and worsen outcomes. We seek to collect oxygen data on retrospective, and then prospective, cases of cardiac arrest that present to our emergency departments.

## FAMILY & COMMUNITY HEALTH

*Frances Barg*

### **Project: Guatemala Health Initiative: Health related research in the Guatemalan Western Highlands**

We are seeking one to two promising students who will work long term with the Guatemala Health Initiative to conduct research in the rural highlands of Guatemala. Since 2005, the Guatemala Health Initiative (GHI) has coordinated interdisciplinary research, education, and service programming involving the School of Nursing, School of Medicine, School of Arts and Sciences, Wharton, and the School of Engineering and Applied Sciences. GHI partners with the Hospitalito Atitlán (HA) in the Mayan communities of Santiago Atitlán, Guatemala and in two other locations in Guatemala (Sacatepequez and Trifinio(Cotepeque)), to develop and organize community initiated programs aimed toward improving the health of the community.

In this position, each student will work with faculty and community partners on one of three projects: a diabetes screening, treatment and community education program, a project addressing anemia on fincas in the rural districts surrounding Santiago Atitlan or another project that will be identified by our community partners in Guatemala. In each of these projects, students will be responsible for primary data collection and data management. Students will learn interviewing skills, database management skills and mixed methods research skills. In addition, students will gain important perspectives on factors affecting the implementation of global health programs. Students will spend 10 weeks in Guatemala in a home-stay (from late May to early August,) supervised by the GHI. Students work under the direction of Dr. Fran Barg, a medical anthropologist and Dr. Kent Bream a family physician and global health specialist.

Qualified applicants will have strong Spanish language skills, excellent organizational skills, a high tolerance for working and living in an environment very different from their own, good interpersonal skills and a desire to be a team player. Students from all schools and all majors are welcome. We are particularly interested in students who are looking for a long-term research commitment.

*Carolyn Cannuscio*

### **Project: Public Libraries as Partners for Addressing the Opioid Epidemic**

Our team is interested in integrating evidence-based public health programming into public libraries. One of our areas of focus is engaging local public libraries and the Philadelphia

[Return to top of document](#)

Department of Public Health in a series of harm reduction initiatives related to the opioid epidemic. We are currently working on implementing and evaluating naloxone (Narcan) trainings for both library staff and community residents. Naloxone is a medication that is used to reverse opioid overdoses and can be used safely and effectively by lay people to prevent opioid overdose deaths. A statewide survey we recently completed demonstrated that 12% of Pennsylvania's public libraries experienced overdoses on-site last year, and the Philadelphia community, including its public libraries, is currently experiencing unprecedented rates of opioid overdose. We want library staff and community residents to be armed with naloxone and ready to respond.

A summer student would be a member of our interdisciplinary team and work with us to facilitate trainings, conduct interviews of librarian and community participants, and help with data analysis and presentation. This project would provide opportunities to develop skills in research methods, working with community partners, and on-the-ground experience in the area of harm reduction/overdose reversal, a key part of the response to the opioid epidemic. We can offer excellent, committed mentoring on projects that are highly relevant to public health policy and action. We also offer practical support, career development coaching, and a team approach that allows for a high degree of shared productivity and fast-paced learning.

## GASTROENTEROLOGY

*Anna Buchner*

### **Project: The Accuracy of Endoscopic Characterization of Colitis associated Lesions in Inflammatory Bowel Disease Patients**

Background: Detection and Characterization of colonic lesions in inflammatory bowel disease (IBD) during colonoscopy exams remains challenging. Patients with ulcerative colitis and Crohn's disease colitis have a significantly higher risk for the development of colitis-associated dysplasia and cancer (CAC), a risk associated with increased duration and extent of disease. Colorectal cancer (CRC) in patients with IBD arises from dysplastic tissue. However, unlike sporadic colorectal cancers that develop from the adenoma-carcinoma sequence, IBD related cancers can develop in the background of chronic inflammation and regeneration. The growth pattern of dysplastic tissue is often multifocal and diffuse, and thus, its detection may not be optimal with the use of traditional white light colonoscopy. Most dysplastic lesions are thought to be visible to endoscopic inspection especially with the current application of enhanced imaging high definition colonoscopy which offers narrow band imaging (NBI) or by applying traditional dye based chromoendoscopy (CE). The Surveillance of Colorectal Endoscopic Neoplasia detection and Management in Inflammatory Bowel Disease Patients: International

[Return to top of document](#)

Consensus Statement (SCENIC) identified the endoscopic techniques that need to be adopted to increase the detection rate of dysplasia as well as introduced a new terminology to describe the lesions adequately and advocated for the use of enhanced imaging allowing better detection and characterization of the lesions (1). The currently available endoscopic classifications of the lesions include the Paris classification, Kudo pit pattern and NICE/WASP classifications but have not been universally applied by practicing endoscopists (1-4). In addition a multimodal (FACILE) classification for optical diagnosis of inflammatory bowel disease has been just introduced (5).

**Aims** The aims of the project to evaluate the feasibility and accuracy of available classifications KUDO, NICE/WASP and FACILE in characterizing lesions in inflammatory bowel disease patients. Secondary aims were to differentiate dysplastic and non dysplastic inflammatory lesions based on using these classifications in IBD population and to examine the learning curve of correctly identifying benign and dysplastic colorectal lesions by using available classifications.

**Methods:**

A diagnostic accuracy study to develop the best classification scheme for endoscopic diagnosis of colorectal lesions in IBD patients using NBI and CE imaging will be conducted. Corresponding images of the same lesion - NBI and dye based chromoendoscopy (CE) and high definition white light images HDWL will be collected from 100 colorectal lesions from patients with long term IBD who underwent surveillance colonoscopy for which concurrent histopathology diagnosis is available. A training set of 40 images with known histology will be first reviewed by three endoscopists to standardize image interpretation using available classifications followed by their blinded review of 80 unknown images. Three endoscopists independently will analyze NBI, CE and white light HD features of each polyp for color, vessel pattern, surface pattern using available classifications and differentiate between low-risk polyps (dysplastic, inflammatory, sessile serrate polyps ) and high-risk polyps ( high grade dysplasia or adenocarcinoma) using available classifications. The learning curve of correctly identifying benign and dysplastic colorectal lesions by using available classifications will be constructed.

**Anticipated Results/Conclusions:** Colorectal lesions in IBD patients can be easily characterized using endoscopic classifications. Accurate interpretation of CE and NBI images for predicting neoplastic lesions can be learned rapidly by GI specialists.

**Keywords:** Narrow-band imaging and Chromoendoscopy • Colorectal lesions Inflammatory bowel disease • Sensitivity and Specificity • Predictive value • Diagnostic use

## GENETICS

*Marni Falk*

### **Project: Mitochondrial disease therapeutic modeling in simple worm and zebrafish model animals**

Project 1: Evaluating mitochondria targeted therapies in *Caenorhabditis elegans* worm invertebrate models of Down Syndrome.

Down syndrome (DS) is the most prevalent chromosomal aneuploidy that results from the duplication of all or part of chromosome 21, which leads to a wide variety of birth defects, neurodevelopmental disability, and multi-system medical conditions. Dysfunction of mitochondrial energy production has emerged as a key-contributing factor to the pathogenesis of DS. Recent studies by others have suggested that treating mitochondrial dysfunction may offer a therapeutic opportunity in DS. Over the past 12+ years, we have successfully developed multiple models for mitochondrial disease using the widely used worm, *Caenorhabditis elegans*, and discovered therapies which improve the survival and health of animals with mitochondrial dysfunction. Here, we propose to test the therapeutic efficacy of these lead mitochondrial disease therapies to improve abnormal behaviors and phenotypes in the DS worm models. The PURM student will work under the supervision of PhD researchers in the Falk Research Laboratory in the Division of Human Genetics in the Department of Pediatrics at Children's Hospital of Philadelphia. They will gain wet-lab experience growing and maintaining *C. elegans*, and performing effective behavioral and phenotyping assays. They will learn to work with drug therapies, to determine if these rescue the DS disease model animal phenotypes. In addition, they will learn how to use automated methods for high-throughput screening in worms, including sorting assays of mitochondrial functions using fluorescence markers and lifespan/activity assays in robotic systems. This project is ideal for Biology, Biochemistry, Bioengineering, and Pharmacology students interested in therapy development and translational science.

Project 2: Identifying therapies for mitochondrial disease using CRISPR/Cas9 Genetic Zebrafish vertebrate animal model.

Our research laboratory has previously demonstrated, using human patient cell and cross-model organism validation approaches, that primary mitochondrial disease phenotypes may be ameliorated by therapeutically targeting the broader cellular pathogenesis downstream of energy failure that occur in these diseases. For this project, we will utilize a CRISPR/Cas9 generated zebrafish model for mitochondrial complex I disease generated in our research laboratory. The efficacy of 17 small molecules we previously found to increase lifespan of the *NDUFS2* (*gas-1(fc21)*) *C. elegans* complex I subunit disease invertebrate animal model will now be evaluated in this complex I assembly factor Zebrafish *NDUFS2* knock-out vertebrate animal model to



[Return to top of document](#)

identify lead therapies most likely to improve the survival and brain function, which will help prioritize therapies to study in human mitochondrial complex I disease LS patients. A range of phenotypes will be quantified in the Zebrafish mutants, including survival, activity, physiology, and organ histology. Automated activity analysis will be performed of swim behaviors in Zebrafish larvae using a Zebrabox, which our preliminary studies show is reduced in NDUFS2 zebrafish and can be improved with specific therapies. The Penn undergraduate student will partner with a post-doctoral fellow in our research group to learn zebrafish husbandry and maintenance, phenotype analyses, and drug screening, under the guidance of Dr. Falk and the CHOP Zebrafish Core Director, Christoph Seiler, PhD.

*Jennifer Kalish*

**Project: Understanding Beckwith-Wiedemann Syndrome**

Beckwith-Wiedemann syndrome (BWS) is an epigenetic overgrowth and cancer predisposition syndrome. BWS affects approximately 1 in 10000 children and the same epigenetic changes that cause BWS also cause other types of seeming unrelated cancers. BWS is due to epigenetic changes on chromosome 11p15 and these patients have a range of clinical features. It is currently unclear how these epigenetic changes on 11p15 affect the broader epigenetic signatures for these patients. We run the international BWS registry and biorepository with both detailed clinical information and samples. Using this registry/biorepository, we are taking both global methylation approaches and region-specific approaches to address this question. This project will combine genome-wide methylation analysis along with development of site-specific methylation analysis using pyrosequencing. This will be a translational research experience from patient bedside to the bench. This experience will include meeting patients with BWS and understanding their clinical experience and then using samples from these patients in the lab environment to study global methylation in BWS. The bench component will include experiment design, sample processing, and data analysis. This project is designed for students interested in physician-scientist careers. There will also be the opportunity to attend and participate in the international BWS conference hosted in Philadelphia in July.

*Iain Mathieson*

**Project: Extending genome-wide association studies to diverse populations**

Genome-wide association studies (GWAS) have been enormously successful at revealing the genomic basis of common diseases. Most diseases and traits are affected by tens of thousands of

[Return to top of document](#)

genetic variants in hundreds or thousands of genes. However, the vast majority of association studies have been carried out in populations of European ancestry and we do not know whether or not these results will translate to non-European ancestry populations, limiting their clinical use. This project will try to answer that question, by testing whether predictions made using European GWAS results make sense in non-European populations. Initially we will use existing prediction methods, but the ultimate aim would be to develop new methods which can correct for some of the differences which are likely to affect the prediction. This project would be ideal for a student who would like to gain experience in modern computational biomedical and genomic research. Previous statistical and/or programming experience would be an advantage, although extensive experience is not required. Keywords: bioinformatics, statistics, computational biology, machine learning.

*Golnaz Vahedi*

**Project: Defining the epigenetic preferences of CAR T cell therapy**

A rapidly emerging immunotherapy approach in cancer treatment is a chimeric antigen receptor (CAR) T cell therapy. Despite the success of CAR T cells, insertional oncogenesis remains a major concern in human gene therapy trials. Although lentiviral vectors are more commonly used in T cell therapy because of their safer integration site profiles, the unknown potential of insertional mutagenesis remain a major concern in CAR T cell therapy. We recently developed a novel genomics approach to simultaneously map the epigenetic states and CAR T cell integration sites in the same population of cells. We are currently working on implementing this approach at the single-cell level.

Working on this project will benefit students with backgrounds in programming and expose them to epigenetics and CAR T cell immunology. Their responsibility includes working with chromatin accessibility data generated in our lab and developing analytical models which can predict the epigenetic preferences of CAR T cell integration sites across individuals. The completion of this project can lead to the development of methods predicting if CAR immunotherapy can create oncogenesis effects in an individual.

[Return to top of document](#)

**Zhaolan (Joe) Zhou**

**Project: Pathogenic Studies of CDKL5 Deficiency Disorder**

CDKL5 Deficiency Disorder (CDD) is a neurodevelopmental disorder characterized by early onset of epilepsy and lifetime intellectual disability. It is caused by mutations on the X-linked gene encoding cyclin-dependent kinase like 5 (CDKL5). Despite of the known and simple genetic cause, the molecular mechanisms by which dysfunction of CDKL5 impairs brain function leading to clinical symptoms defined as CDD remain poorly understood. Currently, there is no effective treatment or cure for CDD. To address the pathogenic mechanisms of CDD, we have developed a series of mouse models recapitulating genetic mutations in CDKL5 and plan to utilize these mouse models to answer two fundamental questions: 1) What are cellular phenotypes associated with CDKL5 loss in vivo in mice? 2) What are the molecular underpinnings of epileptic phenotypes in CDKL5 mutant mice? Ideally, we expect to recruit two undergraduate researchers to investigate the above two projects.

Specifically, project one involves the use of confocal imaging to examine neuronal morphology in mice with and without functional CDKL5 expression. For this project, we are in the process of generating experiential mice where individual excitatory neurons can be visualized using stochastic green fluorescence protein (GFP) expression. Thus, neuronal dendrites and spines, reflecting neuronal connectivity, can be monitored and quantified upon sectioning and confocal imaging. The second project is to determine the extent to which CDKL5 mutant mice exhibit epileptic phenotypes by video-EEG recording and examination. Follow-up experiments include the assessment of candidate signaling pathways using a variety of techniques, such as Western blotting and immunostaining.

Students in biology related majors are encouraged to apply. Priors will be given to candidates with neuroscience background and experience working with mice.

## **GERIATRIC MEDICINE**

**Rebecca Brown**

**Project: Housing and health among older adults**

Project 1: Improving Aging in Place for Older Adults Living in Subsidized Housing

In the U.S., nearly 3 million older adults with low incomes live in subsidized or affordable housing, meaning that they receive federally-funded rental assistance programs. Older adults living in these settings experience health disparities and are at much higher risk for being

[Return to top of document](#)

admitted to the nursing home than older adults in the general community. The goal of this project is to improve "aging in place" for older adults in subsidized housing, meaning to improve their ability to live comfortably and safely in their home and community rather than moving to a nursing home. The first phase of the project includes interviews with stakeholders including older adults, home health aides, and affordable housing staff, and the second phase of the project is a pilot study of an intervention to improve aging in place for this population.

Students would have the opportunity to be involved with several aspects of the project, including observing interviews, conducting site visits to affordable housing for older adults, and participating in data entry, data analysis, and manuscript preparation. Students would be mentored directly by Dr. Brown and would also work closely with the research team including a clinical research coordinator and statistician. Participating in this project would provide students with an introduction to clinical research, including basic skills in primary data collection, qualitative data analysis, and preparation of findings for publication.

#### Project 2: Association between Housing Affordability and Health Outcomes Among Older Adults

Housing affordability is a growing issue in the U.S., especially for older adults who live on fixed incomes. In 2015, one-third of adults aged 65 and older experienced housing cost burden, meaning that they spent more than 30% of their income on housing. Housing affordability may be an important social determinant of health among older adults, but little is known about the association of housing affordability with health outcomes in this population. The goal of this project is to examine the association of housing affordability with health outcomes including hospitalization and skilled nursing facility use. To do so, we will analyze data from a large existing dataset.

Students would have the opportunity to be involved with several aspects of the project, including participating in data analysis and manuscript preparation. Students would be mentored directly by Dr. Brown and Dr. Kira Ryskina, co-Principal Investigator for the project, and would also work closely with other members of the research team including a clinical research coordinator and statistician. Participating in this project would provide students with an introduction to clinical research, including basic skills in analysis of secondary data and preparation of findings for publication.

## HEMATOLOGY-ONCOLOGY

*Daria Babushok*

### **Project: Pathogenic mechanisms of bone marrow failure**

Bone marrow failure is a life-threatening blood disease, in which a patient's bone marrow is unable to produce sufficient blood cells to sustain life. Bone marrow failure can occur for different reasons—e.g. because of underlying genetic condition, such as defective telomere maintenance machinery or because of an autoimmune attack on the bone marrow by the patient's own immune system (e.g. acquired aplastic anemia). Most bone marrow failure syndromes also predispose to the development of blood cancers. This process occurs through acquisition of new mutations by the patient's bone marrow cells over an individual's life time. We aim to answer fundamental questions about the nature and consequences of bone marrow failure: What are the mechanisms by which the immune system can misfire to attack hematopoietic stem and progenitor cells in aplastic anemia? Why do patients with aplastic anemia develop mutations in their blood cells? How do the mutations in aplastic anemia differ from those in inherited bone marrow failure (e.g. short telomere syndromes)?

The summer research student will have an opportunity to participate in one of projects as described below. A successful student will have a good understanding of molecular biology and molecular genetics. Prior experience in a biological laboratory is a plus. The student must be mature, responsible and trustworthy, must be able to work as a member of a larger team and also must be able to work independently. Attention to detail, ability to read scientific literature and to perform basic troubleshooting are a must. All of these skills will be further expanded during this summer research experience.

Project 1. Autoimmune recognition in acquired aplastic anemia.

Our lab has identified two candidate pathogenic T cell receptors in a patient with aplastic anemia who relapsed after a bone marrow transplant. In this project, the student will work under the mentorship of Dr. Babushok and a research specialist to clone a T cell receptor alpha and beta chains in an expression vector, and will express the vector in mammalian T cell line (e.g. Jurkat line). The cell lines expressing the T cell receptor will then be used for testing putative aplastic anemia autoantigens.

Project 2. Aplastic anemia risk alleles.

Our lab recently identified pathogenic Human Leukocyte Antigen (HLA) alleles that determine autoimmune recognition in aplastic anemia. In this project, the student will work under the mentorship of Dr. Babushok and a research specialist to manually review the targeted next generation sequencing results from patients with aplastic anemia to identify and confirm

[Return to top of document](#)

mutations in HLA alleles. The student will also design targeted PCR sequencing primers to selectively amplify specific HLA alleles in individual patients, as needed, for mutation validation. The peptide binding pockets of HLA risk alleles will then be compared to identify common motifs, and analyzed for putative peptide binding prediction.

Project 3. Pre-cancerous mutations in patients with short telomere syndromes.

Our lab recently identified several acquired mutations in patients with short telomere syndrome (Dyskeratosis Congenita). In this project, the student will work under the mentorship of Dr. Babushok and a research specialist to analyze the next generation sequencing data, and will design PCR primers and perform PCR and Sanger sequencing to validate mutations using patient's DNA. Additional in silico and functional analysis to characterize the functional significance of mutations will also be performed.

## **MEDICAL ETHICS AND HEALTH POLICY**

*Norma Coe*

### **Project: Policy Influence of End of Life Care**

End of life (EOL) care is intensive, expensive, and highly dependent on where one lives. Using a mix of claims, surveys, and a newly created database of health care system changes that focus on financial and system integration, this study will estimate the effectiveness of the last 20 years of innovation on the quality of EOL care. This project will help explain the geographic variation in EOL care, identify which of our policies have the most influence over patients and providers, and uncover important variation by disease. The impact of this work will be identifying where future efforts for behavior change should focus in order to match patients' preferences to the care they receive at the EOL.

The PURM student will primarily assist with aim 1 of the project which is to "Create and disseminate a database of health system reforms – at the insurer, hospital, local, and federal level – that provide financial incentives or encourage care coordination, and thus have the potential to influence EOL care delivery." I am looking for a persistent student who is comfortable conducting comprehensive internet searches, literature reviews, and reviewing state and federal websites that document health system reforms. If the student is interested and available, there may be an opportunity to help with peer reviewed publications after the summer program has ended.

[Return to top of document](#)

*Jonathan Moreno*

**Project: Screens: Why We Love Them, Why We Hate Them, and Why They're Not Going Away**

Like nearly everyone else in the developed world, and many in the “global south,” Americans spend about ten hours a day on screens. That includes tablets, smartphones, personal computers, multimedia devices, video games, radios, DVDs, DVRs and TVs. Screen time has been blamed, often justifiably, for problems ranging from ADHD to dry eye to marital discord to mass shootings. Among the items that surveys have found we would rather give up than our cell phones are sex, shoes, partners, keys, alcohol and cars. There's evidence that the social networks visualized in our “friends” graphic are replicated in our neural network – or vice versa. Screens are the ubiquitous elephant in the room.

Our screen addiction is so intense that the people who make the screens are providing us ways to manage out time on the screens. To do that, of course, we need to have a screen on which to view the app that we have downloaded to our screens, thus letting the provider know how much we feel hooked to our screen. There is truly no way out.

We love our screens. And we hate them.

Our fascination with screens can be said to lie at the core of Western philosophy. In The Republic Plato's imagined cave dwellers were confined both physically and intellectually, locked into gazing at walls that imprisoned their imagination. The sheer geographic range of remnants of cave drawings, from France to Australia, suggests a basic physiological need in the early modern human brain for self-expression. Some were realistic representations of the large animals around them like bison, others abstract shapes, and others their hands though rarely the entire human body. Both Neanderthals and the human line from which we descended seemed impelled to project themselves into new worlds using the materials on hand, pigments like ochre and charcoal, sharp stones for carving, and the walls themselves as screens.

Yet, according to some, Western civilization itself seems to be at risk as we collapse into our screens. Whether that's true, or whether these worries will go the way of similar alarms about the social effects of young couples on the loose in motor cars, motorcycles, B-movies, comic books, television is too soon to know. What is certain is that screens aren't going away. A comprehensive, multi-disciplinary account of their role is overdue.

**BENEFITS TO A STUDENT WORKING ON THIS PROJECT:**

In 2019 I will publish a book with President Gutmann and in 2020 I will publish another with a Penn-trained neuroscientist. Thus a student will see what it's like for a senior faculty member to start working on a multi-year project from the ground up. In addition, the undergrad will have

[Return to top of document](#)

important input in a project that is obviously of special concern to her or his generation, having never been in a world in which screens are not everywhere.

*Christina Roberto*

**Project: Communicating the Health Risks of Sugar-Sweetened Beverages**

Obesity is one of the most pressing public health issues our nation faces. Although obesity has many causes, one contributor is over consumption of sugar-sweetened beverages (SSBs), which is linked to weight gain, type 2 diabetes, cardiovascular disease, and tooth decay. This summer, the PEACH Lab will be conducting a study to determine which types of warning labels on SSBs are most effective at increasing consumer knowledge about the potential health harms of SSBs, as well as reducing consumer intake of SSBs.

The study is divided into two aims. The first aim is to test the effect of repeated exposure to different types of warning labels on purchasing behavior in an online shopping setting . The second aim will look at the effect of different types of warning labels on both purchasing and consumption behavior of caregivers and children in a randomized-controlled trial setting. The results of this study will further support the PEACH Lab's mission to identify and evaluate policies and interventions that can improve the world's diet.

I am seeking a student with an interest in food policy and nutrition to assist with this research project. Interested students should have strong organization skills, as well as exceptional written and verbal communication skills. The student will be mentored by myself as well as the PEACH Lab Deputy Director, Dr. Laura Gibson. The summer student will have an opportunity to develop valuable research skills while working on timely and innovative health policy research.

*Heather Schofield*

**Project: Research in Development and Behavioral Economics**

My research group focuses on research at the intersection of development, health, and behavioral economics. Our current research agenda explores the potentially bi-directional relationship between aspects of life in poverty and cognitive function/decision-making and productivity in the labor market.

[Return to top of document](#)



[Return to top of document](#)

Past randomized trials in the lab -- based in Chennai, India -- have focused on topics such as the effect of sleep deprivation and lack of nutrition on health outcomes, labor market outcomes, cognitive functions and broader decision-making, such as savings choices. These projects have found striking results. For example, higher caloric consumption not only increases productivity, but also improves cognitive function and changes decision-making -- for example, participants in the treatment group receiving more food became less impatient.

Currently the lab is building on these early results to consider what other aspects of life in poverty might have similar effects -- for example, we are conducting a randomized trial with 1,500 primary school students working to improve their ability to sustain attention, an element of human capital that may be underdeveloped when growing up in poverty. We are planning on expanding these studies and developing others examining topics such as the effects of reducing loneliness on migration and the impact of poverty on consumption utility.

There is the potential to work in the lab in India in subsequent summers if there is mutual interest and an available project.

Roles and Responsibilities:

- Assist with field research activities (e.g. survey or experimental task design)
- Assist with data collection
- Clean and manage datasets
- Conduct statistical analysis using Stata
- Prepare literature reviews, background research, and other draft content for grant proposals
- Communicate with partner organizations and field staff in India

Desired Qualifications and Experience:

- Excellent academic record. Economics training preferred, but not required.
- Knowledge of Stata is a plus, but not required.
- Strong organizational skills, excellent written and verbal communication skills required
- Familiarity with randomized control trials
- Excellent command of Microsoft Office suite (Microsoft Word, Excel, and PowerPoint)
- Fluency in English is required; Tamil or Hindi proficiency is beneficial but not required or expected

*Harsha Thirumurthy*

**Project: Applications of behavioral economics and empirical methods to global health**

Despite much progress in combating HIV/AIDS in Africa over the past decade, progress has slowed dramatically in recent years and many challenges must be overcome to reduce new infections and mortality. Understanding human behavior and developing interventions to promote healthy behaviors is vital for reducing the global burden of diseases like HIV/AIDS. Building on this recognition, my research program has developed and tested various

[Return to top of document](#)

interventions to promote behaviors such as HIV testing, utilization of HIV prevention services, and safer sexual behaviors in countries with high HIV prevalence. Study populations have included men, adolescent girls and young women, and female sex workers. Other areas of focus have been child health and non-communicable diseases. This project will give students with interests in economics, psychology, medicine, and/or global health with significant exposure to topics at the intersection of these fields. Students will have an opportunity to (1) analyze data from recently completed or ongoing studies in eastern and southern Africa; (2) contribute to the development of key materials (questionnaires, brochures) that will be used in studies in Africa; (3) co-author papers that report findings from ongoing studies of behavioral interventions. Students should have a keen interest in global health and development and have taken courses in economics and econometrics/statistics. Students with strong econometrics or statistics training can also contribute to a distinct project that uses survey data from India to evaluate the effects of health insurance expansion and poverty alleviation programs on key maternal and child health outcomes.

## MEDICINE

*Jaya Aysola*

### **Project: The Center for Health Equity Advancement**

Health Equity and Advancement

Project 1: SOGI and REAL Data Collection Evaluation Project

Student will work with a multidisciplinary team at the Center for Health Equity Advancement on an initiative to evaluate the uptake of new electronic health record (EHR) fields for collecting sexual orientation and gender identity (SOGI) as well as race, ethnicity, ancestry and language (REAL) data. In addition, students will help evaluate a training module that was launched to guide personnel in effective data collection of these new elements. This project will provide critical first steps toward identifying and addressing any unnecessary variations by personal characteristics in the care delivery (health care disparities) or care outcomes (health disparities). Students will participate in team meetings, take notes, assist with data collection, management, and presentation. Student/s will gain experience in how to work collaboratively on a team, conduct semi-structured interviews with patients, understand basic descriptive data analyses, and some key concepts pertaining to health equity, cultural humility, implementation science and quality improvement methodology.

## Project 2: Healthier Together Study-Understanding and Leveraging Social Networks for Cancer Prevention

To evaluate how primary care patients are socially connected and whether the network of their social ties relates to their knowledge and adoption of lifestyle behaviors that reduce cancer risk. We aim to leverage this knowledge to design interventions that improve cancer prevention behaviors in primary care patients. We will describe the social network patterns and their relationship to cancer prevention knowledge, attitudes, and behaviors in a random sample of primary care patients at two clinical sites serving West Philadelphia and then transition to conducting focus groups interviews to inform intervention development. Students would be expected to join a team of researchers engaged in this work and will be trained to assist with patient recruitment, snowball recruitment methods, and conducting semi-structured interviews. Students will gain experience and knowledge in describing social networks, cancer prevention behaviors, and inequities in cancer burden.

## Project 3: The Health Equity Learning Project (HELP)

Ensuring equitable care remains a critical issue for health care systems. System-level efforts to advance health equity at Penn Medicine include the introduction of the Blueprint for Health Equity and Inclusion in 2016 and signing of the American Hospital Association (AHA) Health Equity Pledge in 2017. As part of these efforts, we stratified health system performance measures by personal characteristics such as race/ethnicity, to identify any existing disparities in care delivery. Our evaluations revealed three significant disparities of interest: 1) significant disparity in Emergency Department (ED) wait times between non-Hispanic white (NHW) and non-Hispanic black (NHB) patients from arrival time to departure to admitting floor; 2) significant disparity in nursing communication scores between NHW and NHB patients; and 3) significant disparities in 30-day all cause readmission rates between NHW and NHB. The overarching objective of this initiative is to engage a multidisciplinary team to characterize the key contributors of these equity gaps and develop and test an intervention to address those causes. The student will have a choice to join one of three teams each addressing one of the disparities detailed above. Students will be expected to attend all team meetings, assist with data collection, management, and presentation. Student/s will gain experience in basic descriptive statistics, health care delivery quality of care metrics, health equity concepts and basic quality improvement methodology.

*Rotonya Carr*

**Project: Perilipins in non-alcoholic fatty liver disease**

Non-alcoholic fatty liver disease (NAFLD) is a chronic liver condition that affects approximately 25% of the adult population worldwide. In the USA, 80 million to 100 million people suffer from NAFLD. Despite the prevalence of this disease, most NAFLD patients are unaware of their condition until a “fatty liver” is diagnosed incidentally based on abdominal imaging obtained for evaluation of unrelated symptoms. This silent presentation allows time for NAFLD to progress from the relatively benign “fatty liver” stage (so-called simple steatosis) to non-alcoholic steatohepatitis (NASH), defined by liver inflammation, fibrosis and/or cirrhosis. As there is no cure for NAFLD and only 50% of NASH patients demonstrate any improvement with experimental therapies, NAFLD is now one of the most common causes of cirrhosis, liver transplantation, and liver-related death. The reasons for the lack of efficacy of NASH therapeutics in half of patients are poorly understood but likely relate to genetic influences on how the liver handles lipids (fats). In NAFLD, excess lipids are stored within lipid droplets in hepatocytes, the major liver cells. Some lipids impair the liver’s normal response to insulin and this insulin resistance is associated with both increased risk of liver disease progression and onset of type 2 diabetes and cardiovascular disease. Indeed, patients who are diagnosed with type 2 diabetes subsequently develop NAFLD in approximately 70% of cases. In experimental NAFLD models developed in the Carr laboratory (Carr Lab), it has been shown that lipid ceramides accumulate in the liver, during the early stages of simple steatosis, inhibiting insulin signaling and promoting liver inflammation and cell death. Experiments conducted in the Carr Lab have also shown that Perilipin 2 (PLIN2) – a major hepatic lipid droplet protein that is integral in the onset of steatosis – promotes hepatic ceramide synthesis, whereas lipid ceramides fail to accumulate when PLIN2 is absent. Recently a PLIN2 missense polymorphism Ser251Pro (rs35568725, PLIN2 Ser251Pro) was found to exacerbate lipid droplet accumulation in cultured kidney cells and fibroblasts, supporting the hypothesis that this polymorphism increases the risk of NASH by augmenting both hepatic lipid droplet formation and ceramide synthesis. In the proposed project, we will study the mechanistic effect of PLIN2 Ser251Pro on hepatic lipid droplet biology, insulin signaling, and ceramide metabolism, in an in vivo NASH experimental mouse model. Our aim is to establish the effect of this polymorphism on NASH severity, insulin resistance and plasma ceramide levels in NAFLD. Our conviction is that a better understanding of the underlying factors that promote steatosis and hepatic insulin resistance will lead to the development of novel and effective diagnostic and therapeutic strategies for NAFLD patients.

*Russ Carstens*

**Project: Investigating the role of alternative pre-mRNA splicing in regulation of protein-protein interactions**

My laboratory studies a process known as alternative splicing (AS) in which pre-messenger RNAs (pre-mRNAs) produce different mRNAs in different cell types. Consequently, different mRNAs, though generated from the same gene, produce different proteins (protein isoforms) that often have different functions. This process plays a crucial role in development and dysregulation of AS has been implicated in human diseases. However, a major challenge in the field is to determine how AS alters the functions of the different protein isoforms. Notably, AS has been shown to make protein isoforms that bind to different proteins, thereby impacting the cellular pathways or protein complexes in which they function. My lab studies a splicing factor known as ESRP1 that is only expressed in epithelial cells and produces different protein isoforms in epithelial vs. non-epithelial cells. One project that we propose is to test several different assays in cultured cells to investigate differences in protein-protein interactions by different isoforms that are regulated by ESRP1. To conduct these experiments, different DNAs of ESRP1 regulated genes will be introduced into plasmids that can be used to express different proteins in cells and a fluorescence or luminescence-based readout will be used to indicate whether the proteins bind each other. This project will be co-mentored by Natoya Peart, a post-doctoral fellow in the lab and will allow a student to learn numerous molecular biological and genetic methods that are commonly used in modern research labs. Additionally, this project will provide an introduction to the scientific method and through participation in lab meetings, conferences, and journal clubs students will gain a broader knowledge base in the field of gene expression.

*Simin Goral*

**Project: Microscopic hematuria and urologic malignancies in kidney transplant recipients**

Kidney transplant recipients have a significantly higher risk of urologic malignancies compared to the general population. Microscopic hematuria is a common, and sometimes the only presenting sign of these malignancies. The American Urologic Association recommends referral to a urologist when patients have at least 1 episode of asymptomatic microscopic hematuria, defined as  $\geq 3$  RBCs in a properly collected urinalysis. Referring all patients with a single positive urinalysis may prove cumbersome and costly to our patients, however the importance of early diagnosis and management of urologic malignancies is also important. There is currently very few studies that look at the incidence of urologic malignancies in transplant recipients diagnosed after an abnormal urinalysis. This will be a single center (HUP), retrospective study looking at all adult kidney patients recipients transplanted at HUP between 1/1/2008-12/31/2016.

[\*Return to top of document\*](#)

Anyone with at least one episode of asymptomatic microscopic hematuria ( $\geq 3$  RBCs) will be included in the study. Anyone with a known non-malignancy (menstrual period, kidney stones, infection) etiology will be excluded. Primary outcome will be any urologic malignancy (upper tract and lower tract) identified after episode of hematuria.

We are looking for students to help with data collection from EPIC and preparing for an abstract. Students must be HIPPA trained and certified. Students must be meticulous and careful with the data collection we are planning.

*Joanna Hart*

**Project: Improving mental health care for patients with chronic obstructive pulmonary disease**

Chronic obstructive pulmonary disease (COPD) affects over 16 million individuals in the United States. Patients with COPD frequently experience symptoms of depression, more than patients with any other chronic condition. Over 10% of patients with COPD express thoughts of suicide. While we know evidence-based treatments for depression help these patients, fewer than half of patients with COPD and depression receive them. We aim to design innovative and scalable interventions to improve the recognition of depression in patients with COPD. Students will be trained in implementation science and qualitative methods to enable them to participate in data collection and analysis. These skills and responsibilities will include learning how to develop interview guides based on existing theoretical models, interviewing key stakeholders (e.g., patients, physicians, social workers, and psychologists) alongside research staff, identifying and classifying themes in the interviews, and beginning to perform content analysis. Throughout the summer, students will work directly with patients and clinicians, participate in collaborative meetings with the research team, perform individual analytic work, and complete a program of study tailored to the individual student's goals. In addition to this project, students will be integrated into the Palliative and Advanced Illness Research Center for the duration of the program, including participating in weekly work-in-progress conferences, thus gaining broad exposure to a variety of research methods and faculty members focused on improving the care of patients with serious illnesses. Clinical shadowing would also be encouraged and arranged if aligned with the student's goals.

[\*Return to top of document\*](#)

*Lawrence Holzman*

**Project: DLK cell signaling in insulin sensitivity**

The Dual Leucine Zipper kinase (DLK) is a mitogen-activated protein kinase kinase kinase (MAP3k12) of the mixed lineage kinase family. DLK is known to complex with JIP, MKKs and JNKs. Together; they execute a precise and specialized function within cells. DLK plays an important role in neuronal development in mice and in neuronal injury and axon regeneration. However, the molecular mechanism by which DLK performs its many functions remains to be fully elucidated. We have taken a proximity-based biotinylation (BioID) assay approach to identify the potential interacting proteins of DLK to elucidate DLK -mediated cellular functions. The BioID assay is based on proximity-dependent biotinylation of protein by a promiscuous biotin ligase BirA. Mass spectrometry analysis of the DLK-BirA expressed cell lysate had provided us a list of DLK dependent-biotinylated proteins that are potentially interact with DLK either directly or indirectly.

In this project, the student will learn techniques to perform experiments to validate the candidates from this list of DLK-dependent proteins. S/he will employ Crispr-Cas9 system to delete the gene of interest in N2A cells and characterize it biochemically.

We seek a motivated student who will work under the supervision of an advanced research fellow in the laboratory. We expect the chosen student to participate in all aspects of the projects, hands-on bench work, data analysis and interpretation. Student is expected to keep meticulous notes and present data during lab meetings. It is possible to extend the project to the academic year as an independent research study.

*Ivan Maillard*

**Project: Deciphering the relevance of Notch ligand specificity and microanatomical location for the maintenance of spleen Marginal Zone B**

The Maillard laboratory is looking for a highly motivated student with basic cellular and molecular biology knowledge to perform summer research with our diverse team of researchers. Our laboratory studies the role of Notch signaling in lymphocyte development, differentiation and function. The summer project will focus on studying the distribution and specificity of Delta-like1 (DLL1) and Delta-like4 (DLL4) Notch ligands for the development and maintenance of spleen marginal zone B cells (MZBs) in mice. Marginal zone B cells belong to a unique population of innate-like B cells that are responsible for rapid responses to blood-borne

infections, among other functions. We will utilize tissues from reporter mice expressing fluorescent reporter proteins (GFP, mCherry) under the control of DLL1 or DLL4 regulatory sequences, in conjunction with immunofluorescence, confocal microscopy and image software analysis to elucidate the patterns of expression of the ligands in the spleen and other secondary lymphoid organs. In parallel experiments, we will analyze how changes in ligand availability will affect MZB numbers by utilizing flow cytometry. The student will be involved in tissue processing, staining, imaging and data analysis, in addition to discussion of results and literature. In addition, he/she will participate in laboratory meetings and journal clubs in a very collaborative and stimulating environment to learn about immunology, cell biology and work in a biomedical research laboratory. The student will be mentored by Dr. Maillard and by Dr. Daniela Gómez Atria, a Senior Research Investigator in the laboratory.

### *Nilam Mangalmurti*

#### **Project: How do red blood cells contribute to host defense during sepsis?**

At over 30 trillion cells in circulation, RBCs are the most abundant circulating cell. While RBCs are in continuous contact with circulating pathogens and inflammatory mediators, their role in regulating the innate immune response is unknown. My lab studies how RBCs regulate immune responses during inflammatory states. Sepsis, the dysregulated host response to infection, is the leading cause of death in US hospitals. Currently, besides antibiotics, there are no other therapies for sepsis. We have recently found that RBCs express a receptor (TLR9) that may be important in regulating the inflammatory response during infection. The goal of this project is to understand how TLR9 on RBCs alters the immune response during sepsis. We will use in vivo mouse models of sepsis, human red cell specimens and cultured erythroid progenitor cells to better understand how TLR9 on red blood cells may give red cells immune function.

### *Francis Marchlinski*

#### **Project: Mechanisms of Cardiac Arrhythmias**

The study will assist with clinical and pre-clinical research activities in the Cardiac Electrophysiology Section in the Cardiovascular Medicine Division at the Hospital of the University of Pennsylvania under the supervision of the Director of Cardiac Electrophysiology and a junior faculty member. The student will collect clinical data and participate in data analysis from the pre-clinical research laboratory.



***Kara Maxwell***

**Project: Genetics of human breast and prostate cancers**

Approximately 5-15% of hormonally driven cancers (breast cancer in women and prostate cancer in men) are associated with germline mutations in DNA repair genes. Identification of these alterations may have clinical implications for personalized treatment; in addition, identification of an inherited mutation in a cancer affected patient can have far-reaching beneficial effects on reducing morbidity and mortality in family members via implementation of cancer screening and prevention strategies. However, not all patients with inherited DNA repair mutations develop cancer and we are interested in environmental factors that may drive cancer development in patients with inherited mutations. My laboratory has two projects related to gene/environment interactions in breast and prostate cancer. PROJECT #1: Title: Genotype-phenotype study of DNA repair genes in prostate cancer. Student Roles: We are looking for an undergraduate to assist on a large chart review project abstracting pathological and clinical data on patients in prostate cancer using the electronic health record. Requirements: Biology courses required. Physiology or medicine knowledge beneficial. Excellent organization skills and attention to detail. PROJECT #2: Title: Application and development of genomic and transcriptomic based measures of homologous recombination deficiency in breast and prostate cancer. Student Roles: We are looking for an undergraduate who is interested in bioinformatics to perform computational analyses of genomic and transcriptomic NGS data generated from paired tumor/normal studies in breast and prostate cancer. Requirements: Computer science background with programming skills in R and Python required.

***Nuala Meyer***

**Project: Clinical and molecular factors associated with neurologic impairment following sepsis**

This project is a great opportunity for students who wish to experience clinical research. Students will gain experience in clinical and translational (“bedside to bench”) research and obtain a basic understanding of sepsis (infection + a new organ dysfunction) in the ICU. In addition, students will experience clinical cohort operations and testing associations in an observational setting. The focus of this project is to determine clinical and molecular risk factors for sepsis outcomes. Delirium is one important sepsis outcome that is also a risk factor for mortality. Assessing delirium at the bedside involves interacting with critically ill patients to gauge their attentiveness and their cognitive organization with a simple set of questions called the Confusion Assessment

[Return to top of document](#)

Module adapted for the ICU (CAM-ICU). The student will collect this information for patients enrolled in the Molecular Epidemiology of Severe Sepsis in the ICU (MESSI) cohort study. A second cognitive scale termed the MOCA – Montreal Cognitive Assessment test – will be administered close to hospital discharge to understand patient’s cognition. Students will be taught to extract infection related to the patient’s infection, medical history, physiologic state, and response to treatment while in the ICU from the medical record and to record this information in a computerized database. If students show interest and ability, they will be trained to administer the CAM-ICU and MOCA for direct patient interaction. Students will also: assist with chest X-ray reading and collecting of data and attend lab meetings to discuss ongoing projects, analyses, and manuscripts in progress. Prerequisites: Students should be enthusiastic about working with critically ill patients and their families; professional and adherent to patient privacy standards, and interested in clinical/translational research.

If a more molecular project is desired, our lab also has opportunities to accommodate testing plasma proteins, RNA expression patterns (from circulating white blood cells), or genetic variants (DNA) for association with sepsis-associated organ failure, including delirium/cognitive impairment, respiratory failure / acute respiratory distress syndrome, acute kidney injury, or sepsis survival. This opportunity would showcase the ability of observational human data to discover or validate mechanistic insights that might otherwise only be proven in model systems like animals or cell culture. The skills obtained from this experience will include: RNA extraction from whole blood; ELISA, Multiplex (MSD) protein quantification, and Bradford technique protein quantification, and potentially Western blotting for qualitative protein identification. As the project progresses, there may be additional opportunities to learn techniques like real time PCR for mRNA quantification or for immunohistochemistry. Prerequisites: Students should be interested in translational research and should have completed college-level chemistry. Prior laboratory experience is preferred but not required. Students will need to adhere to standards for handling of biologic fluids and for maintenance of patient privacy.

*Michael Shashaty*

**Project: Understanding organ failure in critically ill lung transplant and trauma patients**

This project is a great opportunity for students interested in a clinical or research career. Students will gain experience in clinical and translational research, have the opportunity to work with human subjects, and have the chance to contribute to research in hospital settings including the intensive care unit and the operating room.

[Return to top of document](#)

[\*Return to top of document\*](#)

The project focuses on studies in two critical illness populations: patients undergoing lung transplantation and patients admitted to Penn's Level I Trauma Center ICU. Both studies involve ongoing cohort studies designed to determine clinical and molecular/genetic risk factors for the development of organ dysfunction, including acute kidney injury (AKI), the acute respiratory distress syndrome (ARDS), and primary graft dysfunction (PGD) in the setting of critical illness precipitated by transplant or trauma. Both cohorts have been the source of multiple prior publications in the transplant and critical care literature both in defining AKI, ARDS, and PGD as clinical syndromes and identifying key risk factors and disease mechanisms that inform treatment strategies. We are currently conducting the largest study to date of AKI clinical and molecular risk factors after lung transplantation and have ongoing studies evaluating the risk of AKI and ARDS associated with ABO blood type, obesity, and circulating molecular mediators of cellular injury such as mitochondrial DNA.

Students will have the opportunity to: assist with obtaining study informed consent from prospective lung transplant recipients, obtain time-sensitive research specimens such as blood and urine from the operating room (transplant patients) and ICU (transplant and trauma patients, collect patient information from the electronic medical record into a computerized database, gain experience reading medical charts, and participate in weekly meetings with the primary investigators to learn about the conduct of clinical research studies. Students will have direct interaction with ICU physician investigators, including Dr. Michael Shashaty and Dr. John Reilly, and will play an integral role in the research team comprised of research coordinators and lab personnel. Students may have the opportunity for exposure to several laboratory methods we are currently using for the analysis of biospecimens, such as ELISAs and DNA extraction. Opportunities will be provided to shadow physicians working in the ICU setting. The opportunity to work on this project may be extendable into the school year.

Prerequisites: Students should be enthusiastic about biomedical research, be ready to adhere to patient privacy standards, and be interested in working collaboratively with our research team.

***Raymond Soccio***

**Project: Targeting PPAR nuclear receptors in non-alcoholic fatty liver disease**

The worldwide epidemic of obesity has led to drastic increases in type 2 diabetes and associated metabolic diseases like non-alcoholic fatty liver disease (NAFLD). Excess liver fat may be nearly universal in obese individuals, and 10-20% progress to liver inflammation (non-alcoholic steatohepatitis, NASH). Some with NASH progress further to liver fibrosis, which causes cirrhotic liver failure and cancer. There is urgent need for better understanding of NAFLD, as there are no clinical predictors for which patients will progress to serious liver disease, and no

[\*Return to top of document\*](#)

[Return to top of document](#)

FDA-approved treatments. Many aspects of hepatic lipid metabolism are controlled by PPAR nuclear receptors, transcription factors that bind DNA and regulate gene expression. Drugs targeting PPARs show great promise in NASH, and large clinical trials are underway. Using a mouse NAFLD model, we have observed worsened hepatic fibrosis in mice lacking PPAR $\alpha$ . In NAFLD, fibrosis is mediated by hepatic stellate cells, yet steatosis occurs in hepatocytes. It is uncertain whether PPAR $\alpha$  exerts its antifibrotic effects directly in stellate cells or indirectly in hepatocytes, and we are generating cell type specific knockouts of PPAR $\alpha$  to answer this crucial mechanistic question. The PURM summer project will focus on assays in such fatty liver samples. The student would prepare RNA and proteins from tissue samples, then perform PCR reactions, gel electrophoresis, Western blots, and other molecular assays, with additional opportunities for cell culture and mouse studies. The student would also participate in specific summer student educational sessions, getting a broad exposure to research in diabetes, obesity, and metabolic disease.

*Ben Stanger*

**Project: Mechanisms of Pancreatic Cancer Progression**

Pancreatic cancer is a highly lethal disease due to its ability to spread (metastasize) early and thrive in hostile environments that are deprived of nutrition. The goal of this research project is to understand how pancreatic tumors manage to spread so readily and overcome the challenge of nutrient deprivation. Through focused experimentation addressing these questions, the student researcher will become familiar with basic cellular and molecular biology techniques - including PCR, tissue culture, and cloning - as well as more advanced techniques in microscopy and next generation sequencing.

## MICROBIOLOGY

*Michael Abt*

**Project: Bacteriophage lysin supplementation of Fecal Microbiota Transplants in the treatment of *C. difficile***

The goals of the Abt lab are to examine interactions between the microbiota and the immune system in the context of infectious disease. Our research focuses on the pathogenesis of and host response to *Clostridium difficile*, a bacterium that infects the large intestine following

[Return to top of document](#)

[\*Return to top of document\*](#)

perturbation of the intestinal microbiota resulting in potentially fatal colitis. *C. difficile* is the first disease effectively treated using fecal microbiota transplantation (FMT), however implementation of this therapy as a reliable treatment option is limited due to inadequate understanding of its mechanism of action. FMT failure is thought to be due to excessive residual *C. difficile* that outcompetes the beneficial microbes of the FMT. Therefore, strategies to augment FMT effectiveness must also preserve the bacterial consortium of the FMT itself.

Our lab seeks to investigate the potential of bacteriophage-derived lytic enzymes to support FMT-mediated clearance of *C. difficile*. The lytic enzyme our lab is investigating has known killing activity specifically against *C. difficile*. However, it is unclear how the lytic enzyme may work in conjunction with an FMT.

This project entails both *ex vivo* and *in vivo* approaches to test the lytic enzyme against *C. difficile* in the context of a FMT. Microbiological techniques will be used to isolate anaerobic bacteria and quantify growth in the presence and absence of various experimental conditions. A component of the project will require training and handling of mice to obtain intestinal bacterial species.

The student will be trained in the various microbiologic, molecular biology and immunologic techniques performed in the lab. The student will be expected to participate in weekly lab meetings and journal clubs. The student will meet with the PI weekly to discuss progress of their project and will present their work in lab meeting at the end of the summer.

***Maayan Levy***

**Project: Decoding interactions between the intestinal microbiome, host immunity and exposure to environmental toxins**

The intestinal microbiome, composed of various fungi, viruses, and bacteria, is a vital part of the human host that has been shown to affect many aspects of our health. The gut microbiome has taken center stage with regard to understanding disease and what causes chronic medical conditions and symptoms. In healthy intestinal mucosa, the microbiome provides the host with nutrients and metabolites that can play a significant role in modulating the immune response. Therefore, alterations of microbial composition and function can increase disease susceptibility.

Our main focus in the lab is to understand what are the environmental factors that alter the microbial community and how these changes can modulate disease outcomes. In this project we aim to define how exposure to environmental toxins changes the gut microbiome and whether these changes influence susceptibility to intestinal inflammation.

[\*Return to top of document\*](#)

In a pilot study mice were exposed to several toxins followed by colitis induction. Disease severity was evaluated using mouse endoscopy. Preliminary results indicate higher susceptibility to colonic inflammation in groups exposed to selected toxins. We will build upon this initial finding and evaluate the effect of these toxins on the intestinal microbiome and determine whether microbial alterations are causatively involved in disease susceptibility.

In this project, students will learn how to perform mouse disease models, from treatment to analysis as well as isolation of intestinal bacteria for next-generation sequencing. The students will gain experience with performing and analyzing animal models of intestinal diseases, and analysis of microbial communities. No prior experience is required.

## *Hao Shen*

### **Project: Bacterial pneumonia**

Project 1: Vaccine development against bacterial pneumonia

Pneumonia caused by *Streptococcus pneumoniae* (Sp) and *Haemophilus influenzae* (Hi) remains a leading cause of serious illness and numerous deaths in children and elderly worldwide. Current pneumococcal and *Haemophilus influenzae* type B (Hib) vaccines are effective in preventing colonization by inducing serotype -specific antibodies. However, there is an increasing prevalence of infection by serotype strains not included in the vaccine; this highlights the need for a universal vaccine that protects against all serotypes. In our recent studies, we have found that bacterial lung infection results in a tremendous CD4+T cell expansion and activation that consisted of mostly IL-17 producing Th17 cells. We have also shown that protection against subsequent bacterial infections and pneumonia is dependent on IL-17 produced by memory CD4 T cells. This PURM project seeks to expand on our findings by testing Sp candidate antigens developed through a pan-genome bacterial sequencing collaboration and analyzing the resulting immune response to identify successful induction of Th17 memory responses. The student will work in collaboration with current lab personnel to culture bacteria, test vaccine candidates in a mouse model of Sp infection and determine protection against clinical isolates. The results of these studies could be instrumental in developing a universal vaccine against bacterial pneumonia.

Project 2: Immune activation and tissue regeneration following lung injury

Pneumonia causes a significant clinical burden annually, particularly among the elderly and cancer patients. Pneumonia is a broad description of lung inflammation and liquid infiltration of the alveolar sacs coupled with immune activation that results in cellular damage to alveolar epithelial cells. Immune-mediated damage is particularly evident in chronic obstructive

[Return to top of document](#)

pulmonary disease (COPD), which may develop from environmental factors, tobacco use, and microbial infection. We have developed microRNA mimics that reactivate embryonic lung development pathways to restore alveolar tissue integrity and respiratory function. This PURM project will focus on the immune mechanisms by which bacterial pathogenesis is augmented by chemical exposure and potentially smoking and e-cigarette use. The student will work in collaboration with current lab personnel to define immune activation caused by polymicrobial infection in damaged lungs and test microRNA mimics in a mouse model of H1N1 influenza (PR8), Streptococcus pneumoniae and Haemophilus influenzae infection. The student will learn basic bacterial culture techniques, animal work, and fundamental immunological assays (ELISA, flow cytometry, etc). If successful, these data will be used to generate preliminary data for grant funding and peer-reviewed scientific publications.

*Christoph Thaiss*

**Project: Microbiome-neuron interactions**

In this project, the student will use cutting-edge methods from the fields of host-microbiome interactions and neuroscience. The goal of the project is to determine how the intestinal microbiome influences neuronal activity. The work will involve and next-generation sequencing, microscopy, and animal models of human disease.

## NEONATOLOGY

*Elizabeth Foglia*

**Project: Physiologic Monitoring During Neonatal Resuscitation**

At birth, complex physiological changes must occur rapidly for the infant to successfully transition to the extrauterine environment. Preterm infants and infants with congenital anomalies struggle during this process and require resuscitation by neonatal providers. I am a neonatologist and clinical investigator with an interest in identifying methods to improve physiologic monitoring and patient outcomes during neonatal resuscitation.

At the Special Delivery Unit at Children's Hospital of Philadelphia was the first delivery unit for infants with congenital anomalies built within a children's hospital. Over 400 high-risk infants are born in the SDU per year, making this one of the largest birth centers for infants with cardiac

[Return to top of document](#)

[Return to top of document](#)

and surgical anomalies in the country. We are interested in using this rich resource to generate better data to inform resuscitation guidelines for these unique patient populations.

In this project, students will be involved in (1) obtaining novel physiologic measurements during newborn transition in infants with congenital anomalies using Near-Infrared Spectroscopy- a non-invasive measure of tissue oxygen saturation, (2) collecting medical data for infants who have undergone resuscitation to better characterize the types of interventions performed in infants with congenital anomalies.

## NEUROLOGY

*Nicholas Abend*

### **Project: Seizures and EEG in Critically Ill Neonates and Children**

Seizures are common in critically ill neonates and children, and they are often only identified using EEG monitoring. Identifying and managing these seizures to reduce seizure exposure could reduce secondary brain injury and improve neurodevelopmental outcomes. We are conducting clinical research using a team approach across Neurology, Critical Care Medicine, and Neonatology.

*Kathryn Davis*

### **Project: Brain Atlas for Seizure Semiology**

Approximately 1/3 of all epilepsy patients are resistant to treatment with antiepileptic drugs. For these patients epilepsy surgical intervention is the only chance for cure. Clinicians use multiple variables to make the clinical decision as to whether surgical intervention will be successful. One of the most critical variables is the seizure semiology (what the patient does or feels during a seizure). However, the current semiology literature is difficult to interpret and utilize clinically. We propose to create a 3-dimensional web-based platform in Blender to display the seizure semiology data by brain region. We will enable additional data to be uploaded into the system and plan to share this platform worldwide with other epilepsy researchers and clinicians. Dr. Joel Stein from Neuroradiology will also be mentoring the student for this project. The project requires the ability to code in matlab. The student will also be collecting seizure semiology data from Penn Epilepsy patients undergoing intracranial EEG. We expect to publish a methods paper from this work in addition to releasing our web-based platform to the epilepsy community.

[Return to top of document](#)



## *Jay Gottfried*

### **Project: The Fine Structure and Function of the Human Olfactory System**

Research in our lab focuses on the most unheralded yet most mysterious of the senses: smell. There are two unique and singular properties of the olfactory system. First, the olfactory system is virtually synonymous with memory, emotion, and decision-making, with projections from the nose terminating directly on limbic brain regions such as the amygdala, entorhinal cortex, and insula. These anatomical connections likely explain why smells are so often associated with memory "flashbacks" that reactivate potent emotional and autobiographical memories. The second intriguing property is that smell loss is often the very first symptom of neurodegenerative diseases such as Alzheimer's or Parkinson's, even before the emergence of overt symptoms and signs. This PURM project will focus on characterizing the anatomy, circuitry, and gene expression profiles in human olfactory tissue samples obtained from autopsy patients and from patient biopsies. Students will have an opportunity to gain direct hands-on experience with sectioning human brain specimens, using immunohistochemical assays to stain the tissue, imaging the tissue slides on a confocal microscope, and analyzing the digitized data. These experiences should provide students with a solid conceptual and methodological foundation in wet-lab neuroscience and neuroanatomical techniques. Dr. Jay Gottfried, MD, PhD, is the PI of this project, and he and his colleagues, postdoc Dr. Lulu Korsak and research technicians Sarah Kwon and Sepideh Cheheltani, will all be directly involved mentoring the students. No prior experience is necessary, other than having an interest and curiosity in doing basic science research on human brains!

## *Roy Hamilton*

### **Project: Noninvasive Brain Stimulation to Characterize and Enhance Human Cognition**

The Laboratory of Cognition and Neural Stimulation (Roy Hamilton, MD, MS, Director) supports undergraduate research in projects that employ transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS) to study human cognition. Prior coursework in cognitive neuroscience is desirable. Additional recommended experience varies by project.

Project 1: This project employs electroencephalography (EEG) and network-based analyses to characterize relationships between individual-specific brain states and physiologic and behavioral responses to TMS. Our goal is to predict individual responses to TMS in order to tailor stimulation to specific clinical presentations and neural activity patterns. An undergraduate

[\*Return to top of document\*](#)

student will assist with EEG administration and data analysis. Engineering experience is recommended.

Project 2: Unilateral spatial neglect (USN) is the inability to attend to or act toward one side of space due to a brain lesion. Virtual reality (VR) technologies may be a promising approach for assessing and rehabilitating USN. We will use TMS in healthy individuals to temporarily induce neglect-like symptoms, in order to validate our newly developed VR neglect assessment tool. Students will help to pilot the VR neglect tool, implement the TMS experiment, and assist in data analysis.

Project 3: Primary progressive aphasia (PPA)—a neurodegenerative syndrome of progressive language loss—has no effective treatments. We are conducting a sham-controlled pilot investigation of High-Definition tDCS (HD-tDCS) to treat PPA. Students will interact with PPA patients, assist in the administration of behavioral testing, and code and analyze behavioral data.

There may be opportunities for undergraduates to aid in preparing manuscripts for all projects.

*David Irwin*

### **Project: Ex vivo mapping of Alzheimer's disease and related disorders**

Neuropathology is the gold standard for age-associated neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease, Lewy body dementia, Frontotemporal Dementia and Amyotrophic Lateral Sclerosis as the diagnosis of these disorders is clinically challenging. Our lab uses innovative digital assessments of neuropathology tissue to develop biomarkers to diagnose the underlying pathology of these disorders during life. This project will use post mortem brain samples from patients with neurodegenerative disease and scan intact hemispheres on 7.0 T MRI scanner to develop a 3D printed mold of the brain. We will use the 3D mold and the MRI data to guide detailed pathological sampling of the brain and section tissue for neuropathological analysis. We will stain histology sections and use digital pathology to measure pathology burden in the brain to map back onto the MRI data to model disease spread and compare across diseases. PURM researchers will learn to section brain tissue and perform immunohistochemical staining as well as digital neuropathological assessments. PURM researchers are also welcome to shadow in cognitive neurology clinic to obtain clinical experience with neurodegenerative disease patients.

[\*Return to top of document\*](#)

*Daniel Licht*

**Project: Neurometabolic Optical Monitoring (NOM)**

The project is to develop novel non-invasive devices for neurometabolic real-time monitoring for the purpose of organ directed, individualized care during critical illness. The lab is a multidisciplinary lab, composed of clinicians in neurology, surgery and critical care, as well as physicists, engineers and statisticians. Within this project there are opportunities to assist with engineering aspects of the study, with testing and data analysis.

*Brian Litt*

**Project: Center for Neuroengineering and Therapeutics: Translational Research Positions**

PROJECT ONE

In the past five years, implantable closed-loop brain-computer interfaces have been developed to target pharmaco-resistant epilepsy by alternately recording cortical signals and providing electrical stimulation in response to the detection of seizure onset. Optimization of seizure detection techniques and stimulation parameters is predicated on developing a standardized toolset to extract meaningful information about device performance that can be applied across patients. In this project, we will be using machine learning approaches to systematically evaluate detection accuracy, develop benchmarks, and create a public toolbox for future collaborations. Through this project, students will be introduced to algorithm optimization, GUI and software development, and/or data analysis after an initial learning phase where they may further develop a knowledge of relevant programming tools.

BE, CIS and EE majors with some programming experience preferred. Experience with MatLab and python, signal processing, and linear algebra a plus.

PROJECT TWO

Responsive neurostimulation and targeted laser ablation techniques are increasingly being used to alleviate seizure burden and improve quality of life. These interventions are hypothesized to act by disrupting connections and pathways involved in seizure spread. Identifying these important control regions is a critical step toward realizing the potential of these newer, less invasive techniques and for optimizing the use of established resective surgery. In a cohort of epilepsy patients implanted with intracranial EEG, we utilize rigorous quantitative techniques to localize electrodes and to measure the true extent of intervention, and use expert clinical annotations of seizure onset and seizure type to compute brain network measures. By combining extensive a priori clinical variables with dynamic network measures, we hope to identify the full

pathological subpopulation of neurons that participate in seizure initiation and propagation in this interconnected cortical and subcortical system. In this way, we hope to identify specific targets for resection and augment clinical decision-making, thereby preserving healthy tissue and increasing a patient's chance of seizure freedom. Students will participate in various aspects of this project, including but not limited to reading scientific literature, improving real world programming & basic machine learning skills, learning about networks and how to test network neuroscience hypotheses. Exact tasks will be tailored to suit the individual student skills & interests.

BE, CIS and EE majors with interest in network science, machine learning, neuroscience, and/or medicine would be well suited for this project. Basic knowledge of computer programming and an introductory linear algebra course is a plus but is not required. Individuals should be self-motivated and able to work well independently and collaboratively within a multidisciplinary research environment.

### *Dawn Mechanic-Hamilton*

#### **Project: Smartphone App Development and Testing for Rapid Assessment of Cognition in Aging**

As the population of older adults in the US increases, so does the need for reliable and valid cognitive testing throughout the lifespan. The widespread use of mobile devices in all age groups opens up the possibility of mobile measurement of cognition outside the laboratory and clinic setting. Mobile measurement will address some of the limitations of current cognitive assessment practices and allow for rapid collection of large amounts of data. A team of researchers in the Penn Memory Center is developing an app for mobile measurement of memory, which we are piloting with a longitudinal cohort of older adults with and without cognitive impairment.

The student will be involved in pilot testing the app, collecting feedback from users, project design and data analysis. Students will also have an opportunity to join PMC consensus conferences and shadow in the PMC clinic. The student will be mentored by members of the interdisciplinary team, including Dawn Mechanic-Hamilton, Ph.D. (neuropsychologist).

*Jennifer Orthmann-Murphy*

**Project: The role of reactive astrocytes in remyelination**

Astrocytes are a type of glial cell in the central nervous system that become ‘reactive’ under pathological conditions like multiple sclerosis, an inflammatory demyelinating disease of the brain and spinal cord. Reactive astrocytes change their morphology and function in response to various types of injury, but it is not yet known whether reactive astrocytes in the cortex of the brain promote or prevent repair; any molecular and functional changes they develop may be a target for therapy. In our laboratory we perform multiphoton imaging of the living brain of transgenic mice to visualize cell-specific expression of fluorescent proteins, so that we may longitudinally monitor the dynamics of individual glial cells over the course of demyelinating damage and repair. For a summer research project, an undergraduate will learn how to cryo-section, mount, immunostain and acquire fluorescent images of transgenic mice from time-points matching those from longitudinal in vivo experiments. In doing so, they will learn experimental design, including the identifications and use of proper controls and how to modify future experiments based on these results. They will also learn how to perform cell counts using ImageJ and be introduced to analysis tools developed in MATLAB or Python. They will be encouraged to explore the literature to identify alternative approaches to test the expression and functional changes in reactive astrocytes.

*Xilma Ortiz-Gonzalez*

**Project: Establishing molecular mechanisms in novel neurogenetic syndromes**

Our lab is interested in deciphering the molecular mechanism of novel neurogenetic syndromes, in particular focusing in the role of mitochondrial dysfunction in rare neurodegenerative disease that manifest in childhood. Our research is translational and informed by clinical cases, most of the work is performed in human cellular models, including induced pluripotent stem cell (iPSC)-derived neurons

*David Raizen*

**Project: Using round worms to understand sickness behavior**

Have you ever had the flu or a bad cold? you likely had a fever, slept more, and socialized less. This sickness behavior is observed across all animals, even in tiny invertebrates, but the

mechanism of this behavior is not well-understood. We use powerful molecular genetic tools available to study the roundworm *Caenorhabditis elegans* to understand sickness behavior. The undergraduate student would work closely with Dr. Raizen and with a graduate student to study the genetic basis of sickness behavior.

## *Adeline Vanderver*

### **Project: Modeling and examining mechanisms of white matter leukodystrophies**

Current Projects in the lab:

1. Aicardi Goutières Syndrome (AGS): Aicardi- Goutières syndrome (AGS) is an auto-immune disease occurring due to several different genetic mutations, with a phenotype of elevated interferon (IFN) alpha in the CSF and plasma of the patients. The clinical manifestations of AGS includes early-onset encephalopathy, progressively resulting in loss of motor and cognitive skills with severe intellectual disability. This accompanies progressive neurodegeneration resulting in cerebral and brain stem atrophy, bilateral striatal necrosis and intracerebral vasculopathy. Numerous genetic mouse have failed to show a CNS phenotype for the disease models while they display peripheral phenotype.

We are interested in creating models to study AGS and understand whether this IFN mediated neurodegeneration is contributed through a peripheral activation or central nervous system (CNS) activation. To address the peripheral immune activation, we will be using in vitro cultures of hematopoietic stem cells expressing AGS mutations to examine IFN signature of these cells, followed by in vivo bone marrow transplantation in mouse models. To investigate the role of CNS glial cells called astrocytes and if they contribute to the IFN phenotype and eventual neurodegeneration in AGS. In addition, human stem cells will be used to model the disease and understand the underlying mechanisms. This work has the opportunity for the student to learn rodent and human tissue culture technique, biochemical assays, in vivo mouse studies and microscopy.

2. We are working on the TUBB4A associated leukodystrophy which includes hypomyelination with atrophy of the basal ganglia and cerebellum (H-ABC) which affects children at an early age and symptoms include delayed motor development, cognitive impairment, rigidity. The diagnosis of H-ABC is based on clinical MRI findings and TUBB4A pathogenic variant identified by molecular genetic testing. The common causative of H-ABC is TUBB4AD249N (Vanderver A, et al., 2014). TUBB4A is tubulin beta-4A chain protein encoded by TUB4A gene which is building block of cytoskeleton profoundly expressed in brain. Our lab has developed a knock-in mouse model of Tubb4aD249N which has been characterized using behavioral, molecular and biochemical experiments along with cellular work which will give

deeper understanding how mutation in Tubb4aD249N causes H-ABC. Simultaneously, we are working on neuronal lineages of induced pluripotent stem cells (iPSCs) derived from patients' blood and skin cells. iPSCs's will be used in vitro to understand the cellular and molecular mechanism underlying H-ABC. Ongoing and future work involves developing therapeutic strategies using gene therapy or anti-sense oligonucleotides to rescue the disease phenotype in the mouse and human stem cell model.

This work has the opportunity for the student to learn neonatal behavior battery tests for assessing motor function and cognitive dysfunction, histopathology of mouse tissue, rodent and human tissue culture technique, biochemical assays, in vivo mouse studies and microscopy.

### *Flavia Vitale*

#### **Project: Nanomaterials for brain-machine interfacing applications**

Brain-machine interfaces have enabled paralyzed individuals to regain their independence via thought-control of robotic limbs. The Vitale Lab is developing a neural electrode technology based on nanomaterials which significantly improve the functional properties of brain-machine interfaces. However, the long-term stability and safety of these nanomaterials are unknown. The goal of this project is to use imaging and electrochemical methods to assess the chemical and structural stability of novel nanomaterials for brain-machine interfacing electrodes. This is a critical assessment that must occur prior to long-term animal or clinical human trials.

The student will learn the basic, though critical, processing steps involved in nanofabrication, including parylene-C deposition and spin-coating of conductive nanomaterial inks. Fabrication will be carried out at the Singh Center for Nanotechnology under the supervision of graduate students. Additionally, the student will learn the theory and practice of electrochemical characterization of neural electrodes as well as scanning electron microscopy (SEM) and atomic force microscopy (AFM) characterization techniques.

This project is intended for students interested in the intersection of neural engineering and materials science, and potentially looking for a longer-term research opportunity. Some prior wet lab or fabrication experience and familiarity with electrochemistry or electrical engineering (signals and systems theory) are preferable, but not required.

## NEUROSCIENCE

*Amelia Eisch*

**Project: Dentate gyrus stimulation for animal models of neuropsychiatric disorders**

Humans diagnosed with neuropsychiatric disorders - depression, anxiety, addiction - and laboratory animal models for these disorders often present dysregulated memory, mood, and/or reward processing. These symptoms are indicative of disrupted function of a key brain region: the hippocampal dentate gyrus (DG). This DG dysfunction is accompanied by structural maladaptations - smaller hippocampal volume, dysregulated adult-generated neurons - which normalize with treatment and remission. We propose the connection between neuropsychiatric disorders and dysregulated DG neurogenesis is beyond correlation or epiphenomenon, and that the regulation of adult-generated DG neurogenesis merits continued and focused attention in the ongoing effort to develop novel treatments for neuropsychiatric disorders. Led by Dr. Eisch and supported by Assistant Professor Dr. Sanghee Yun, we will mentor 2 undergraduates for a summer experience testing the hypothesis that stimulation of the hippocampal DG increases neurogenesis and improves DG function. Trainees will receive guidance in basic laboratory skills (data collection and management, animal handling and care, cognitive testing, brain dissection and sectioning, immunohistochemistry, microscopy, stereology) and relevant scientific concepts (neuroanatomy, adult neurogenesis, the study of animal models for psychiatric disorders). Trainees will be full participants in weekly Eisch Lab meetings and journal clubs, and will receive near-daily guidance in key academic and professional skills (how to read and organize scientific papers, read and edit scientific protocols, present their scientific progress, ask questions during seminars). Every Eisch Lab member - from technician to lab leader - is committed to mentoring, resulting in a team- and training-oriented atmosphere which has trained 100+ trainees in the past.

*Marc Fuccillo*

**Project: Exploring molecular mechanisms of striatal circuit formation**

Projections from the cortex to striatum are crucial for many behaviors and are dysfunctional in human diseases such as OCD and autism spectrum disorder. Nevertheless, little is known about the development and maintenance of these synaptic connections from early postnatal life to adulthood. We propose two parallel projects to address this:

1. Determining the time course of corticostriatal synapse development in distinct striatal neuron populations. Little is known about whether striatal synapses follow a pattern similar to other



brain regions with substantial pruning of initial synaptic overgrowth. In exploring this, students would learn immunohistological and imaging techniques to investigate the morphological and synaptic development of two functionally distinct populations of striatal neuron. Following imaging, the student will learn to use image analysis software to quantitatively analyze the data.

2. Characterizing the structure/function relationship of Zswim6. While mutations in the Zswim6 gene are associated with neurodevelopmental disorders, little is known about the protein's function. The aims of this project are to study the localization and dynamics of Zswim6 in a neuronal cell culture system, to characterize the effect of Zswim6 loss of function in neurons, and to determine how mutations in Zswim6 affect its function and localization. Student would learn molecular biology techniques to make and characterize Zswim6 mutants, immunocytochemistry, imaging techniques, and become familiar with the necessary tools to analyze the acquired data.

In completing these projects, students will have characterized unexplored aspects of nervous system development relevant to our understanding of the brain both in health and disease.

## ***Ethan Goldberg***

### **Project: Cell type-specific manipulation to treat epilepsy and autism in experimental models of neurodevelopmental disorders**

The Goldberg Lab studies mechanisms of cerebral cortical circuit function and circuit dysfunction in neurodevelopmental disorders. We use mouse and human genetics, electrophysiology, pharmacology, imaging, optogenetics, and behavior, in a range of experimental model systems ranging from heterologous cells in culture, neurons generated from induced pluripotent stem (iPS) cells derived from human patients, and ex vivo and in vivo approaches in animal models of human disease. We are particularly interested in the function of a prominent subtype of neuron known as the GABAergic inhibitory interneuron and the role of interneuron dysfunction as a cause of disease.

The goal of the lab is to develop novel, mechanistically-oriented treatments and cures for epilepsy syndromes and other neurodevelopmental disorders. In this project, the student will study mechanisms of seizures and epilepsy in Dravet syndrome, a severe childhood-onset epilepsy due to mutation of the sodium channel gene SCN1A. We use electrophysiology, pharmacology, optogenetics, and two photon calcium imaging in acute brain slices and in awake behavior experimental animals (Scn1a<sup>+/-</sup>mice). We are also developing the application of cell transplantation as a novel treatment for neurodevelopmental disorders, using interneuron progenitors engineered from mouse embryonic stem (ES) cells and human iPS cells to treat epilepsy and epilepsy-associated circuit abnormalities in preclinical experimental model systems.

[Return to top of document](#)

The student will work directly with the PI as well as senior laboratory staff (graduate students and fellows) to learn basic lab techniques commensurate with prior experience including anatomical and electrophysiological techniques, for targeting, labeling, recording, and manipulating brain neurons in experimental animal models of disease and gain valuable lab exposure and experience.

*Wenqin Luo*

**Project: Role of TRPV1 hot-pain-sensing pathways in burning mouth syndrome**

Through collaboration between the Department of Oral Medicine, Penn Dental and the Department of Neuroscience, School of Medicine, this project studies neuronal mechanisms underlying etiology of a unique chronic pain patient population. Most people have experienced the mild to severe pain in the mouth after eating a hot chili pepper. Now imagine if that burning sensation never quite goes away. In burning mouth syndrome, patients experience nonstop burning of the tongue, and in most cases with a sudden inexplicable onset. Currently, there is no cure for burning mouth syndrome and little is known about the underlying mechanisms. We hypothesize that the burning that these patients experience may involve TRPV1+ primary afferents that mediate hot-sensing. In fact, the molecule that gives chili peppers their hotness, capsaicin, is a natural ligand for TRPV1. We will recruit burning mouth patients and study the sensitivity of their TRPV1 pathway in comparison with the normal population. In addition, we will test sensitivity of cool-sensing TRPM8 pathway of these patients, which normally antagonize the hot sensation and could be potentially used as a treatment. With the pilot data collected, we intend to publish our findings in a scientific journal. Depending on the level of involvement of the student, he/she could be included as a co-author. We are looking for motivated, meticulous, and independent students who have an interest in working in both a basic science and dental clinic environment. Responsibilities would include: preparing experimental materials, working alongside the clinician to collect data, interfacing with the patient population and performing the sensitivity tests, participating in meetings to discuss and interpret data, and writing parts of draft manuscript.

*Sandra Maday*

**Project: Mechanisms and regulation of autophagy in neuronal homeostasis and neurodegeneration**

Our research focuses on autophagy, an evolutionarily conserved lysosomal degradation pathway that eliminates damaged organelles and proteins from the cytoplasm. Autophagy protects against

[Return to top of document](#)

[Return to top of document](#)

fatal neurodegeneration as neuron-specific loss of autophagy induces axon degeneration and neuron death in mice. Further, mutations in several key autophagy proteins have been linked to the progression of neurodegenerative disease in humans. Despite evidence that autophagy is essential for neuronal homeostasis, the fundamental mechanisms driving this process in neurons are poorly understood.

In this project, we will determine the molecular underpinnings and key functions for autophagy in neurons and glia. We will also assess how autophagy might be altered in the context of neurodegenerative disease. We utilize quantitative techniques in cell biology and biochemistry to analyze autophagy in primary neurons and glia.

***Guo-li Ming***

**Project: Functional analysis of human neurons for disease modeling**

This is a new project in which we are developing analytical tools to investigate functional properties of human neurons derived from induced pluripotent stem cells (iPSCs). Following the discovery that adult somatic cells can be reprogrammed to iPSCs and then differentiated to nearly any cell type in the body, we have been using this technology to generate human neurons to study the biological basis of psychiatric and neurological disorders. Recently, we have begun to analyze the electrophysiological properties of human neurons and neuronal networks in 2D and 3D cell cultures using iPSC lines from neurotypical and patient donors. The student will receive training in the analysis of electrophysiological data and neural signal processing. Additional laboratory experience and training may include image analysis, optogenetics, computer-aided design, and immunohistochemistry. No prior experience required but interest in programming and data analysis preferred.

***Hongjun Song***

**Project: Functional role of adult hippocampal neurogenesis**

This project will focus on the role of newborn neurons in mediating acquisition, consolidation, and/or recall of hippocampal-dependent memory. In the adult brain, the dentate gyrus subregion of the hippocampus is one of the only brain areas to support neural stem cells, which give rise to newborn neurons that gradually mature and integrate into the local circuitry throughout life. Recently, adult hippocampal neurogenesis has been implicated in various behaviors, including the ability to recognize subtle differences in the surrounding environment, an important feature

[Return to top of document](#)

of episodic-like memory formation. This project will be focused on understanding the role of this population in learning and memory consolidation. The student will receive training on how to design, analyze and interpret a behavioral experiment. Additional laboratory experience and training may include assisting with surgeries, immunohistochemistry, image analysis, mouse breeding and genotyping, and optogenetic techniques. No prior experience is required but the student should be comfortable being trained to work with mice.

Co-Mentor: Dr. Kimberly Christian, Research Assistant Professor

## NEUROSURGERY

*Zarina Ali*

### **Project: Enhanced Recovery After Neurosurgery**

Despite surgical, technological, medical, and anesthetic improvements, spinal surgery still often results in significant post-operative morbidity, including chronic opioid dependency and poor functional outcomes. Excluding complications related to anesthesia or surgery, the surgical stress response with its increased metabolic demands on the body serves as a critical pathogenic factor in postoperative morbidity. Enhanced Recovery After Surgery (ERAS) is a multimodal, multidisciplinary approach to patient care that focuses on the reduction of this surgical stress response. ERAS pathways have been widely adopted and implemented in many surgical disciplines. However, broad application of ERAS principles to the general spine surgery population has not yet been studied thoroughly. The Penn Neurosurgery ERAS protocol incorporates evidence-based principles designed to promote the expeditious surgical recovery of the spine surgery patient. We propose to study a prospective cohort of patients undergoing spinal surgery to assess the feasibility and efficacy of our ERAS protocol in the neurosurgical population in order to improve clinical/functional status and decrease postoperative opioid use.

Students interested in this project will be required to review patient data and surgical outcomes and assist with statistical analysis and manuscript preparation under the mentorship of a research team.

***Gordon Baltuch***

**Project: Thirty Day Readmission Rates in Deep Brain Stimulation Patients**

For the past two decades, deep brain stimulation (DBS) has proven to be an effective and safe treatment option for patients suffering from movement disorders including Parkinson's Disease (PD), essential tremor (ET), and dystonia. The efficacy of DBS in the treatment of movement disorders has been well defined in the literature, and recent studies have shown that its benefits persist in long term follow up. However, DBS surgery has been associated with high instances of infection and 30 day readmissions. Additionally, it is hypothesized that advancements in the medical management of PD has resulted in an older and sicker surgical patient population. In the present study, we hope to investigate the annual infection and 30-day readmission rate over the past 15 years at Pennsylvania hospital in patients who have undergone DBS surgery. We plan to perform a subset analysis to examine how the DBS population has changed over this time. Interested student responsibilities and expectations include: data collection, data analysis, compiling meaningful background research and manuscript preparation under mentorship of a PENN Neurosurgeon.

***Victoria Johnson***

**Project: Understanding Post-Traumatic Epilepsy**

Traumatic brain injury (TBI) is a substantial health problem with over 2.5M TBIs occurring in the US each year. Of further concern, TBI has been linked with an increased risk of the later development of epilepsy in some individuals - known as post-traumatic epilepsy (PTE). However, the mechanisms by which epilepsy develops after TBI are poorly understood. Emerging data describes the potential for on-going neuropathological changes that can persist for months and even years after severe TBI. Our lab is undertaking a series of studies to determine how these evolving brain changes may contribute to the development of PTE. The student will have the opportunity to work on this project in a busy and collaborative laboratory environment. They will be able to learn a variety of techniques, including the preparation of tissue samples for neuropathological analysis. They will learn the principles of immunohistochemistry and perform this technique to explore post-traumatic brain changes at the cellular level. The student will also have the opportunity to further their understanding of brain structure and function in the context of traumatic injury. They will be encouraged to participate in our ongoing academic activities including attending seminars.

*John Lee*

**Project: Assessment of Long Term Outcomes and Need for Re-operation in Patients Following MVD Surgery**

Though major advancements have been made in the treatment of facial pain through medical management, patients who are clinically diagnosed with trigeminal neuralgia often undergo surgical intervention. Trigeminal neuralgia (TN) is a chronic pain disorder that affects the 5th cranial nerve. Classic TN is characterized by sudden electrical shock-like facial pain along the nerves distribution. While the precise mechanism of the pathogenesis of TN is not known, vascular compression, through either arterial or venous compression, of the trigeminal nerve is the most widely suspected etiology. Several neurosurgical interventions, such as microvascular decompressions (MVD), are available to treat this disorder. The short term outcomes of MVD surgery have been well documented in the literature, however long term benefits have not been well defined. The goal of our study is to assess the long term outcomes and need for re-operations in patients following MVD surgery at a single institution. Patient outcomes will be assessed using the novel Penn Facial Pain Scale.

Students interested in this project will be required to review patient charts, assist with statistical analysis, and help with manuscript preparation under the mentorship of a University of Pennsylvania Neurosurgeon.

*Ali Ozturk*

**Project: Understanding the Rate of Complications in Corrective Spine Surgeries**

Adult spinal deformity (ASD) is becoming an increasingly prevalent disease in the elderly population. These deformities encompass a complex group of pathologies, such as a lumbosacral curve in the sagittal (kyphosis, lordosis) or coronal (scoliosis) plane, and present with a variety of clinical symptoms including axial back pain, leg pain, and other neurologic symptoms. Surgical correction of ASD often involves long fusions to the sacrum in an effort to decompress the spinal cord and stabilize the degenerative process. Due to the magnitude of this surgery, ASD corrections are associated with high complication rates including instrumentation failure, infection, and neurologic deficits. However, with new advancements in surgical techniques, neuro-monitoring, and instrumentation have resulted in improvements in complication rates. A recent study from the International Spine Study Group observed a reduction in complication rates from 73.2% to 62.6% over about a 7-year time period. Additionally, patient-reported outcomes and pain scores have shown a significant trend in the positive direction. The goal of the present study is to examine all aspects of complications associated with corrective spine

[Return to top of document](#)

surgery at a single institution. To understand the complications, we will look at pre-, intra-, and post-operative measures, as well as patient-reported outcome measures.

Students interested in this project should be eager to engage in medical research and prepared to aid in statistical analysis and manuscript preparation under the mentorship of a Penn neurosurgeon.

*William Welch*

**Project: Utilization of Machine Learning in Neurosurgical Decision Making**

Advancements in the feasibility and accessibility of machine learning has opened new doors in all aspects of living, from social entertainment to autonomous cars. This new technology provides exciting new opportunities in neurosurgery clinical research, specifically in understanding the complex decision making of the neurosurgeon. The decision on surgical treatment is largely dictated by judgment and experience, resulting in large variations between providers. This is illustrated most clearly in the surgical treatment of lumbar back and leg pain. There are marked variations in the suggested treatment of lumbar stenosis with little medical evidence supporting the large variability. The goal of our research is to utilize machine learning to better understand how a senior neurosurgeon evaluates and recommends laminectomy vs. laminectomy with fusion for patients suffering from lumbar stenosis. We plan to review patients who underwent surgery over a one-year period to collect pre-operative clinical and radiographic information. Imaging will be layered and analyzed in our software to find predictive patterns between the two groups.

Students interested in this project should be prepared to review patient information, work with machine learning technology, assist with statistical analysis, and aid in manuscript preparation with the mentor and their research team.

## **OBSTETRICS AND GYNECOLOGY**

*Lily Arya*

**Project: Cognitive function in women with nocturia**

The main objective is to compare cognitive function in terms of attention and episodic and working memory in women with and without nocturia. Women between 50 to 65 years of age

[Return to top of document](#)

with and without nocturia, defined as two or more episodes of nocturnal voiding per night, that present to the UPHS Urogynecology Department will be eligible for enrollment. The study consists of two visits. The screening visit will include enrolling, consenting, and completing a variety of questionnaires on cognitive impairment, depression, sleep apnea, and sleep disturbance. The second (study) visit will include administration of a battery of cognitive function tests to assess attention and episodic and working memory. Students will be responsible for enrolling participants, consenting them, and administering questionnaires. Interested students could also administer the computer-based cognitive function tests to participants. Students will be trained in all study tasks. They will work under direct supervision of a physician. Students will gain experience in clinical and neuropsychiatric research and work directly with patients. Opportunities for getting involved in publications is available for interested students. The opportunity will be useful for pre-med students or those seeking to engage in hands-on clinical research.

## OPHTHALMOLOGY

*Jean Bennett*

### **Project: Gene therapy for inherited retinal degeneration**

The project aims to test gene-based interventions for specific forms of inherited retinal degeneration in cell or animal models. Test (vs. control) reagents will be applied and efficacy and safety measures will be made. The student will learn about experimental design, the attributes of the specific models and how they relate to human disease, data analysis, and specific techniques related to the system under study. The techniques may include cell culture, molecular biology or physiologic methods. The student will be under direct supervision of a postdoctoral fellow or other experienced laboratory member and will attend meetings with the entire lab.

*Jessica Morgan*

### **Project: Adaptive Optics Imaging of Individual Photoreceptor Structure and Function in Retinal Disease**

The Morgan laboratory in the Department of Ophthalmology studies the human visual system using adaptive optics, a technology which permits visualization of individual light-sensing cells—rod and cone photoreceptors—in the living retina. With the ability to noninvasively



[Return to top of document](#)

observe the photoreceptor cells comes the ability to quantify parameters of the cell mosaic in the diseased retina in comparison to the normal retina. In addition, using the same adaptive optics imaging technology, we can probe the limits of vision by presenting small light stimuli confined to single or small groups of cones and investigate visual system function both in normal sighted individuals and in patients with retinal disease.

For one part of the project, the student(s) will work with data collected from patients with Choroideremia, a blinding inherited retinal degeneration. We aim to measure cone densities at several retinal eccentricities in patients with Choroideremia over time to assess disease progression at the cellular level and will compare the Choroideremia data to data acquired from normal-sighted controls. A second part of this project is to investigate advanced visual function testing with our high-resolution adaptive optics ophthalmoscope. Specifically we aim to link cellular-scale structure and function in patients with Choroideremia (or other inherited retinal degenerations), and to better understand how the retina and brain convey information about the world by studying the percepts elicited by stimulating individual neurons in the retina.

During this project, the student will participate in state-of-the-art ophthalmic research, interact with normal control and diseased study participants, learn image processing techniques, optics and retinal anatomy, and participate in all aspects of data collection, analysis and interpretation. In addition to lab work, students will attend weekly lab meetings giving them exposure to all ongoing projects in the lab. Motivated individuals with an interest in clinical research, pre-med, bioengineering, biology, neuroscience or psychology are encouraged to apply. Students must be highly organized, as this project will involve working with large datasets of retinal images. Prior experience with Photoshop and/or Matlab is preferred but not required.

## ORTHOPAEDIC SURGERY

*Nathaniel Dymnt*

### **Project: Elucidating the cellular response within tendon and ligament healing**

Tendons and ligaments are one of the most frequently injured orthopaedic tissues. Their limited innate healing potential leads to chronic pain for the patient and a difficult challenge for surgeons and scientists attempting to repair these injuries. One of the significant shortcomings in this field is understanding the origin (i.e., location) and phenotype (i.e., behavior) of cells that contribute to tendon and ligament healing. Our lab utilizes novel transgenic mouse models to tag specific types of cells prior to injury and then map their fate (i.e., determine what they become) during the healing process. We then create injuries in these models to mimic what happens to patients. We finally repair the injury using different surgical and tissue engineering strategies to improve

[Return to top of document](#)

the repair outcome. These studies will be compared to normal growth and development to identify shortfalls in the adult healing process that could potentially be altered to improve the repair outcomes. Students interested in developing regenerative therapies to traumatic injuries will likely enjoy working on this project. Students will learn novel histological, fluorescent imaging, microCT, and biomechanical techniques during this project. Ideally students will continue on with us after the PURM program has ended to continue their training and mentorship.

### ***Foteini Mourkioti***

#### **Project: Novel specialized properties of stem cells in muscle disease**

Project 1: Muscle stem cells play a major role in muscle regeneration. Following muscle injury, muscle stem cells become active, proliferate, and fuse with the surrounding tissue, allowing for the full regeneration within a few days. Pax7 is a marker of muscle stem cells that is conserved across many species, including humans. To look at muscle stem cells in vivo in a live animal, a Pax7EGFP mouse model was generated by inserting an enhanced green fluorescent protein (EGFP) cassette in the Pax7 gene (Tichy et. al., Skeletal Muscle, 2018). This allowed for the expression of EGFP driven by endogenous promoter and regulatory elements. Using 2-photon microscopy, we were able to visualize for the first time muscle stem cells in vivo and have identified unique and novel properties of these cells that have never been reported previously. Moreover, the study of muscle regeneration has primarily relied on retrospective analysis of static images from tissue section histology. Our system allows for longitudinal studies of muscle regeneration in a substantial reduced number of experimental animals and gives us the opportunity to test therapeutic interventions to reveal how early pathological symptoms correlate with later disease outcomes.

Project 2: Muscle stem cells (MuSCs) must complete a specific set of benchmarks at the appropriate time to promote proper muscle regeneration following muscle injury. Using both mice with muscular dystrophy and patient samples, we have identified a signaling pathway that is dysregulated in MuSCs. To gain insight into the function of this pathway during the regeneration process, we have generated mice that carry mutations of this pathway. We are seeking a motivated individual to work closely with a talented postdoc in the lab (Dr. Elisia Tichy) in the characterization of these mice. Work will include several techniques, such as tissue handling, stem cell isolation, histology, immunochemistry and quantification using an imaging software. As a result of these efforts, the student is going to be a co-author in any publication, which will utilize these experimental efforts. This work has the potential to advance the muscle regeneration field by promoting faster healing of muscle injuries and to delineate new targets for therapeutic intervention.

*Neil Sheth*

**Project: Creating a Sustainable Model for the Delivery of Musculoskeletal Orthopaedic Care in Sub-Saharan Africa - Tanzania**

The global burden of musculoskeletal disease and resulting disability is enormous and only expected to increase. There is also a large discrepancy between the supply and demand for musculoskeletal care in the developing world, with devastating consequences. In Tanzania, there are only 35 orthopaedic surgeons for a population of approximately 50 million people.

Current solutions to meeting the unmet burden of musculoskeletal disease in Tanzania and other developing countries are grossly inadequate. A recently published from our group quantified the regional burden of disease and modeled that approximately 90% of the 12 million people living in Tanzania's northern corridor do not have access to timely, safe, and affordable musculoskeletal care when needed. (Premkumar A 2018)

We propose a locally sustainable model to meet the currently unmet burden of musculoskeletal disease in Tanzania, via the construction of an International Orthopaedic Center of Excellence in conjunction with our local university partner, Kilimanjaro Christian Medical Center (KCMC). KCMC is the largest medical, nursing and therapy school in Tanzania and is home to the most robust orthopaedic training program in the country. This center will partner international providers with local doctors and healthcare professionals to provide the year-round surgical care and build long-term Tanzanian surgical capacity. There are 25 other universities than Penn, mainly from the US, that have agreed to provide 2 weeks of care. Each team would sign-out the service to the next incoming team. All 26 teams will cover the hospital year-round - essentially bringing 26 training fellowships for education of the local team.

The construction of this center requires multi-disciplinary collaboration between healthcare providers, architects, engineers, public policy and epidemiology experts, and various industry partners. This center would employ its own insurance system to deliver care and promote healthy behaviors to the most vulnerable and neglected populations in Northern Tanzania, and thus is directly aligned with the aims of the Penn Undergraduate Research Mentoring program.

The funds for this grant would specifically be used to support undergraduates from Penn for Summer travel to Tanzania, to become an integral part of the Penn team (consisting of students from the medical school, MPH school, and Wharton School) and focus on the current health insurance environment of Tanzania. The project is at a critical junction with expected opening of the center in 2020 - a complete understanding of the health insurance market in Tanzania is of utmost importance, and this Summer fits well with the timing and the needs of the project. The undergraduate student would work closely with myself, and several graduate students from

[Return to top of document](#)

Penn, as well as local partners in Tanzania, to collect data on the ground at KCMC regarding the current state of affairs with regards to orthopaedic patients and how they are able to pay for care. Dr. Honest Massawe from KCMC, an Adjunct Professor at Penn Orthopaedics, will oversee the project on the ground. The student will have the ability to develop skills in interacting with patients, formulating a specific research question, collecting and analyzing data, and learning how to put together a manuscript. Most of our prior undergraduate students have published a manuscript with the team focused on their specific question.

There are 5 previous Penn undergraduates that have been a part of this project over the past five years, and they have made significant contributions to the advancement of this endeavor. Undergraduate involvement in this project has made an incredible impact - my hope is to inspire the next generation of students through this experience to include global health as a part of their future endeavors.

*Louis Soslowsky*

**Project: Orthopaedic Bioengineering**

The overall goals of our research program are to determine fundamental relationships and mechanisms of tendon and ligament injury, healing, repair, and regeneration and to use this information to develop and evaluate potential treatment modalities. Undergraduate researchers are important to our research program as we have mentored many over the years. Students can expect to work with graduate students and postdocs on mechanical testing, histology, animal surgery, and other experiments. Ideally, students will continue on with us following the PURM project to gain additional experience and mentorship.

## OTORHINOLARYNGOLOGY

*Yale Cohen*

**Project: Discovering networks in the brain**

The brain contains a multitude of neurons that process information regarding our perceptions, thoughts, and actions. However, these neurons do not act in isolation. Instead, they talk to one another and form intricate circuits or networks in the brains. Although we know a lot about what individual neurons do, we know very little about how networks work in the brain. This project will enable students to explore and test how networks in the brain work using actual data from

[Return to top of document](#)

[Return to top of document](#)

brain recordings. They will work with Professor Cohen and other members of his lab to discover how individual neurons differ from networks of neurons. Prerequisites: knowledge of computer programming (ideally Matlab).

Academic/professional skills: Students will learn how to process neuronal data, how to develop algorithms to test different hypotheses, and how to present quantitative data in a clear manner. Students will also learn how to work in a team environment.

*Ian Jacobs*

**Project: The Optimization of Tissue-Engineered Cartilage for Pediatric Laryngotracheal Reconstruction**

The student will assist in the design of engineered cartilage for airway reconstruction in an animal ( rabbit ) model. State-of-the-art tissue-engineering techniques will be used and the constructs will be mechanically and histologically analyzed in a Penn Bioengineering Core lab. Knowledge of cell culture techniques and biomechanics is helpful, but not required.

*Erle Robertson*

**Project: Small RNAS Regulation in Oncogenic Viruses**

Program summary 20% of all human cancers are associated with viruses functioning as biological cofactors in driving these cancers. Some of these viruses may have a direct role in mediating these cancers as in the case of HIV related cancers which includes Kaposi's sarcoma, pleural effusion lymphomas and lymphoproliferative disease. There is also an increase in the number of HPV related patients for example in the immunocompromised patients who are on HAART therapy and in head and neck squamous cell carcinomas.

This project will investigate interactions between small RNA and proteins encoded by oncogenic viruses to regulate cellular processes important for oncogenesis.

[Return to top of document](#)

*Elizabeth White*

**Project: Human Papillomavirus-Host Cell Interactions**

Infections cause 15-20% of all human cancer and infection with human papillomavirus (HPV) is a major cause of cancer worldwide. A summer in the White laboratory will provide students with the opportunity to conduct research at the interface of virology and cancer biology. The summer student researcher will conduct experiments in cultured cells and will learn and practice cell and molecular biology techniques which may include DNA and RNA isolation and analysis, protein analysis by Western blot, cloning, basic and advanced cell culture techniques, and more.

Research in the laboratory is focused on the interactions of HPV E6 and E7 proteins with host cells. Two main questions in the lab are: 1) how do HPV E6/E7 reprogram cells to cause cancer? and 2) how do HPV E6/E7 enable virus-infected cells to evade immune detection? Projects are available in both of those areas and will be supervised by Dr. White and/or by a graduate student and postdoctoral fellow in the lab. Specific experiments will be determined based upon the student researcher's interest and experience. There will be the potential to extend the research into the academic year based on mutual interest and student eligibility.

## PATHOLOGY

*Yair Argon*

**Project: Visualizing and measuring the unfolded protein response in primary cells**

The unfolded protein response (UPR) is a universal stress response that, remarkably, is used in a variety of responses to metabolic changes, such as rapid changes in glucose or oxygen levels due to diet or exercise, respectively. The UPR is also used to respond to bacterial or viral infections. Each of such conditions alters the protein synthesis machinery of the affected cells, an alteration that is detected through the UPR sensors IRE1, PERK and ATF6. The activation of these sensors, either singly or together, leads to a set of responses that initiate a set of molecular coping mechanisms to restore the cells to their original equilibrium.

We have made a variety of fluorescent proteins that are activated in cells undergoing the UPR and are using them to visualize the response of primary cells (pancreatic beta cells, neurons or glial cells) to metabolic changes and quantify the response. The student will participate in live imaging of the cells and in analyzing the recorded responses. The goal is to determine how the UPR changes with increased level of metabolic stress (e.g. ranges of glucose fluctuations, lipotoxic agents or hypoxic levels) and how the graded response relates to the outcome of the coping response.

[Return to top of document](#)

The project involves preparation of expression clones, expressing them in cultured cells, measuring expression by biochemical assays, visualizing the cells containing the fluorescent proteins over time and analyzing time lapse images with appropriate software.

*Vijay Bhoj*

**Project: Engineering Chimeric Antigen Receptor T cells (CAR T) to prevent organ transplant rejection**

Chimeric antigen receptor (CAR) T cells are genetically engineered T cells that have proven incredibly effective at eradicating aggressive cancers. We are now developing platforms to harness these cells for treatment of non-cancer diseases. This project will focus on evaluating novel CARs aimed at eradicating antibodies that result in organ transplant rejection. The project will involve basic molecular biology, cell culture to make CAR T cells and cellular immunology techniques to evaluate CAR T cell efficacy in vitro. Future work is expected to involve additional in vitro and in vivo efficacy and toxicity studies.

*Janis Burkhardt*

**Project: Defining the role of moesin in T cell adhesion and migration**

The actin cytoskeleton is needed for almost everything that T lymphocytes do, including migration through tissues, proliferation, differentiation, and effector functions such as killing tumor cells. By coupling the cell membrane to the actin cytoskeleton in a reversible manner, the actin binding protein moesin modulates the stiffness of the cell and creates fences that constrain the movement of cell surface proteins. Children with mutations in moesin are immunodeficient at least in part because they have almost no blood T cells. We have generated mice lacking moesin, and have found that they, too, lack blood T cells. Interestingly, T cells are present in these mice, but they have profound defects in movement through the body. Isolated T cells show increased integrin-dependent adhesion. In this project, the student will work with graduate student Tanner Robertson and postdoctoral fellow Lyndsay Avery to ask whether loss of moesin leads to defects in activation of integrins, defects in integrin clustering, or whether the cells are abnormally flattened, thereby allowing more integrin binding. Students will learn tissue culture, flow cytometry, and live cell fluorescence microscopy techniques. Students will be encouraged to take part in all lab activities, and in the lively scientific and social exchange in our Division at CHOP.

[Return to top of document](#)

*Youhai Chen*

**Project: Immunity, inflammation, and intestinal wound healing**

The intestinal epithelium undergoes constant self-renewal, regenerating every 4 days. However, the typical stem cells responsible for daily regeneration are highly susceptible to death during injury, and the reserve stem cell niches, and cellular pathways involved in intestinal wound healing, remains unknown. This summer project focuses on understanding the key pathways, stem cell niches, and regulatory proteins involved in intestinal wound healing.

Undergraduates involved in this project would explore the role of autophagy and necroptosis in the injury response to intestinal ischemia and acute chemical colitis with pathway-specific knockout mice. They would also use stem-cell lineage tracing mice in these injury systems to help identify the important stem cell niches in these injury models. This project has two available roles; one performing experiments on the lineage tracing mice, and one performing experiments on the apoptosis/necroptosis null-mice.

Undergraduates would learn how to perform sophisticated mouse surgery as well as the DSS colitis model. They would learn how to harvest tissues, and would learn how to perform basic histopathology, immunohistochemical staining/immunofluorescence staining, western blotting, and real-time PCR. They would also learn basic murine husbandry skills. This combination of murine lab skills and subsequent analytical techniques will be of great value to any undergraduates who plan to pursue a further career in the biomedical sciences.

Additionally, the supervising post-doctoral fellow overseeing this project is an MD/PhD and invites his mentees to shadow him clinically, assuming they are interested and fill out the proper paperwork, providing an additional academic experience for the undergraduates.

*Paul Gadue*

**Project: Using Human Pluripotent Stem Cells to Model Genetic Bleeding Disorders**

Familial platelet disorder (FPD) is a genetic disease resulting in low platelet counts. Considering the critical role that platelets play in blood clotting, these patients present with increased bleeding. A variety of genetic lesions can cause FPD, but a subset of these patients have germline heterozygous mutations in either ETV6 or RUNX1 and additionally have a heightened risk of developing acute myeloid leukemia (AML). These distinct phenotypes given by mutations in two unrelated transcription factors suggest that there may be a common pathway



underlying both the bleeding disorder and leukemia predisposition. Mouse models have been used to study FPD/AML but there are currently none that fully recapitulate the human disease. As an alternative approach, the directed differentiation of patient derived induced pluripotent stem cells (iPSCs) can be used. The goal of this project is to elucidate the mechanism of FPD/AML due to mono-allelic mutations in ETV6 or RUNX1, and determine if these two transcription factors function in common pathways. We have generated iPSC cell lines from FPD patients harboring either RUNX1 or ETV6 mutations and have genome edited stem cell lines via CRISPR/Cas9 technology to generate additional lines harboring mutations in these genes. Differentiation of these stem cell lines into megakaryocytes, the cell type responsible for platelet production, shows defects in megakaryocyte development and function. We have also performed genome wide gene expression analysis comparing megakaryocytes derived from RUNX1 and ETV6 mutant stem cell lines. The summer student will work with a senior graduate student in my laboratory to study targets of ETV6 and RUNX1 and interrogate the roles of these genes in megakaryocyte development via knockdown and overexpression studies utilizing the human stem cell model. Skills that will be learned include molecular biology to generate the DNA constructs to test the ETV6/RUNX1 targets, tissue culture to maintain and differentiate stem cells and assays of megakaryocyte development and function. The students will also be trained to critically interpret data and make conclusions based upon their results. Overall, this project will help define the roles of ETV6 and RUNX1 during megakaryopoiesis and may have implications for therapeutic strategies in treating FPD/AML patients, both for their thrombocytopenia and their risk of AML.

### ***Malay Haldar***

#### **Project: Regulation of Sarcoma Lung Metastases by a novel IL13-endothelin axis**

Soft tissue sarcomas (STS) comprise a heterogeneous group of solid tumors arising from mesodermal tissues. They are rare in adults but accounts for more than 7% of all pediatric cancers. Surgery is effective with localized disease but nearly 60% of patients with high-grade STS will develop metastases, which is almost uniformly fatal. Lung is the most common site of metastases but pathways controlling pulmonary metastasis is poorly understood. We recently found that interleukin 13 (IL13) produced by tumor-infiltrating leukocytes (TILs) induce expression of endothelin 1 (Edn1) in sarcoma cells. Importantly, Edn1 expression in tumor cells was required for lung metastasis. These findings suggest the existence of a previously unknown pathway wherein IL13 from tumor-infiltrating leukocytes promote lung metastasis by upregulating Edn1 expression in tumor cells. The proposed research will examine the molecular underpinnings of this pathway and test therapeutic approaches to target it for controlling metastases

***F. Brad Johnson***

**Project: Targeting telomeres to treat lung fibrosis**

We are investigating the mechanisms underlying lung fibrosis caused by telomere dysfunction. This disease occurs in rare genetic syndromes caused by defects in telomere maintenance (e.g. dyskeratosis congenita) and with natural aging. We are using cultured human lung "organoid" and mouse models to understand underlying mechanisms and to test potential treatments.

An undergraduate student would work on this project together with an MD-PhD student and senior PhD scientist in the lab, and would learn 1) molecular biological techniques, including how to measure telomere lengths, 2) histologic techniques, including how to visualize gene and protein expression in tissues using microscopy, and 3) cell culture techniques. There are no absolute prerequisites, but interested students should have completed at least one chemistry or biology course at Penn.

***Priti Lal***

**Project: Tumor microenvironment of Muscle Invasive Bladder Cancer**

Use of immunotherapy promises to revolutionize cancer treatment. Despite its many successes in treating hematologic malignancies and malignant melanoma, immunotherapy has only recently found its way in the treatment of metastatic bladder cancer. The response rates while encouraging are not high. It is therefore critical to study the host immune response in bladder cancer to successfully identify patients who will benefit from this therapy vs those who will not. My current project is funded for molecular subtyping of bladder cancer with the aim to design a genetic panel to predict treatment response. The second arm of this project would be suited well for a student where we would review slides corresponding the cases analyzed molecularly with the aim to

- understand the immune response in the tumors using H&E slides
- understand the subtypes of immune cells in chemo responsive and non responsive tumors using IHC and
- analyze outcomes data

The student will be responsible for:

- Collecting data with me and entering it into a data base
- Analyzing the data with me and formulating an abstract for the upcoming meeting.

*Frank Lee*

**Project: Molecular Mechanisms of the Hypoxic Response**

Low oxygen concentration, otherwise known as hypoxia, is a feature of many common human diseases, such as heart attack, stroke, and anemia. Therefore, understanding how cells respond to hypoxia may provide the basis for new therapies for these diseases. The central cellular pathway by which cells sense oxygen concentration is the Hypoxia Inducible Factor (HIF) pathway. HIF is a transcription factor that regulates many genes involved in the cellular response to hypoxia. The key oxygen sensor in this pathway is an enzyme called Prolyl Hydroxylase Domain protein 2 (PHD2), which hydroxylates and thereby regulates HIF activity. We are interested in understanding, mechanistically, how this important enzyme works. We employ biochemical, molecular biologic, and cell biologic approaches. Prior experience working in a research laboratory is preferred but not required. More important is a strong motivation to learn about laboratory research. The student will gain an understanding of this critical stress response pathway, obtain experience in the design and interpretation of experiments, and learn basic molecular biologic techniques, including polyacrylamide and agarose gel electrophoresis, western blotting, recombinant DNA procedures, and handling and manipulation of proteins and nucleic acids.

*Zissimos Mourelatos*

**Project: The secret life of messenger RNAs (mRNAs)**

A central tenet behind all gene expression profiling methods, including RNA-Seq, is that mRNAs exist largely as full-length molecules in cells. In this paper we show that this commonly held assumption is false and that living human cells are awash with endogenously generated mRNA fragments, with very important implications for interpretation of RNA-Seq and related experiments. By studying how these fragments are generated we made another arresting discovery: the natural decay of all mRNAs involves repeated, cotranslational and ribosome-phased endonucleolytic cuts at the exit site of the mRNA ribosome channel, in a process that we term ribothrypsis. We identify important features of ribothrypsis and show that it is a conserved process (from humans to yeast). Ribothrypsis opens up a new field of study in molecular biology. Please see Nature SMB, 2018, 25:302-310 (PMCID: PMC5889319, PMID: 29507394). The student that undertakes this project will be guided by very experienced and collegial postdoctoral fellows and will participate in generation of libraries for next-generation sequencing, cellular fractionations and purifications and setting up assays, including genetic assays in yeast, to study ribothrypsis.

***Kai Wang***

**Project: Exploring microsatellite expansion in human genome using Oxford Nanopore long read sequencing data**

Microsatellites, repeats of certain DNA motifs (typically 1-6 bases), widely exist in human genomes. The repeat expansions of microsatellites in human genome have been found to cause many brain diseases, such as Huntington's disease and spinocerebellar ataxia. However, traditional next-generation sequencing techniques cannot assay microsatellite accurately, due to technical limitations of the sequencing platforms. Long-read sequencing platform developed by Oxford Nanopore can potentially address these limitations. Our lab has developed RepeatHMM, a computational tool for detecting microsatellite from long-read sequencing data on human genomes. The goal of this project is to build a microsatellite benchmarking database of normal repeat range by using RepeatHMM on Nanopore long reads data on human populations. The candidate should ideally have some familiarity with Linux and basic command line tools to process files. Prior knowledge on biology or genetics is preferred but not required. Through this summer project, a student interested in bioinformatics will gain strong research experience, learn how to pre-process and analyze genomic sequencing data, and participate in the writing of high-quality genomics publications.

***Paul Zhang***

**Project: Application of machine learning and deep learning in radiology and medicine**

Our lab in the Departments of Pathology and Radiology at the Hospital of the University of Pennsylvania works on a variety of projects related to AI/deep learning/machine learning and its application to radiology and medicine. Examples include using CT perfusion to predict outcome after mechanical thrombectomy to treat ischemic stroke, distinguishing benign from malignant renal tumors based on routine MRI, and predicting volume reduction of fibroid and outcome after uterine artery embolization. The majority of the datasets (Penn and other institutions) are already collected and annotated. Although the summer student's main focus will be on data analyses and manuscript writing, he/she will participate in data collection initially to be familiarized with the process. Access to high-end GPU (V100 or P100) to run the analyses will be provided. Code from our previous publications on the topic will be available for adaptation with help from the person who wrote the code. Students of all background with interest are welcome and we will provide the necessary training. Authorship on multiple publications is expected. At the end of the summer, the student will have learned how to design an AI/machine

learning/deep learning project in medicine, how imaging and pathologic data are collected and annotated, what steps are needed to preprocess the data for analysis, how to adapt the existing machine learning/deep learning model and framework for the problem at hand, and how to write a manuscript for publication in a high impact journal. Here are two examples of prior publications from our group: <https://www.ncbi.nlm.nih.gov/pubmed/29167275> and <https://www.ncbi.nlm.nih.gov/pubmed/28339588>

## PEDIATRICS

### *Amanda Ackermann*

#### **Project: Investigating Disease Models of Dysregulated Insulin Secretion**

The Ackermann Lab studies diabetes and congenital hyperinsulinism, both of which are caused by dysregulated secretion of insulin by the pancreatic beta cells. We use a combination of mouse models, cell lines, and primary human pancreas tissue to investigate the function, genetics, and epigenetics of pancreatic beta cells. Dr. Ackermann is also involved in clinical studies related to congenital hyperinsulinism.

One project utilizes a rat beta cell line that we have engineered using CRISPR to carry a mutation in the enzyme phosphoglucomutase 1 (PGM1). Patients with the rare disorder of PGM1 deficiency have increased glucose-stimulated insulin secretion, and we hypothesize that this is due to a novel role of PGM1 in regulating beta cell glycolysis. The student would learn techniques including cell culture, CRISPR gene editing, and biochemical analysis of the glycolysis pathway. If successful, the student will be included as an author on a manuscript describing PGM1 regulation of insulin secretion, and will gain experience in manuscript preparation.

Another project uses a mouse model of human disease in which epigenetic regulator genes are deleted in beta cells, with the hypothesis that gene expression, beta cell differentiation, and insulin secretion will be affected. The student would learn how to analyze tissue histology and protein and RNA expression.

We have a variety of projects from which students may choose to work on, including basic, translational, and clinical research. There is also the possibility of extending the research experience beyond the summer, depending on the student's interest.

[Return to top of document](#)

*Elizabeth Bhoj*

**Project: Uncovering a novel mechanism of pediatric neurodegeneration**

The Bhoj lab is interested in the discovery, mechanism, and treatment of novel neurogenetic disorders in children. One recently discovered disorder is an untreatable form of pediatric neurodegeneration caused by mutations in the genes that code for Histone 3.3. We currently have a mouse model of the disease and this project would be to learn more about the mice who carry a copy of one of the human mutations. This would involve performing behavioral testing on the mice and some basic molecular biology (PCR, sequencing) on the mice. In addition there may be opportunities if there is interest in learning about culturing mouse cells and studying how these mutations change the neurons. This would be an opportunity to learn cell culture. Our goal would be to uncover the specific pathologic mechanism of the disorder to start a targeted therapy trial in the mice, and ultimately the affected children. As we are a translational human genetics laboratory there would also be the opportunity to attend pediatric genetics clinics with the MD/PhD PI to meet affected children. This would be an ideal project for a student interested in medical/veterinary/dental school or graduate school in biology.

*Christopher Bonafide*

**Project: Pediatric Patient Safety Learning Lab at CHOP**

Our Patient Safety Learning Lab is tasked with identifying some of the toughest challenges in pediatric patient safety and solving them using creative approaches drawn from engineering, design, human factors, and other disciplines. We are currently focused on rethinking and redesigning the ways we monitor children's heart and lung health when they are in the hospital and when they are at home. Students involved will learn about clinical research and quality improvement methodologies, and get a high level of exposure to pediatric medical care, including shadowing opportunities. We are seeking highly motivated students who are excited about pediatric healthcare and like to creatively tackle complex problems.

*Heather Burris*

**Project: GeoBirth**

In the United States 400,000 infants are born preterm each year resulting in an infant mortality rate that is worse than 26 other economically developed countries in the world. Preterm birth

[Return to top of document](#)

[Return to top of document](#)

(PTB) risk is not evenly distributed throughout American society, resulting in massive racial disparities with black women having 50% higher risk than white women. Social and environmental factors may explain disparities in PTB. Location can affect health through exposure to pollution and violence. Identifying and addressing local factors that contribute to unequal chances at term births is critical to reducing racial disparities in PTB and subsequent childhood disparities in health.

In this ongoing study, “GeoBirth”, of singleton births at Penn Medicine in Philadelphia from 2008-2017 (n=100,000), we adjudicate each PTB as either spontaneous (sPTB) or medically-indicated (mPTB). We will link to our co-investigators’ innovative air pollution models as well as meticulously curated violence data in Philadelphia so as to determine the contributions of air pollution (specifically particulate matter <2.5 microns in diameter or PM2.5) and exposure to neighborhood violent crime on the risk of PTB, sPTB and mPTB. Further, we will to quantify the extent to which these exposures mediate racial disparities in these outcomes. Finally, we will determine whether a social stressor (violent crime) modifies susceptibility to air pollution in predicting these outcomes. Identifying and addressing area-level factors that contribute to PTB among African Americans is critical to reducing racial disparities in PTB.

*Leslie Castelo-Soccio*

**Project: Impact of adding medical diverse education to diversity, equity, inclusion education**

Stigma is often associated with visible skin and genetic diseases. These diseases have great impact on quality of life for children and their families living with these diseases. We would like to create an innovative lesson plan to include in elementary school to introduce medical differences to children with the hope of decreasing stigma around these differences. We believe this fits nicely into diversity, equity and inclusion education. After creation of lesson plan we would perform pretest and post-test analysis of children receiving the new education. Looking for creative approaches to teaching and an interest in education as well as medicine.

*Sara DeMauro*

**Project: Quality of Life in Severe CLD**

Preterm infants with severe chronic lung disease (CLD) experience adverse developmental and medical sequelae throughout childhood. Our group has reported that severe CLD is associated with decreased parent reported health related quality of life (HRQoL) until at least 2 years of

[Return to top of document](#)

[Return to top of document](#)

age. However, the effect CLD on child and parent reported health related quality of life (HRQoL) during later childhood, and the relationships between poor developmental and medical outcomes and HRQoL in older children with CLD are unknown.

The CHOP Newborn/Infant Intensive Care Unit CLD team has been caring for infants with severe CLD from a wide geographic region for nearly 10 years. The goal of the current project is to assess current health status and HRQoL in children who were treated by the CHOP CLD team during infancy. In this IRB-approved study, families of former CHOP CLD patients will be contacted, and both medical outcomes and HRQoL will be assessed.

The student will participate in contacting families, administering questionnaires, data collection and analyses, preparation of an abstract for a national meeting, and writing of a manuscript. In addition, to better familiarize her/himself with the patient population being studied, the student will participate in the CHOP CLD team clinical activities. No formal research experience is necessary. The student will develop expertise in the outcomes of neonates with CLD, will have the opportunity to interact with families of current and former CHOP CLD patients, and will learn fundamentals of clinical research.

### ***Marcella Devoto***

#### **Project: Computational analysis of genetic data in complex pediatric disease**

The focus of Dr. Devoto's research is identification of genetic defects responsible for complex pediatric disorders using computational approaches. Two disease areas are very early onset inflammatory bowel disease (VEO-IBD) and neuroblastoma (NB). VEO-IBD is a severe disease affecting children <6 years old. VEO-IBD is more severe than the common, adult onset IBD, and conventional therapy is often unsuccessful. We have recruited >400 patients and we use whole exome sequencing and SNP genotyping to identify disease-causing mutations. This approach has in some cases allowed to direct treatment to the underlying molecular defect, with resolution of the disease.

NB, a severe pediatric cancer with a high clinical heterogeneity, is rarer in African-American (AA) children than children of European descent. AA children with NB, however, are more frequently affected with the high-risk form of NB, and have lower survival rates. Genome-wide association studies have identified several NB associated loci. These studies have been performed in children of European descent, and only a few loci have been confirmed in AA children. Whole genome sequence data is now available on a cohort of NB patient and parental trios, including individuals of AA descent. These data, in combination with our AA cohort of 674 NB cases and 3113 controls, will form the foundation for a detailed analysis on the genetic susceptibility of NB in this population.

[Return to top of document](#)



[\*Return to top of document\*](#)

Students may participate in one or the other of the projects. They will learn to perform computational analysis of genetic data and apply bioinformatics approaches to identify disease causing mutations. Students interested in pre-med curriculum or computational biology are encouraged to apply. Some knowledge of genetics or bioinformatics or computer programming is preferable.

*Joel Fein*

**Project: Complete Eats: Summer Meals at CHOP**

21.5 million low-income children nationwide receive free or reduced price meals during the school year, including nearly 660,000 in Pennsylvania. During the summer, many of these children go hungry. In Pennsylvania, only one in ten eligible children continue to get free or reduced price meals through the USDA Summer Food Service Program. Complete Eats is a partnership between CHOP and the Nutritional Development Services of the Archdiocese of Philadelphia to provide free summer meals in clinical settings at the point-of-care, and to connect families with food resources in their community. Summer 2019 will be the program's 3rd year of operation and we anticipate continued rapid growth of the program; in the summer of 2018 CHOP served 7,433 meals across 3 clinical sites.

This summer we will be studying the feasibility, acceptability, and reach of the program, as well as the impact of the program on child health and food security. We are looking for 2 students to assist with program operation at the clinical sites, and data collection from program participants. Responsibilities will include communication with CHOP and community partners, participant recruitment, survey administration via iPad, phone interviews with participants, and data collection. Students will be welcome to attend meetings with community leaders and hospital partners, city public health officials, and governmental officials, as they arise throughout the summer. Students can expect to gain valuable experience in public health program design and implementation, qualitative and quantitative research methods, community based participatory interventions, and an in-depth understanding of the social determinants of health.

Applicants for this position should have an interest in public health/community health and excellent interpersonal communication skills. We look forward to meeting you

[\*Return to top of document\*](#)

*Rebecca Ganetzky*

**Project: Zebrafish as a model for Mitochondrial Complex V Deficiency**

Zebrafish are good animal models for better understanding genetic disease because they are transparent, reproduce extremely quickly and are very easy to modify genetically. Our group is using zebrafish embryos to model genetic mitochondrial diseases. In human cell models and animal models of mitochondrial disease, we are able to measure ATP levels, mitochondrial function (how good mitochondria are at oxidative phosphorylation), lactate levels (as a sign of reliance on glycolysis) and other biochemical markers. However, many of those methods have not yet been fully developed for zebrafish.

We are looking to further develop biochemical techniques for zebrafish, by finding ways to apply established techniques to zebrafish embryos. In this project, the student would be responsible for breeding zebrafish, collecting embryos and preparing zebrafish larvae in different ways for biochemical analysis. We would work together to apply previously established biochemical techniques (ATP luciferin/luciferase assays, respirometry, organic acid analysis and others) to the larvae and the student would be responsible for comparing the results across preparation techniques to determine the best methods. Particular techniques pursued can be targeted to the student's interest

Students would learn how to work with zebrafish in a research capacity, which is a core skill for many research labs, and would also develop experience with PCR and biochemical assays. More broadly, this project is designed to help students learn how to bridge clinical and research questions. Student would have the opportunity to present their work at the end of the summer.

*Andrew Glatz*

**Project: A Mechanistic Exploration of Abnormal Angiogenesis in Single Ventricle Congenital Heart Disease: Discovering Novel Therapies**

Children born with a form of congenital heart disease with only a single functioning ventricle are among the most challenging children to care for. These children typically require multiple surgical procedures to survive, but numerous challenges remain. In particular, these children are at high risk for abnormal angiogenesis (disorders of new blood vessel formation), which can cause significant morbidity and mortality. The biological basis of this abnormal angiogenesis is poorly understood, and no durable therapies exist. We have a multi-departmental collaborative research group which has been extensively studying this issue, combining the unique clinical research expertise of Andrew Glatz MD MSCE with the vascular biology expertise of Carlo Bartoli MD PhD. We have an ongoing prospective trial to sample blood from various vascular

[Return to top of document](#)

compartments of single ventricle patients during cardiac catheterization with Dr. Glatz. These samples are analyzed in Dr. Bartoli's laboratory to explore mechanistic pathways and identify potential novel therapeutics. The angiogenic molecular signatures are then correlated with the patient's clinical outcomes. The interested student would gain exposure to basic and translational science methods in Dr. Bartoli's laboratory (gel electrophoresis, immunoblotting, microarray, ELISA, cell culture, etc.) as well as clinical research experience with Dr. Glatz (patient recruitment/screening/consent, blood sampling techniques, observation of clinical outcomes, etc.). Opportunities for clinical shadowing in the Cardiac Center at CHOP will also exist. This is an ideal opportunity for the dedicated, hard-working student considering careers in medicine, scientific research, or drug discovery.

*Matthew Hocking*

**Project: Neurophysiological and Neuroanatomical Processes Related to Autism Spectrum Disorder in Neurofibromatosis Type 1**

This project seeks to identify neurobiological processes associated with a diagnosis of autism spectrum disorder (ASD) in youth with neurofibromatosis type 1 (NF1) and determine associations between neurophysiological processes and clinical phenotypic markers of ASD in youth with NF1. This research employs a between-groups, cross-sectional design that compares four total groups: 1) youth with NF1 with ASD diagnosis (NF1+ASD); 2) youth with NF1 without an ASD diagnosis (NF1-ASD); 3) youth with idiopathic ASD (ASD-I); and 4) typically developing youth. Groups are compared on relevant neurophysiological and neuroanatomical factors (MEG, MR Spectroscopy and diffusion weighted imaging).

*Peter Kurre*

**Project: Mechanisms of stem cell loss in Fanconi Anemia**

Loss of hematopoietic stem cells is a principal cause of illness and death in children with inherited bone marrow failure (BMF) syndromes. While these syndromes are rare, CHOP is a leading center for the care of BMF patients and research into the underlying causes. The Comprehensive BMF Center at CHOP operates one of the largest sample repositories for the study of BMF diseases. Additionally, several faculty within the center direct laboratories engaged in research using tissue culture and animal models.

[Return to top of document](#)

[\*Return to top of document\*](#)

Dr. Kurre directs the Center and his laboratory is actively investigating the cause of stem cell losses in Fanconi Anemia. Recent studies have identified a novel mechanism of fetal stem cell loss and ongoing work will uncover the molecular basis. This project is translationally driven and students will work within a group of post-doctoral researchers and research technicians in Center labs using molecular cloning, tissue culture and advanced analysis techniques. Students will learn about BMF Syndromes, suitable animal models, stem cell analysis approaches and how to design correlative studies involving repository samples. The aim of the project is to identify novel therapies for the rescue of stem cells. An active group of collaborators meets weekly for lab meetings to discuss progress in addition ad hoc meetings on a more frequent basis and students are an integral part of the team, actively participating at the bench and in presentations.

Dr. Kurre has extensive experience with Student mentoring and previously directed a Summer Internship Program. In addition, he served on MD and MD-PhD admission committees and several Graduate students completed their PhD thesis work in his lab.

*Elizabeth Lowenthal*

**Project: Global Child Health**

Dr. Lowenthal's team works on a variety of child health related projects, with most focused in resource-limited settings outside the United States. Two large ongoing studies, one in Botswana and one in the Dominican Republic, have roles for student work this summer. The PURM student will be based in Philadelphia, providing remote support to the teams on the ground in the host countries. The project in the Dominican Republic is focused on a novel approach to iron supplementation in a population of young children with a high rate of iron deficiency anemia. The study in Botswana is focused on assessing the neurocognitive function of school-aged children with the ultimate goal of helping to decrease the impact of deficits that are more common among children who are infected with HIV-- through early identification of their neurocognitive differences and appropriate interventions. Student responsibilities will include assisting with data quality checks, data analysis, and drafting of study-related documents. There are opportunities to take part in both qualitative (e.g. reviewing and coding interviews) and quantitative (e.g. statistical analysis) aspects of research.

[\*Return to top of document\*](#)

*Stephanie Mayne*

**Project: Wellness and Healthy Lifestyle Factors among Children and Families in Pediatric Primary Care**

My research focuses on helping children and families maintain cardiovascular health by reducing risk factor behaviors like smoking, unhealthy diet, and physical inactivity. I study these factors from a multi-level perspective that considers how policies, neighborhoods, and health system factors influence health. I am interested in understanding how best to promote wellness (including physical, mental, and social health) among families in pediatric primary care and community settings.

This summer research project will involve participating in pediatric primary care research focused on understanding determinants and patterns of wellness-related outcomes among children and their families. Potential projects include survey research with families in primary care to collect data on neighborhood environments and health behaviors, examining patterns in wellness outcomes using electronic health record data, identifying parent and clinician priorities for wellness promotion in primary care, and participating in additional projects focused on primary care innovation. No prior research experience is required.

The participating student will learn key techniques for clinical and social/behavioral research, including 1) critical literature review, 2) participant recruitment for research studies, 3) survey data collection, 4) data entry, and 5) basic data analysis skills. They will interact with a diverse team including pediatricians, epidemiologists, quality improvement experts and clinical research staff. They will participate in weekly meetings on primary care innovation planning and project development, and will receive individual mentorship on their research project and career development.

*Laura Mercer-Rosa*

**Project: The right ventricle in tetralogy of Fallot**

I have a prospective cohort study of infants ( babies up to 1 year of age) that have tetralogy of Fallot, a heart disease that requires surgical repair to ensure that blood reaches the lungs without obstruction. These babies develop a residual disease called pulmonary insufficiency and the right ventricle dilates, however the rate of dilation and the need for reoperations and reinterventions is quite variable from patient to patient. This project focuses on different forms to assess the ventricle- we are collecting blood to measure biomarkers of ventricular fibrosis, we do echocardiograms (ultrasound of the heart) to assess the function of the right ventricle, and we are now proposing a study to enroll patients to do cardiac magnetic resonance studies prior to

surgery. We are also initiating a study of biomarkers, cardiac magnetic resonance (to measure myocardial fibrosis) in older patients with tetralogy prior to replacing the pulmonary valve. These studies will further our understanding of the right ventricle and allow us to identify future therapies, such as drugs, that will affect the right ventricle directly. If involved in one of these studies, the student would participate in data collection, data entry, and data analysis, and be involved in all aspects of the research study. For the older patients that will have a cardiac MRI, the student will have the opportunity to train to measure fibrosis on cardiac MRIs using a special software. Can also be engaged in direct patient interaction by joining the research coordinator in the consenting process.

### *Sage Myers*

#### **Project: Improving Team Performance in Pediatric Resuscitation**

As part of a quality improvement project in the Emergency Department at Children's Hospital of Philadelphia, we video-tape every patient care event that occurs in the resuscitation bay. This includes both trauma and medical resuscitations, with a subset of these videos being reviewed in detail. In addition, we collect prospective information on every resuscitation from the physician leader to create a complete database for every resuscitation which occurs in the emergency department. Resuscitations include any event for which a multi-disciplinary team needs to gather immediately to treat a time-sensitive, acute-care-responsive illness or injury; examples include seizures, sepsis, traumatic injury, and patients requiring CPR and/or intubation. The database has been ongoing since 2011, and this project would involve collating and analyzing data to look at improvements in care after specific interventions over this time period, as well as video-review of recent resuscitation to add to the database. If desired by the student, in person observation of resuscitations can also be included as well as shadowing physicians or other healthcare providers in the emergency department. Facility with the use of a database and/or statistical software package is required (such as Excel, SAS, STATA, etc) and previous experience with REDCap is helpful, but not necessary. This project is likely to be most beneficial for a student who is considering a profession in a medical field or statistics/mathematics, and the actual job tasks can be somewhat tailored to the student's future goals (eg. more heavily-weighted on statistics/analysis vs medical care) as well as the ancillary opportunities. Dr. Myers works within the CPCE (Center for Pediatric Clinical Effectiveness), which is a broad-based research center with faculty from a variety of backgrounds and every attempt would be made to honor student-specific requests for observation or discussion with other faculty or staff to allow for real-world understanding of the day-to-day life in these clinical or research arenas.

***Laura Prosser***

**Project: PLAY (Play and Learning Across a Year) at CHOP**

Our lab is looking for 1-2 students to assist with the start of data collection for the PLAY project. PLAY: Play and Learning Across a Year is a large, multi-site study funded by the National Institute of Child Health and Human Development to develop a shared, 900-video database for developmental science. Videos will be collected in the homes of children aged 1, 1.5 and 2 years. Videos will be coded for basic variables prior to open data sharing, including object manipulation, locomotion, language, emotion, and cognition.

Our lab at The Children's Hospital of Philadelphia is responsible for collecting 30 videos that meet specific quality standards and for coding 60 videos for locomotion. Students will be taught data collection and coding procedures through PLAY video tutorials and in person training with Dr. Prosser. They will make phone calls to potential candidates to explain study procedures and schedule visits. They will conduct data collection visits in the children's homes, at first with assistance from Dr. Prosser or other lab members, and will code videos for locomotion.

Students should have excellent communication skills (such that they are able to gain the trust of caregivers when speaking by phone or in person), some experience with infants or young children (in any capacity), and an interest in human development, movement or pediatric research. Students will gain experience conducting research with children through a landmark study. They will also gain skill using video coding software that is the current scientific standard in behavioral science.

***Ron Rubenstein***

**Project: Protein Trafficking in Cystic Fibrosis**

My laboratory is interested in the mechanism of action of novel small molecule drug therapies for Cystic Fibrosis (CF). These studies have led us to investigate how novel drugs may regulate the biogenesis, intracellular trafficking and function of proteins and/or epithelial ion channels that are important in CF.

Potential summer research project:

The lab has several projects focused on understanding how molecular chaperones that are regulated by sodium 4-phenylbutyrate, the prototype small molecule, mechanism based therapy for CF, may regulate the biogenesis and function of CF-relevant ion channels (CFTR, ENaC) in epithelial cells.

*Lisa Schwartz*

**Project: Self-Management of Adolescents and Young Adults Impacted by Cancer**

My behavioral oncology lab focuses on self-management and adjustment of adolescents and young adults (AYA) impacted by cancer. Specific ongoing studies aim to 1) test a randomized controlled trial testing the impact of a mobile app on uptake of survivorship care plans, 2) evaluate barriers and facilitators of implementing survivorship care plans, 3) longitudinally track daily pain with text messaging and acceptability of acupuncture (for those opting in to acupuncture for pain), 4) longitudinally track self-management and readiness to transition to adult care among survivors, and 5) evaluate behavioral/psychosocial impact of germline testing for cancer predisposition. Based on PURM student interest and skills, we can tailor a summer experience focused on one or two studies. Potential tasks include electronic health record screening, recruitment and phone calls, qualitative interviews, coding qualitative data, conducting literature reviews, data analysis and presentation. The team across these studies is multi-disciplinary and includes MDs, psychologists, NPs, genetic counselor, and various trainees, thus allowing the PURM student access and exposure to various disciplines and possible mentors.

*Shaon Sengupta*

**Project: Circadian regulation of lung inflammation**

My lab has two main interests-- circadian regulation of lung inflammation and the effect of adverse early life exposure on the developing lung. We use an influenza infection model for the inflammation and a hyperoxia model to simulate bronchopulmonary dysplasia (BPD). BPD is a form of chronic lung disease prevalent in prematurity. We have previously shown that mice infected at the beginning of their rest period have better outcomes from influenza than mice infected at the outset of their active periods. We have a large number of genetic mouse mutants targeting individual aspect of the lung-innate immune system interplay and the mechanism underlying this gating is an active line of investigation at present. For the second project, we are studying the effect of neonatal hyperoxia in recovered adults. Mice are born with lungs that approximately correspond to 27-28 weeks gestation (term gestation being 40 weeks) human lungs in terms of maturity and hence serve a great model for prematurity related lung disease.

Student(s) will be assigned to either project and will be supervised on a day to day basis by either a postdoctoral fellow, Dr. Amruta Naik or a research technician, Yasmine Issah. Incidentally



Yasmine herself is a Penn graduate. I will meet with and orient the students at outset and thereafter weekly to review progress. The tasks for the students may include assisting with genotyping (tail digestion, PCR, running gels), scoring animals with supervision, injury scoring of the lung and cytopins, participating in tissue preparation for flowcytometry. Further involvement may be based on interest, experience and skill level. High-achieving students who have made meaningful contribution would be eligible for co-authorship on abstracts to national or international conferences.

## ***Maully Shah***

### **Project: Sudden Cardiac Arrest in the Young**

Few medical events are more traumatic than the sudden, unanticipated death of a young person. Sudden cardiac death (SCD) due to cardiac arrhythmias is statistically uncommon in the young, but its dramatic presentation and cascading effects in the family and community make it a newsworthy event. Widely publicized cases of SCD in athletes personify the metaphor of hidden vulnerability lurking in the body of a vigorous, healthy young person. Underlying genetic etiologies may predispose young patients to these unforeseeable events. The heritable cardiomyopathies including hypertrophic cardiomyopathy (HCM), arrhythmogenic right ventricular cardiomyopathy (ARVC), dilated cardiomyopathy, and left ventricular non-compaction cardiomyopathy and the heritable cardiac channelopathies including long QT syndrome (LQTS), short QT syndrome, Brugada syndrome (BrS), and catecholaminergic polymorphic ventricular tachycardia are potentially lethal but highly treatable genetic heart diseases. Defining the genotype - phenotype characteristics of each of these inheritable diseases is crucial to making an accurate diagnosis and risk stratifying patients who are at risk for sudden cardiac death. Treatment of patients includes drugs, devices (pacemakers and defibrillators) and life style management. We have a collaborative research group that has been studying genotype-phenotype correlations, device therapy , lifestyle management and clinical outcomes of young patients with inherited arrhythmias under the clinical research expertise of Dr. Maully Shah. The interested student would gain exposure to clinical research experience with Dr. Shah (patient recruitment/screening/consent, observation of clinical outcomes, etc.). Opportunities for clinical shadowing in the Cardiac Center at CHOP will also exist. This is an ideal opportunity for the dedicated, hard-working student considering careers in medicine, and scientific research.

[Return to top of document](#)

*Rebecca Simmons*

**Project: Baby Doctor Mamas**

A podcast hosted by attending neonatologists at CHOP: Joanna Jean Parga-Belinkie and Diana Montoya-Williams. This podcast provides information to families with a focus on pregnancy and the postpartum period. It provides new parents with support, encouragement, and information regarding infant care.

Primary Care Perspectives (<https://www.chop.edu/health-resources/primary-care-perspectives-podcast-pediatricians>)

An educational podcast for primary care pediatricians hosted by Dr. Katie Lockwood. This podcast provides ongoing education on general pediatrics topics, and offers continuing medical education (CME) credit for listeners. It uses CHOP doctors to comment on clinical practices in their areas of expertise.

The undergraduate for pediatric podcasting must have an interest in pediatrics. The responsibilities of this summer internship include: shadowing the hosts, learning about the role of podcasts in medical education (for both parents and providers), literature reviews on pediatric topics, podcast production (scripting, audio quality management, sound editing, photography) and social media engagement.

The intern would shadow neonatologists on critical care rounds in the NICU and general pediatricians in a CHOP practice. When not observing clinical duties, the intern would learn hands-on skills in podcast production. Their responsibilities include: helping to curate new content (literature reviews/surveys of families), assisting with recordings/guest interviews, and learning about sound equipment and editing. Additionally, the intern would take part in promoting episodes through engagement in social media platforms (Instagram, Facebook and Twitter). Through mentorship, the intern will work on writing an abstract and/or publication regarding the efficacy of podcasts in educating parents and pediatric providers

*Diana Stanescu*

**Project: The role of SLC38A5 in pancreatic alpha cell development**

Over the past several years great strides have been made in understanding the factors that lead to pancreatic insulin producing  $\beta$  cell differentiation and maturation, contributing to in vitro guiding of human pluripotent stem cells to the  $\beta$  cell fate. However, little is known about similar processes in glucagon-producing  $\alpha$  cells. More than the neglected siblings of  $\beta$  cells,  $\alpha$  cells are emerging as an important and needed partner. Adequate numbers of  $\alpha$  cells and normal glucagon

[Return to top of document](#)

(Gcg) secretion will be required in order to bring a viable cell replacement therapy to patients with type 1 diabetes, who lack both regulated insulin and glucagon secretion.  $\alpha$  cells are also interesting candidates for transdifferentiation, since following  $\beta$  cell ablation in mice and humans,  $\alpha$  cells can upregulate the  $\beta$  cell transcriptional program [1, 2]. A more in depth understanding of developmental processes that lead to  $\alpha$  cell differentiation and maturation is needed. Our previous single cell transcriptomic analysis of  $\alpha$  cells in mouse development proposed that the amino acid transporter SLC38A5 is an  $\alpha$  cell commitment marker. Hence, we hypothesize that SLC38A5 has a specific, time-limited role in the specification and maturation of pancreatic  $\alpha$  cells.

Aim 1: To investigate the temporal role of Slc38a5 in  $\alpha$  cell differentiation.

Aim 2: To determine the role of L-glutamine on  $\alpha$  cell differentiation.

Significance: The results of these aims will support the long-standing observation that nutrient availability during gestation in mouse or human can impact the number of pancreatic endocrine cells. Furthermore, this will be the first study of an amino acid transporter as a maturational marker for pancreatic endocrine cells. Lastly, the identification and characterization of SLC38A5 could be used for positive or negative enrichment of stem cell derived progenitor cells to increase the yield of stem cell differentiation protocols to  $\beta$  or  $\alpha$  cells.

## ***Wei Tong***

### **Project: Stem cells, leukemia, and gene therapy**

Hematopoietic (blood) stem cells are the source of all circulating blood cells throughout life. Allogenic bone marrow transplantation (BMT) or hematopoietic stem cell transplant (HSCT) is used to treat a variety of hematopoietic malignancies and congenital blood diseases, such as aplastic anemia, bone marrow failure, myelodysplastic syndrome, or leukemia. However, HSCT is an invasive therapy with associated mortality and cytotoxicity. Thus, it is of great importance to elucidate the regulation of HSC expansion and differentiation, identify new druggable developmental regulators, explore novel therapeutic avenues and improve current clinical practices for the treatment of various benign and malignant blood disorders. The Tong laboratory studies the mechanisms that underlying HSC fitness and self-renewal, and prevention of leukemogenesis. Furthermore, we are investigating novel signaling pathways that underlie various blood disorders.

*Jennifer Walter*

**Project: Improving Interprofessional Teamwork in the Pediatric Cardiac Intensive Care Unit**

We are currently conducting a pilot clinical trial in the Pediatric Cardiac Intensive Care unit to test an intervention to improve interprofessional teamwork and family support for seriously ill children with cardiac disease. We will have a student participate in the enrollment of parents and clinicians who will take part in the study, collect and manage online survey data, perform literature searches and learn how the basics of qualitative data analysis.

*Joseph Zorc*

**Project: Assessment of Family and Providers' Recommendations for the Care of Children with Medical Complexity in the Emergency Department**

Our qualitative study, entitled “Assessment of Family and Providers’ Attitudes and Recommendations for the Care of Children with Medical Complexity in the Emergency Department” will explore the attitudes and experiences of care providers (both parents and physicians) of children with medical complexity through semi-structured interviews of these groups. The students’ duties will include participating in interview training, performing semi-structured interviews, qualitative coding and analysis of qualitative data, and manuscript construction. There are no prerequisites for this project as the student will be mentored in all of these duties by the principal investigator (Dr. Zorc) and a clinical pediatric emergency fellow (Dr. Christian Pulcini), who will be working side-by-side with the student with the same duties. Academic and professional skills potentially gained include 1) experience and knowledge in professional interviewing, 2) qualitative coding and analysis, 3) construction and completion of an academic abstract/manuscript, and 4) qualitative methodology. The benefits and experiences, in addition to the skills mentioned above, will include a leadership role in a mentored academic study from start to finish, as well as inclusion as an author in the study. Students will also interact with families and physicians in a professional setting on a regular basis, which in regards to professional development is an important skill for future endeavors. Students will also have the opportunity to become involved in a systematic review of emergency care of children with medical complexity if they desire, which is currently underway and led by the PI and clinical fellow.

## PHARMACOLOGY

*Miao He*

### **Project: Discover new biomarkers for classic galactosemia**

The aim of this proposal is to discover new biomarkers for classic galactosemia. Classic galactosemia is associated with a potential lethal multi-organ disease with E. coli sepsis in the newborn period and chronic long-term diet-independent complications such as learning disability, premature ovarian failure, tremors, dyspraxia, ataxia, introverted personality. Newborn screening and restriction of dietary galactose early in life has largely eliminated the acute lethal neonatal component, but chronic complications may occur even in patients who are treated immediately after birth. The cause of these complications is now the single biggest issue in this field. These chronic complications are highly variable between patients and there is no good correlation between current clinical markers such as RBC gal-1-p or urine galactitol and these complications. In order to devise a personalized treatment strategy, we need new biomarkers to monitor the disease progression and guide the treatment. We propose to evaluate plasma N-glycans as novel biochemical biomarkers and study the correlation between their levels and the clinical severity in 10-20 galactosemia patients. This study involves collecting clinical data from medical records, establishing a clinical severity score for galactosemia by working with Dr. Can Ficicoglu in the metabolic disease clinic at the Children's Hospital of Philadelphia (CHOP) and collecting the measurements of plasma N-glycan levels by working with Dr. Miao He at CHOP metabolic and advanced diagnostic lab. By working on this project, the student will learn how to (1) design a study protocol (2) establish clinical trial readiness for a rare genetic disease. The candidate is required to have a strong interest in clinical research and be familiar with medical terminology. Laboratory wet bench experiences are also preferred.

*Akhilesh Reddy*

### **Project: Thermal Proteome Profiling to Decipher the Mechanism of Action of Metformin**

Metformin is a US Food and Drug Administration-approved drug commonly used as a first line therapy for treatment of type 2 diabetes. Metformin is derived from a natural product (galegine) and mainly acts to make tissues more sensitive to insulin, thereby enhancing the effects of insulin produced by the pancreas to homeostatically lower blood glucose levels. Importantly, however, Metformin also inhibits tumour growth, prolongs lifespan, delays the onset of aging, and reduces the risk of cardiovascular diseases (Foretz et al., 2014 and references therein). It is thought that activation of the energy-sensor AMPK, and disruption of mitochondrial signaling by inhibition

of complex I, are possible mechanisms by which Metformin exerts its effects. However, astoundingly given its widespread clinical use, the exact molecular mechanisms underlying Metformin's wide-ranging health benefits are unknown, and further investigation is required to identify such cellular targets.

Recent studies have demonstrated that changes in the thermal stability of proteins upon ligand binding can be used to identify the targets of small molecules (Franken et al., 2015; Savitski et al., 2014). Drugs alter the thermal stability of proteins directly through compound binding, or indirectly through changes in overall protein state. Thermal proteome profiling (TPP) determines melting curves for thousands of proteins and tracks drug action in cells. In this project we will apply TPP, in a convergent approach, to decipher the potential molecular targets of Metformin in different model organisms. This unbiased screening of the potential binding-partners of Metformin in the entire proteome will be much faster and effective than the low-throughput candidate-by-candidate screening approaches. We anticipate that this approach will provide novel insights regarding the mechanism of action and molecular targets of Metformin.

Enthusiastic students with a basic know-how of regular molecular biology research are encouraged to join this project. The undergraduate student taking up the project will receive comprehensive hands-on training on the complete proteomics (TPP) workflow starting from protein extraction to mass spectrometry data analysis and interpretation. They will be supervised by Dr Sandipan Ray in addition to Dr Akhilesh Reddy, the laboratory head. This proposed project will enable the participant to become familiar with various aspects of cutting-edge advanced proteomics technologies. Taken together, the project will be a blend of practical learning and skill development for anyone who wishes to venture into disruptive molecular biology research in future.

References:

Foretz M, Guigas B, Bertrand L, Pollak M, and Viollet B. Metformin: from mechanisms of action to therapies. *Cell Metab.* 2014, 20(6), 953-66.

Franken H, Mathieson T, Childs D, Sweetman GM, et al., Thermal proteome profiling for unbiased identification of direct and indirect drug targets using multiplexed quantitative mass spectrometry. *Nat Protoc.* 2015, 10(10), 1567-93.

Savitski MM, Reinhard FB, Franken H, Werner T, et al., Tracking cancer drugs in living cells by thermal profiling of the proteome. *Science* 2014, 346(6205),1255784.

*Steven Thomas*

**Project: Neurotransmitter signaling in cognition, aging and Alzheimer's disease**

The adrenergic nervous system is an arousal system that contributes to the "fight or flight" response. In the periphery this is mediated by the release of norepinephrine from the sympathetic nervous system and epinephrine from the adrenal gland. In the brain, arousal is mediated by the release of norepinephrine and possibly dopamine from brainstem adrenergic nuclei. To better understand the physiologic roles of this system in health and disease, the lab has recently created a genetic system in mice that permits the inducible loss of norepinephrine and its precursor dopamine. This mimics some disease states in which the adrenergic neurons degenerate, including Alzheimer's, Parkinson's and Down syndrome. To better understand what symptoms underlie the loss of adrenergic signaling, the lab is now studying this novel genetic model. Because a focus of the lab has been to better understand the molecular mechanisms that underlie learning and memory, one set of experiments will be to utilize these mice in behavioral studies that assess learning and memory. Various paradigms will be used to assess declarative memory, implicit memory, and motor learning. The student will be able to perform tests of memory using wild-type and mutant mice, and combine these experiments with pharmacologic manipulations. In parallel, there will be opportunities for ex vivo analysis of expression in brain sections, as well as the performance of biochemical measurements and gene expression analyses. Professor Thomas will provide training.

## PHYSIOLOGY

*Joseph Baur*

**Project: Nicotinamide adenine dinucleotide in heart failure**

Nicotinamide adenine dinucleotide (NAD) is a critical cofactor for many enzymes that is derived from vitamin B3. Recently, novel NAD precursors such as nicotinamide riboside (NR) have been shown to protect rodents from a range of diseases and conditions. We are currently exploring the consequences of NAD depletion or supplementation in a condition with enormous clinical significance: heart failure. It is now established that NAD depletion occurs in human heart failure and several mouse models have suggested a protective effect of NAD precursors. We have generated a novel mouse model to test whether NAD deficiency per se is sufficient to cause the metabolic or functional changes associated with heart failure. Based on our data suggesting that the heart benefits more from intravenous precursors than from oral dosing, we will also collaborate with Dan Kelly's group here at Penn to test the utility of intravenous NR in two human-relevant models: heart failure secondary to ischemic injury or treatment with a

chemotherapeutic drug. There will be opportunities to learn echo cardiography, studies of mitochondrial function, and metabolomics under the co-mentorship of Tim Luongo, a current postdoc in the Baur lab. Together, these studies will reveal fundamental details of how NAD metabolism influences physiology, and will help guide efforts to develop novel therapeutic approaches for the treatment or prevention of diseases associated with obesity and aging.

## PSYCHIATRY

### *Rinad Beidas*

#### **Project: Accelerating Research-to-Practice in Community Health**

Dr. Rinad Beidas, leader of the Accelerating Research-to-Practice in Community Health (ARCH) Lab, is looking to mentor two undergraduate students through PURM. The ARCH lab works to improve the health and mental health of underserved and underrepresented populations through implementation science. Undergraduate research assistants will have the opportunity to support the two projects described below along with opportunities to support other ARCH lab projects as well. Dr. Rinad Beidas has mentored a number of PURM students who have gone on to stay in the lab and to do additional individual mentored research projects through other CURF opportunities (e.g., UScholars).

Project 1: Accelerating the Reach and Impact of Treatments for Youth and Adults with Mental Illness (ALACRITY)

The P50 ALACRITY grant leverages lessons from behavioral economics and implementation science to support the rapid development, testing, and refinement of novel and integrative approaches for (1) optimizing the effectiveness of treatments for and prevention of mental disorders; and (2) organizing and delivering mental health services in community settings. Behavioral economics combines insights from psychology and economics to explain people's behavior, and to create environments that make it easier for people to make optimal decisions. Implementation science focuses on the adoption of evidence-based practices into routine health care and public health settings.

This grant, a partnership between the Penn Center for Mental Health (CMH) and the Center for Health Incentives and Behavioral Economics (CHIBE), encompasses three main projects each designed to improve the delivery of mental health services by changing processes at the organizational, practitioner, or patient level. The first is a randomized trial that compares the effectiveness of different financial incentives to increase antidepressant adherence among adults recently diagnosed with depression. The second project will test the effect of social comparison



[Return to top of document](#)

(e.g., injunctive norms) in increasing therapeutic support staff's (TSS) data collection in their work with children with autism. Finally, the third project involves learning from clinicians how to make it easier for them to use evidence-based practices.

The undergraduate research assistant will have the opportunity to work on all three of these projects. They will work within a dynamic, collaborative research lab and help to prepare materials and process data.

#### Project 2: Fidelity Accuracy: Comparing Three Strategies (FACTS)

What do therapists in community mental health agencies do in sessions with their youth clients? How can we measure the extent to which therapists deliver cognitive behavioral therapy (CBT), an evidence-based practice, as it is intended to be delivered – in other words, how do we measure fidelity? Project FACTS looks to answer these questions by studying three different methods used to measure therapist fidelity to CBT and assessing which is the most accurate and cost effective. Successful completion of this project will identify accurate fidelity measurement methods as well as factors that can increase their uptake in community mental health settings. This multifaceted study provides those working on it opportunities to learn about a number of topics with cross-cutting relevance, like implementation science, cost effectiveness, community-academic partnerships, and approaching complex topics like therapist-client interaction with both sensitivity and scientific rigor.

The undergraduate research assistant work within a dynamic, collaborative research lab and help to prepare for agency visits and process data. They may also have the opportunity to accompany researchers on visits to community mental health centers—a rare and valuable experience for undergraduate students.

*Frederick "Chris" Bennett*

#### **Project: Programming macrophages into microglia**

Microglia are the brain's tissue resident macrophages. They play critical roles in healthy brain development and are highly implicated in the pathogenesis of many brain diseases, including schizophrenia, Alzheimer's disease, and traumatic brain injury. We are developing new ways to treat brain diseases by replacing disease associated microglia with transplanted therapeutic surrogates. A critical factor in replacing microglia is engineering donor cells, derived from the bone marrow or blood, to appropriately perform microglial functions.

Transcription factors play a key role in regulating cellular identity and function. In this project, a summer student will test whether forced expression of microglia-specific transcription factors can make bone marrow-derived macrophages (BMDMs) become more similar to microglia.

[Return to top of document](#)

Supervised by Dr. Bennett and a post-doctoral fellow, the student will use retroviral transduction to over-express candidate transcription factors in mouse BMDMs, purify transduced cells by flow cytometry, and then measure their gene expression compared to untransduced BMDMs and true microglia.

The project is geared to allow a student to take ownership over experimental and analysis steps with close supervision. The student will build foundational skills in experimental design, cell/molecular biology techniques, data analysis, and scientific communication. She or he will also gain knowledge in glial cell biology, neuroimmunology, and their translational relevance. Prior experience with sterile technique and basic principles of molecular biology will allow maximum benefit from this summer research experience.

### ***Keith Bredemeier***

#### **Project: Repetitive Negative Thinking and Working Memory**

Project #1: Repetitive negative thinking (RNT; e.g., excessive worrying, rumination, obsessions) is a core component of many emotional difficulties. Psychotherapies for these problems (e.g., anxiety disorders, depression) reduce RNT but are not a cure all, as many individuals will continue to struggle with RNT after treatment. Based on cognitive science research showing that elevated RNT may result in part from difficulties with working memory (the capacity to temporarily store and manipulate information), some recent research has tested working memory training as an intervention strategy for reducing RNT, with promising results. However, based on constraints of this work, the clinical implications are not yet clear. Led by Dr. Keith Bredemeier, the Center for the Treatment and Study of Anxiety will be developing a new working memory training program (Enhancing working memory to Reduce Undesirable Persistent Thoughts – ERUPT) aimed at reducing RNT, designed and tested explicitly as an adjunct to established treatments provided at our Center for individuals with anxiety-related disorders. Further, this program will: 1) be transdiagnostic in nature; 2) have some clinician/staff involvement to facilitate engagement, and 3) include elements from other cognitive skills/remediation programs. We hypothesize that these unique features of the program will bolster its clinical outcomes and utility. Undergraduate volunteers who assist with this project will have an opportunity to make substantial contributions to the development of ERUPT (as well as a control intervention for the trial study, focused on relaxation skills) by conducting literature reviews of existing programs and drafting program materials (e.g., manual educational content, practice logs).

Project #2: Repetitive negative thinking (RNT; e.g., excessive worrying, rumination, obsessions) and related forms of emotional distress (e.g., anxiety, depression) have been linked with

difficulties in working memory (the capacity to temporarily store and manipulate information) and other cognitive abilities involved in goal-directed behavior (i.e., “executive functions”). However, the nature of these links is not fully understood. For example, which cognitive difficulties are most robustly associated with RNT, or a particular symptom/diagnosis? Importantly, these relationships have yet to be explored in the context of treatment for emotional distress/disorders. In adult clients seeking treatment for anxiety-related disorders at the Center for the Treatment and Study of Anxiety, Dr. Keith Bredemeier and colleagues plan to test associations between (self-reported) levels of RNT and emotional distress with performance on various behavioral performance measures of working memory and other executive functions. Further, this study will explore whether cognitive performance reliably improves as a function of treatment, and whether these cognitive measures predict how much individual clients will benefit from treatment. Undergraduates who assist with this project will learn about research on cognitive difficulties linked with RNT (e.g., through recommended readings), contribute to the implementation of study cognitive performance measures (selection and testing of computerized tasks; training and consistency methods for clinician-administered tasks), and support participant recruitment, consenting, and testing sessions. Although data collection for this project is just beginning, there will be opportunities to provide input on study hypotheses and analysis plans at study meetings, with potential for authorship on journal articles to result.

### *Gregory Corder*

#### **Project: Uncovering the brain neural circuits of pain and emotion**

The Corder Lab (Department of Psychiatry and Department of Neuroscience) is looking to work with highly motivated students that are interested in gaining lab experience and assisting with a cutting-edge neuroscience project to use a combination of genetically engineered mice and fluorescent viruses to discover the brain cells that encode our perception of pain and negative emotions.

The mission of the Corder Lab is to decipher the neural basis of how the brain generates the experience of pain, and how pathological changes within these brain networks promotes the transition to chronic pain and drug abuse. Using advanced in vivo imaging of neural activity, neuroanatomical tracing, and optical neuromanipulation techniques, in rodent model systems, our group continues to deconstruct the brain circuits and molecular mechanisms involved in pain and pleasure. From our lab’s investigations, we aim to identify translational targets for developing novel treatments that reduce the mental health disorders associated with chronic pain and addiction to opioid drugs.

[\*Return to top of document\*](#)

Students will have an opportunity to be a part of a young and dynamic lab, and to gain experience in advanced neuroscience techniques, including viral-assisted neural circuit mapping, stereotaxic brain surgery, tissue histology and immunohistochemistry to visualize fluorescent proteins in neurons, and laser-confocal microscopy. Students pursuing, or intending to pursue, degrees in biology, neuroscience, psychology, or other medically related fields are encouraged to consider these projects. We also encourage students with electrical engineering or computer science backgrounds who are interested in the crossroads of neuroscience and engineering to uncover how brain circuits excel at extracting information from our senses to come work with us. Experience in MatLab / Python / R / TensorFlow or other deep learning platforms is desired for some projects. A willingness and/or comfort working with mice is required.

The lab's Principal Investigator, Dr. Gregory Corder, as well as other lab members of the lab will provide one-on-one training in these techniques. You can expect that Dr. Corder and the entire team will do all they can to make the lab an exciting, fair, and rewarding place to gain new insights into the neurobiology of the mind and brain.

*Matthew Hayes*

**Project: Amplification of satiation signaling by melanocortin-4 receptors in the nucleus tractus solitarius**

The astounding prevalence of obesity presents major public health and economic consequences. The development of more effective therapeutics for weight loss is paramount and requires basic science research to characterize the neural control of feeding behavior. Melanocortin signaling, through melanocortin 4 receptors (MC4Rs) in the nucleus tractus solitarius (NTS) contributes to energy balance control by reducing food intake via amplification of within-meal gastrointestinal (GI)-derived satiation signals. However, the mechanism of MC4R signaling within the NTS is not clear and the translational significance of the interaction between NTS melanocortin signaling and other hormonal systems at the level of the NTS has not been adequately explored. The proposed research aims to test the hypothesis that endogenous pre- and postsynaptic NTS MC4R activity amplifies NTS neural signaling, food intake and body weight suppression evoked by the GI-derived satiation signals cholecystinin (CCK) and glucagon-like peptide-1 (GLP-1). Proposed in vivo fiber photometry and behavioral pharmacology studies will be conducted in mice. Duties and responsibilities will be overseen by a postdoctoral research fellow (Dr. Samantha Fortin) and two laboratory technicians (Rinzin Lhamo and Jack Chen) and will include: maintenance of a transgenic mouse colony, food intake and body weight readings, assistance with surgical preparations including craniotomies and viral injections into the nodose ganglia. Student will also be responsible for data entry and analysis. Students should have a

[\*Return to top of document\*](#)

[Return to top of document](#)

background in neuroscience, be comfortable with in vivo mouse work, and have an interest in joining the lab as an undergraduate researcher after the conclusion of the PURM experience.

*Matthew Kayser*

**Project: A fruit fly model for social behavioral dysfunction in autism**

My laboratory uses the fruit fly to explore the molecular and neural circuit basis of social behavioral dysfunction in autism spectrum disorders (ASDs). Because of complex underlying genetics in ASDs, monogenetic neurodevelopmental disorders (NDDs) with autistic features have served to provide critical insights into the basic pathophysiology in autism. As in ASDs, dysregulated social behaviors represent one of the most significant sources of disease burden in NDDs such as neurofibromatosis type 1 (NF1). NF1 is a genetic disorder caused by loss of function mutations in the protein neurofibromin (Nf1). Currently, no treatments for NF1 or ASDs effectively address social behavioral deficits. We have recently found in a *Drosophila* model of NF1 that mutant males display impairments in social behavioral decisions. We are using this model to examine where, when, and how social behavioral dysregulation arises in NF1. The project can accommodate multiple PURM students. PURM students will (1) learn how to conduct and analyze social behavioral assays in *Drosophila*, (2) become familiar with a wide range of genetic approaches in the fly, including manipulation of neural circuit activity, and (3) gain expertise with a technique that allows us to monitor neural activity in an awake, behaving fly as it engages in social interactions. These approaches present a unique opportunity to determine the neurobiological mechanisms of social behavioral dysfunction in NF1, and, we hope, pave the way for new therapeutic targets in ASDs.

*Sara Kornfield*

**Project: Psychophysiology, PTSD, and Pregnancy**

Students working with me this summer will have the opportunity to participate in one or more projects that are currently ongoing at the PCWBW.

Project 1: Spontaneous Preterm Birth (sPTB) is a traumatic event that has been associated with the development of posttraumatic stress disorder (PTSD). The physiologic symptoms and neuroendocrine consequences of PTSD (i.e., hyperarousal) create an unfavorable environment for a subsequent pregnancy and may predispose a woman to recurrence of sPTB. Our previous research has shown that women with PTSD are significantly more likely to deliver early.

[Return to top of document](#)

Moreover, we found an association between levels of physiological arousal and gestational age at delivery such that women with heightened arousal response to neutral or unpleasant stimuli were more likely to experience sPTB. The goal of this study is to examine the relationship between physiologic arousal, as assessed by computer-based testing, and recurrent PTB in a sample of women with a previous sPTB. PTB and PTSD tend to be more prevalent in low-income women of color, and both are associated with poor maternal mental health, impaired maternal-child bonding, and child developmental outcomes. Therefore, our study aims to develop a novel method of assessment that will identify those at highest risk of sPTB and PTSD, and will inform future studies to develop psychosocial treatments that reduce the effect of trauma-related physiological symptoms on sPTB and to mitigate racial disparities.

Project 2: Posttraumatic stress disorder (PTSD) is highly prevalent in populations of people living with HIV infection (PLWH). PTSD has been linked to poorer outcomes among PLWH such as lower CD4/CD8 cell count ratios, increases in mortality, and increased viral load. Gut microbiome alterations and inflammatory markers/immune dysregulation have also been associated with PTSD diagnosis and/or severity, however these relationships have not yet been investigated in PLWH where viral load and HIV disease burden are the outcomes of interest. This study aims to determine the extent to which PTSD status affects the relationships between gut microbiome dysbiosis and increased inflammation on viral load/CD4 count in HIV infected women and men. A secondary goal of this study is to examine sex as a biological variable (SABV) in these relationships as future research studies may include the investigation of the role of PTSD in neonatal transmission of HIV among women living with HIV. It is the goal of this study to identify biomarkers that can be used as measures of improvement in future treatment intervention research.

The student intern's responsibilities as a member of the study staff would be to assist in recruitment of study participants from two obstetrics clinics and/or HIV clinics on Penn's campuses; learn how to conduct telephone interviews and obtain consent from interested and eligible participants; observe and become trained in the administration of the acoustic startle procedure (laboratory stressor); become trained in how to administer participant assessments, enter data into the study database; work with the electronic medical record to learn how to extract relevant participant information. In addition, there are opportunities for shadowing the study PI during research and/or clinical therapy sessions, and other center faculty in psychiatric medication consultations. This opportunity will provide exposure to both an intervention based clinical trial and integrated mental health-medical care (prenatal/gyn) settings for those interested in interdisciplinary work. As part of this internship, the PCWBW offers a 10-week didactic curriculum to introduce students to introductory concepts in women's mental health across the lifespan. Students are invited to attend and participate in all center-wide meetings, lectures, and research presentations.

*David Mandell*

**Project: Evaluation of Public Mental Health Programs in Philadelphia**

We are Penn Center for Mental Health (CMH), the premier academic center for advancing mental health research, policy, training and practice. Our dedicated, multidisciplinary faculty and staff connect research and evaluation findings to policy decisions and to delivery and implementation of services to improve the lives of people with psychiatric and developmental disabilities.

CMH was founded in 1984 at the Perelman School of Medicine at the University of Pennsylvania and is nationally recognized for its research, technical assistance, practice and academic training in adult and children's mental health services. Since then, we have been a champion for people living with or at-risk for mental health problems, supporters of the people and programs responsible for creating policy and system change, and have conducted rigorous research, and have provided unparalleled community partnerships and research training for undergraduate, graduate, doctoral and postdoctoral trainees.

The CMH partners with the City of Philadelphia's Department of Behavioral Health. Through this partnership, we carry out research and evaluation activities for the City of Philadelphia's behavioral system and support the Department of Behavioral Health in setting data-driven policy priorities.

We seek a student intern who will help the CMH carry out evaluation projects by conducting systematic literature reviews, writing summary papers, and creating analysis reports. The student will participate in the monthly meetings with the city and gain real-world experience in working with government administrators and policy makers, health care professionals and researchers in planning and conducting community-based research.

*Jennifer Mautone*

**Project: The right care at the right time: Scaling up integrated behavioral health services in pediatric primary care**

Mental health conditions are estimated to occur among at least 20% of children and adolescents; however, less than 30% of children with significant mental health needs receive services. Increasingly, models of care involving integration of behavioral health providers (psychologists, psychiatrists, social workers) into primary care practices are being used to address gaps in service access and delivery for children and adolescents. Integrated primary care services aim to ensure that patients receive the right service at the right time, with a focus on preventing the

onset and worsening of mental health concerns. The purpose of this project is to evaluate service delivery in the integrated care program at CHOP, which is known as Healthy Minds, Healthy Kids (HMHK).

Students working on this project will have the opportunity to participate in HMHK research and clinical team meetings to learn about the development, scale up, and evaluation of HMHK services throughout CHOP's primary care network. Our current research is focused on identifying factors related to patient attendance and engagement in services, particularly in our practices that serve predominantly Medicaid-insured families, who often face barriers to accessing care. This is an outstanding opportunity for students interested in behavioral health service delivery in underserved communities. In particular, students will obtain foundational patient-oriented research experience that is necessary for pursuing graduate school training in behavioral health. Student activities include data entry, data management, medical record review, manuscript and abstract development. Some experience with data entry and management is preferred. Ariel Williamson, PhD is a co-mentor for this project.

### ***Judith Miller***

#### **Project: Does autism screening lead to earlier diagnosis and treatment?**

The promise of universal autism screening is that earlier identification will lead to earlier intervention. Recently, however, the United States Preventive Services Task Force (USPSTF) highlighted that there have been no studies examining whether universal screening leads to earlier treatment. This has led to significant concern in the autism community that screening efforts will diminish and that children will be negatively affected.

CHOP has what may be the largest universal autism screening program in the country, through our extensive primary care network. The first cohort of children screened as toddlers are now between the ages of 4-9 years. Diagnoses and the start of intervention can be examined through the electronic health record to create the first population-based community data on the impact of autism screening. This will be done through electronic extraction of data from health records, augmented with manual chart reviews. We will then compare the age of diagnosis and intervention for children seen before (and after) the universal screening program began.

The PURM student will learn about Autism Spectrum Disorder and health records research by reviewing health records to find and document the child's age of diagnosis and intervention, conducting descriptive analyses, and conducting a critical review of the literature. The PURM student will work closely with Dr. Miller and study coordinator Manisha Udhnani, and be encouraged to attend other research meetings at the Center for Autism Research. The student will



[Return to top of document](#)

also be welcome to observe the Regional Autism Clinic's interdisciplinary diagnostic training clinic.

*Desmond Oathes*

**Project: Working memory augmentation with non-invasive brain stimulation**

Using guided personalized targets from MRI brain scans, we will attempt to augment working memory performance on the Nback task using non-invasive brain stimulation (transcranial magnetic stimulation) in healthy participants. This will set the stage for studies in psychiatric disorders for whom working memory performance is known to be compromised.

*Rebecca Pearl*

**Project: Behavioral Weight Loss and Stigma**

The Penn Center for Weight and Eating Disorders is seeking summer students to work on studies relating to psychosocial aspects of obesity and weight loss. The students will primarily work on a behavioral weight loss trial testing a psychological intervention to help patients with obesity cope with weight bias and stigma.

The students' duties may include: participant recruitment efforts; conducting phone screening interviews with potential study participants; data entry and verification; data management; organization of study materials and documents; interacting with patients; and other tasks as assigned by the supervisor. Students will have the opportunity to observe treatment group sessions focused on behavioral weight loss and strategies for coping with weight stigma. This position will provide an excellent introduction to clinical research if students are interested in pursuing careers in medicine, psychology, public health, nursing, social work, or related fields.

Qualifications:

Coursework in psychology, social work, public health, medicine, nursing, or similar fields is preferred. Experience in clinical or social science research (including data entry) is also helpful but not required. Students interested in attending treatment group sessions must be available one evening per week and must feel comfortable interacting with patients. Most importantly, the ideal candidate is self-motivated, able to work and problem-solve independently, flexible, personable, and professional.

[Return to top of document](#)

*Courtney Wolk*

**Project: Understanding implementation and informing scale up of the Penn Integrated Care (PIC) program**

Our project examines the implementation of a Collaborative Care pilot program at Penn, the Penn Integrated Care (PIC) program. The University of Pennsylvania Health System, which includes 80 primary care practices in Philadelphia and the surrounding area, is undergoing a major integration of behavioral health services. This health system transformation is designed to improve the ease at which clinics and providers can implement Collaborative Care, but it is unknown if this will be enough to change provider screening, diagnosis, referral, and treatment of behavioral health concerns. This project will allow us to identify challenges so that we can inform scale up. The specific aims of this project are to understand how access to and engagement in primary care is impacted by the implementation of Collaborative Care; examine mental and physical health outcomes for patients enrolled in Collaborative Care; and determine the costs associated with Collaborative Care implementation and potential cost savings incurred. To address the aims of this project, we will utilize data from the electronic health record (i.e., EPIC) and health care claims data. The student will assist with data management, literature reviews, and preparing manuscripts for publication under the co-mentorship of Dr. Wolk, an implementation scientist, and Dr. Molly Candon, a health economist. Opportunities to assist with data analyses and to co-author manuscripts may be available as well depending on the student's needs and interests. Students with experience conducting literature reviews, using Microsoft Excel and/or EndNote are especially encouraged to apply. Strong communication and writing skills are essential for this project.

## PSYCHOLOGY

*Liisa Hantsoo*

**Project: Physiologic stress response and role of neuroactive steroid hormones in Premenstrual Dysphoric Disorder (PMDD)**

Premenstrual Dysphoric Disorder (PMDD) is a cyclic mood disorder that affects approximately 3-5% of women, translating to millions worldwide. PMDD has been compared to severe premenstrual syndrome (PMS), although its symptoms are similar to those of major depression (e.g. irritability, low mood, anxiety). In PMDD, these mood symptoms only occur in the

[Return to top of document](#)

premenstrual phase of the menstrual cycle. This clinical study seeks to understand the role of neuroactive steroid hormones that fluctuate across the menstrual cycle, such as progesterone and its metabolites, in PMDD. The overall goal is to shed light on how hormones interact with the central nervous system (CNS) to influence mood and stress response. This study uses a laboratory stressor to measure stress response (e.g. cortisol, acoustic startle response) in women with and without PMDD at different points in the menstrual cycle.

PURM students will assist in participant recruitment and screening, prepare materials for participant laboratory visits, enter and manage data in REDCap, assist with laboratory visits including psychological measures and psychophysiology assessments, and prepare blood samples for hormone assays. PURM students also benefit from attending educational activities within the Penn Center for Women's Behavioral Wellness (PCWBW), including journal club and lab meetings. Critical thinking skills are emphasized, and students are asked to think actively about study design and research hypotheses. Students should have an interest in psychology/psychiatry, women's health, and clinical research. Students will receive research mentorship from Dr. Liisa Hantsoo, and individualized feedback and coaching from the PCWBW research staff.

### *C. Alix Timko*

#### **Project: Psychosocial functioning in adolescents with anorexia nervosa and their parents**

##### Project 1: Psychological Distress and Burden in Parents of Adolescents with Anorexia Nervosa

Anorexia Nervosa (AN) is a serious eating disorder characterized by restriction of food intake and reduction of body weight below what is healthy or expected for someone of the same age and height. AN has the highest mortality rate of all psychiatric disorders and is associated with significant morbidity. Caregiver burden is high. Research has investigated the link between burden, distress, and communication style in caregivers of adults with anorexia. More research is needed to understand caregiver burden in the parents of adolescents with anorexia. PURM students will explore the relationship between caregiver experiences of adolescents with AN to psychological distress, expressed emotion, and effectiveness of treatment. Responsibilities include conducting a comprehensive literature review, data entry and management of database as well as statistical analysis of the data collected. The student will, in return, gain valuable experience conducting clinical research and join a dynamic lab. Students will be supervised by Dr. C. Alix Timko, PhD and will work closely with the research team. All research will take place at Children's Hospital of Philadelphia and the Roberts Center for Pediatric Research. As such, students are required to undergo FBI background and child abuse clearance as well as IRB and human subjects training.

[Return to top of document](#)

## Project 2: Descriptive Analysis of Comorbidities in Adolescents with Anorexia Nervosa

Anorexia Nervosa (AN) is frequently co-morbid with anxiety disorders and depression. It can impact adolescents' psychosocial functioning. Comorbidities may be associated with poor outcome (particularly co-occurring obsessiveness). However, many common co-morbidities may also be a side effect of malnutrition and may resolve with re-nourishment. Using existing self-report and parent report on the Behavior Assessment System for Children (BASC), a tool to assess socio-emotional functioning, PURM students will conduct a descriptive study of the profile of adolescents with restrictive eating disorders on this measure. Existing data include parental and self-report on the BASC and eating disorder symptomology assessed via the Eating Disorder Examination. Data is primarily from baseline assessment, however, there is a small sample of post-treatment data which will allow for assessment of change over treatment. Students will learn how to administer and score each measure in order to fully understand the previously collected data. Responsibilities will include an in-depth literature review, data organization and entry using REDcap, and statistical analysis. Students will join a dynamic research lab and gain mentoring from Dr. C. Alix Timko, PhD. Those interested in clinical psychology are encouraged to apply for this specific project. All research will take place at Children's Hospital of Philadelphia and the Roberts Center for Pediatric Research. As such, students are required to undergo FBI background and child abuse clearance as well as IRB and human subjects training.

## RADIATION ONCOLOGY

*Edgar Ben-Josef*

### **Project: Cardiac toxicity of proton and photon radiotherapy in esophageal cancer patients**

The goal of this project is to determine whether proton radiotherapy is associated with reduced cardiac toxicity in esophageal cancer patients and to understand quantitatively the differential radiation dose distribution in various parts of the heart that may explain difference in toxicity.

The project involves outlining the various anatomical sub-structures of the heart (segmentation) based on existing atlases in approximately 150 patients previously treated with protons or photon therapy. This will require interaction with radiation oncology residents, physicist, with myself and with a cardiologist with expertise in cardiac imaging. Once these segments have been contoured, the dose distributions in these segments will be extracted from their radiation treatment plan and statistically compared (photon versus protons). Cardiac toxicities (already available in a database) will be examined for associations with dose distribution in the various

[Return to top of document](#)

structures of the heart to understand what dose-volume relationships are associated with severe toxicity.

The project does not require knowledge in medicine or anatomy. Relevant training will be provided in identification of the anatomical structures of the heart and the various software involved. There will be significant exposure to research methods and strong multidisciplinary interactions.

*Timothy Zhu*

**Project: Experimental and Monte Carlo simulation of tissue optical properties for anal PDT**

Tissue optical properties (absorption and scattering coefficients) are important dosimetric quantities that determine the light penetration during photodynamic therapy (PDT). This project develops a method to determine the tissue optical properties for anal PDT, where the site to be treated (or the site for optical properties) is located within the anal canal. The instrument to be developed include a transparent cylinder with 1 inch diameter. On the side of the cylinder, two transparent catheters are placed with 5 mm spacing between the two. One catheter is used to introduce a point light source that emits light the same wavelength used for PDT treatment, the other catheter is used to detector the signal after the light has transported through the tissue. The complication of the anal canal is the presence of integrating sphere effect when the light will be multiple scattered with the cylindrical cavity. Both experiment in liquid optical phantoms of known optical properties and Monte-Carlo simulation will be performed to determine an analytical formula to quantify the relationship between the measured light fluence to the tissue optical properties in this particular geometry.

We are looking for 2 different students who would each have independent roles.

*Jennifer Wei Zou*

**Project: Beam angle selection for proton adaptive radiotherapy**

The Radiation Oncology department in Penn provides the state-of-art proton radiotherapy to cancer patients of various disease sites. The Penn proton center has been successfully treating patients since 2011. During the radiation treatment, the change in the tumor target, the patient anatomy will result in the radiation beam delivery uncertainties. Due to the high sensitivities of the proton beams to the local tissue variations, an adaptive patient treatment plan is often necessary to account for the patient anatomy changes in order to guarantee the beam dose

[Return to top of document](#)

delivered to the tumor locations while sparing the surrounding healthy organs. This project is going to retrospectively identify cohorts of the lung and head and neck patients that had received the proton radiation treatments and examine the anatomy changes. An algorithm will be developed to calculate the proton beam paths variations due to the anatomy changes at different proton beam angles. A set of robust angles will be selected for the disease sites. Such selection of the beam angles have clinical significances in guiding the development of patient proton treatment plans.

## RADIOLOGY

*Abass Alavi*

### **Project: Evolving Role of Molecular and Structural Imaging in Modern Medicine**

Mentor Areas:

Abass Alavi specializes in the field of molecular imaging, most notably in the imaging modality of positron emission tomography (PET).

Description:

I conduct research in almost in all disciplines in medicine by utilizing the most advanced imaging techniques such as MRI, PET and CT. My lab is particularly interested in quantifying disease activity by very advanced segmentation techniques. By adopting structural imaging techniques like MRI and CT along with molecular imaging methodologies (PET), we are able to assess and characterize many serious diseases that we face in medicine at the molecular and cellular levels. Such diseases include cardiovascular disorders, cancer, brain dysfunction including dementias, infection, inflammatory disorders, and age-related abnormalities.

Currently, our discipline is judged as being the most exciting domain for research for the foreseeable future. We are able to use some hard core sciences such as physics, math, chemistry and biology to detect disease at its earliest stage and also discover the most effective therapeutic interventions for future management of patients.

Ongoing and potential projects include:

- 1) PET-Based Assessment of Radiation Therapy Induced Pulmonary inflammation and Vasculitis
- 2) Detection of Cognitive Impairment Due to Cerebrovascular Disorders by Advanced PET Imaging techniques
- 3) Advanced PET-CT imaging Methodologies to Examine Musculoskeletal Injuries

[Return to top of document](#)

- 4) Evolving Applications of PET/CT-Based novel imaging techniques to assess and quantify atherosclerosis in Major and Coronary arteries
- 5) Novel imaging Schemes for Accurate Quantification of Disease Activity in Hematological Malignancies
- 6) Detection and Characterization of Atherosclerosis in Patients with Cancer
- 7) Detection and Characterization of Atherosclerosis in Patients with Inflammatory disorders psoriasis and Rheumatoid Arthritis
- 8) Critical Role of PET in quantitative measurement of Bone and Muscle metabolism in Health and Disease

Requirements:

I prefer students with backgrounds in biology, chemistry, physics and computer sciences. The students take the primary responsibility for conducting these projects but work very closely with the faculty assigned to her/him while working in the lab.

*Tessa Cook*

**Project: Machine Learning in Radiology: Rising to the Challenge of the Radiology Report**

Machine learning is currently everywhere you look in radiology. However, most researchers and developers are focusing on the findings detection task, i.e., finding an abnormality or abnormalities on an image or set of images. Instead, I am interested in applying machine learning to radiology reports. Radiologists are board-certified physicians who spend upwards of 6 years after medical school training to interpret medical images generated by x-ray, computed tomography (CT), magnetic resonance imaging (MRI), and a variety of other methods. Some radiologists even do image-guided surgery--sometimes called surgery without a scalpel. Regardless of whether they are describing a set of images or the steps of an image-guided procedure, all radiologists generate a report: an interpretation of the images or the findings and intervention during the procedure. These reports are usually unstructured text, created by voice dictation to a computer system. In some instances, they are loosely consistent in format, and in others, can be heavily structured. This variety in format, content, phrasing, and terminology makes it very challenging to automate report analysis. With the recent advances in processing hardware and introduction of new algorithms, machine learning promises to make this type of processing easier. Within Penn Radiology, we have upwards of 18 million reports going back in time since the beginning of electronic radiology reporting at Penn. I am the co-director for the Center for Practice Transformation within Penn Radiology. We are looking at novel ways to change the radiology workflow by incorporating machine learning to replace tasks radiologists currently do in manual or inefficient ways. If you choose this project, you will get to work

[Return to top of document](#)

[Return to top of document](#)

alongside premier radiologists here at Penn, as well as with a talented team of developers within the Center.

The ideal student for this project is one that either has prior programming experience or is willing to take on a steep learning curve (with Python and scikit-learn, among other tools) to acquire a set of technical skills that promises to be extremely valuable in their future. The project will involve learning how to pre-process radiology data for machine learning, as well as developing and testing machine learning models to work with text-based report data. You will learn more about radiology and medicine at an academic medical center. Best of all, you will get to work on something that could actually change the way we practice radiology one day.

*David Cormode*

**Project: Drug-eluting, radiopaque, tumor casting hydrogels for interventional radiology treatment of hepatocellular carcinoma**

Hepatocellular carcinoma (HCC) is the fastest rising cause of cancer-related death in the United States. To treat this disease, the development of biodegradable materials that can block blood vessels, have tunable drug release, as well as incorporate materials with radiopaque properties, would be advantageous. We will develop a novel injectable, thermo-sensitive, radiopaque and drug-eluting hydrogel as a therapeutic platform for HCC treatment, which will completely occlude tumor blood vessels. Renally clearable gold nanoparticles (AuNP) will be used to render the gel radiopaque since they have strong X-ray attenuation, excellent biocompatibility and can eventually be excreted. Preliminary results have indicated the successful incorporation of both AuNP and doxorubicin (DOX) within the hydrogel. In this proposed research, the AuNP/drug loaded hydrogel will be physically and chemically characterized. The release profile of AuNP and DOX in the proposed hydrogel system will be demonstrated. In-vivo studies examining the contrast generating properties of the gel, its anti-tumor effects, its biodistribution and clearance will be performed.

*Michael Farwell*

**Project: Imaging the Immune System and Tracking CAR T Cells**

My research focuses on the development of new imaging tools to visualize the immune system in the setting of cancer immunotherapy. I am particularly interested in developing novel PET

[Return to top of document](#)



[Return to top of document](#)

radiotracers / reporter genes for tracking CAR T cells in vivo, and I am also interested in utilizing radiolabeled antibodies for PET imaging of the immune system.

This research project will provide the following experiences:

- molecular biology and cell uptake studies, which will utilize cell culture, cell transduction, PCR, FACS, and microscopy.
- image analysis, including assisting with small-animal PET imaging experiments, data processing, and data analysis.
- participation in weekly group meetings, to present and discuss the data and subsequent experiments.
- critical reading of the literature, including gathering additional information relevant to the current project.

The undergraduate student will be working in a highly collaborative environment, and will be working with chemists, biologists, physicists, and imaging experts, who will be available to assist with questions or problems that arise.

*David Mankoff*

**Project: Molecular and Metabolic Imaging of Breast Cancer**

Our research focus on the application of positron emission tomography to study breast cancer metabolism with the goal of identify factors mediating therapeutic resistance and identifying opportunities for metabolically-targeted treatments. Our research focuses on imaging studies of glucose and glutamine metabolism in tumors. Our research is broad and multidisciplinary, ranging from pre-clinical animal and animal imaging studies of breast cancer models, to clinical studies in breast cancer patients. Students would have an opportunity to work in a biology lab on the pre-clinical work, on image analysis and kinetic modeling a computer lab, or in clinical research in data management and study coordinator. Combinations of different areas of focus is also possible.

*Peter Noël*

**Project: Advanced CT imaging for assessment of treatment success**

Computed tomography (CT) serves as a workhorse in many clinical settings throughout the world. Contrast-enhanced CT is a standard imaging technique for detection and characterization of many diseases. The Laboratory for Advanced Computed Tomography Imaging is dedicated to developing next-generation x-ray and computed tomography solutions.

[Return to top of document](#)

[\*Return to top of document\*](#)

In this project, the student will be part of evaluating novel imaging concepts. Under the supervision of the PI and other lab members, the student will learn how to design and perform an entry level experiment with a CT scanner; for example, a topic could be tracking the temperature of a tissue. After image acquisition, the student will use standard software tools to analyze the collected data. Every step will be done as a team, and no prior research experience will be necessary. The student will learn basic academic skills on how to conduct experimental research in the domain of biomedical imaging. Interest in imaging and or software development is a plus.

***Chamith Rajapakse***

**Project: Radiology Applications**

We have various projects related to Radiology, Orthopaedics, Cardiology, Oncology, 3D printing, Artificial Intelligence, and Augmented Reality, and more. These projects span multidisciplinary topics including collaborations with faculty at various Departments in Medical School, SEAS, College, Wharton, and Dental School. No experience is needed and training will be provided. Preference will be given to students intending to apply for medical school and/or academic careers and who are interested in continuing the research beyond summer.

***Ravinder Reddy***

**Project: Human Brain Imaging**

This project involves analyzing 3D Brain GluCEST, MR spectroscopic and functional imaging data acquired from our 7T scanner from control subjects as well as subjects with some neurological disorders such as epilepsy, schizophrenia, addictions etc. using existing MATLAB based post processing packages and tabulate regional differences based on analysis of data from regions of interest (ROIs) (prescribed manually or automatically).

Requirements:

Additionally, this project would involve correlating/comparing these results from multiple subjects. The student is expected to collaborate with clinical research professionals during this project. Specifically, the student is expected to gain rudimentary understanding of MRI and statistical data analysis skills at the end of this project.

Responsibilities:

[\*Return to top of document\*](#)

[Return to top of document](#)

Generally, the student is expected to gain valuable analytical skills as well as get a good understanding of challenges and rewards associated with research in the development of imaging biomarkers. The student is also expected to gain valuable teamwork experience working with both basic scientists and clinical scientists.

*Mark Sellmyer*

**Project: Molecular and Cellular Technologies Lab : Synthetic Biology Approaches to Imaging**

We develop molecular systems using principles of synthetic biology which allow cells to report on the activities of other nearby cells. This approach, termed cell-based diagnostics, is especially exciting with the recent advances in modern cell-based therapeutics such as CAR-T cells.

For example, we developed a first-in-class technology to report when two cell populations interact or come into close proximity in an animal using bioluminescent imaging. The “proximity reporter” is based on a caged luciferin and sequential enzyme catalysis. Reporter cells nearest to activator cells that encode beta-galactosidase are exposed to higher local concentrations of luciferin – resulting in a higher bioluminescent signal.

(<https://www.med.upenn.edu/sellmyerlab/research.html>) We used the proximity reporter to find sites of immune surveillance in a metastatic breast cancer model that would have otherwise escaped conventional imaging techniques. Our work was highlighted in *Science* and *Nature Methods*, and was an important milestone in developing synthetic biology tools to observe cellular interactions in vivo on a whole animal scale. We are currently working on the next generation tools for imaging the immune system and its relationship to cancer and infection.

Your role would be to learn and perform basic tissue culture of human cells, transfections of DNA plasmids into cells to express engineered genes, and test the function of those genes using imaging assays including microscopy, flow cytometry, and bioluminescence imaging. All of this would be done with support of a grad student or post-doc.

Basic biology course work and some understanding of genetics / molecular biology are the prerequisites.

This project is hoped to build into a multi-year effort in the lab for undergraduates who are interested in Graduate School or Medical School and who understand that sustained endeavor (and publication) in one area reflects well on those applications. Happy to talk more if you have questions.

[Return to top of document](#)

## SURGERY

*Pavan Atluri*

**Project: Heart Remodeling: Improving Recovery**

Heart failure therapies have undergone massive changes in recent times, one of the most significant of which is the use of mechanical circulatory support as a means of inducing cardiac recovery. Left ventricular assist devices take blood from the left ventricle and transmit it to the ascending aorta, relieving the workload of the left heart and supporting the circulation. It was discovered that in selected patients, these devices can be used to recover cardiac function. The mechanisms of how this happens could lead to new therapeutic targets. We have an animal model of cardiac recovery in mechanical unloading and will be examining protein expression of key calcium handling proteins and proteins which regulate cell structure, to correlate with physiological changes at the organ level. Specifically, the student would be involved in a project examining protein expression changes related to calcium handling in a model of mechanical unloading and recovery. Some experience with basic lab techniques would be ideal but is not required.

*Christian Bermudez*

**Project: Long term outcomes of patients supported on VA ECMO for cardiogenic shock and cardiac arrest**

To assist in all the steps of data collection , analysis and manuscript preparation of a review of patients supported on VA extracorporeal membrane oxygenation for cardiogenic shock and cardiac arrest at a major academic center (HUP)

*Daniel Lee*

**Project: Surgeries: Reducing complications and Opioid use**

Project 1:

Complex surgical procedures for malignancies often have high complication rates and readmission rates. Any intervention that could provide more information and data about these patients, help us analyze who would be most at risk for complications, and provide a method for

earlier intervention could reduce readmissions, visits to the Emergency Room, length of stay, and costs of care significantly.

For this project, we would use wearable technology for patients undergoing complex surgical procedures with high complication and morbidity rates to track user-generated data, such as steps taken, weight loss, and hours of sleep. This data has not been systematically characterized or tested in the post-surgical or oncologic population, where the majority of patients are elderly, malnourished, and physically debilitated. The data and intervention infrastructure developed by working with the most complex surgical procedures can then be tested to assist elderly patients undergoing any surgical procedure or with any malignancy.

#### Project 2:

In 2016, opioid use disorder affected 2.1 million people and caused over 42,000 deaths; 17,000 of which involved a prescription opioid. Surgeons are at the center of this problem; of patients on long-term opioids, almost one-third had their initial opioid prescription from a surgeon.

Our objective in this proposal is to evaluate a novel, non-opioid protocol after robot assisted radical prostatectomies (RALP). The Division of Urology at the University of Pennsylvania Health System (UPHS) is initiating a prospective study to reduce opioid use called the Preventing Excess Narcotic Use in New Discharges (PENN) Initiative in October 2018. Our central hypothesis is that the PENN Initiative non-opioid protocol will decrease unnecessary opioid prescriptions, while maintaining equivalent pain control. Thus, we are proposing a pilot study to accomplish the following aims:

#### Objectives/Aims:

- 1) To evaluate variation in opioid prescription practices after RALP among urologists at UPHS by investigating opioid dispensary data from the Pennsylvania Prescription Drug Monitoring Program (PDMP) before the PENN Initiative
- 2) To measure the percent of opioid prescriptions issued and utilized after implementation of the PENN Initiative non-opioid protocol
- 3) To measure the patient reported pain scores between those who were on the PENN Initiative non-opioid protocol compared to standard practice

*Christopher Long*

**Project: Assessing Adequacy of Penile Curvature Correction in Pediatric Hypospadias Repair**

Hypospadias is the 2nd most common birth defect in boys, occurring in approximately 1:250-300 births. The diagnosis is based upon a triad which includes dorsally hooded foreskin, and ectopic urethral meatus, and penile curvature. Surgical reconstruction is performed to improve both function and cosmesis for these boys. The most effective mechanism for correction of penile curvature has not yet been elucidated. Penile curvature that is not corrected properly in childhood are at risk for development of recurrent penile curvature as an adult, resulting in significant morbidity and often requiring several procedures to correct the issue. This project will focus on properly assessing the degree of curvature, identifying the ideal approach to correction, and parameters that determine a successful repair.

As a summer research assistant you will be a part of an active research program within the Division of Urology at the Children's Hospital of Philadelphia (CHOP). You would be responsible for collecting patient data and measurements. You will also participate in database management and data assessment in addition to statistical analysis. This project will require a full time commitment Monday through Friday during normal business hours. Opportunity for continuation of this project as well as additional projects would be an option for an interested individual. This project is structured such that a properly motivated student could travel to and present their work at a national meeting as well as prepare a manuscript for publication.

The lead on this project will be Christopher Long, MD in the Division of Urology at CHOP. There will be opportunity to work with all 11 pediatric urology faculty members at CHOP as well as our resident team and fellows. This experience will provide an excellent opportunity to develop first-hand experience in a medical field for individuals seeking a health care related profession after completing your undergraduate studies. Opportunity will exist for continuation beyond the summer months on this project and others depending on the student's interest level.

## **Nursing**

### **BIOBEHAVIORAL HEALTH SCIENCES**

*Ariana Chao*

#### **Project: Binge Eating and Neural Treatment Outcomes**

I am currently conducting a randomized clinical trial examining how brain responses to food change before and after cognitive behavioral therapy for binge eating disorder. In this study, participants will be randomized to either a 16-week, one-on-one, cognitive behavioral therapy intervention or to a wait-list control. Both groups will have functional magnetic resonance imaging (fMRI) scans at baseline and after 16-weeks. Research procedures include 16 weeks of cognitive behavioral treatment; study-related medical examinations and two fMRI brain scans.

This study will provide a rich clinical research experience for undergraduate researchers interested in obesity, eating disorders, neuroscience, and intervention development.

The undergraduate researchers, under the supervision of Dr. Chao, will have the opportunity to be involved in a wide range of research experiences. These include:

- Helping to prepare IRB materials;
- Building a REDCap database;
- Recruiting participants;
- Conducting phone screens;
- Performing vital signs and measuring weight;
- Observing fMRI scans;
- Completing data entry;
- Creating study treatment materials;
- Assisting with abstracts and publications.

*Nancy Hodgson*

#### **Project: The Role of Palliative Care Interventions to Reduce Circadian Rhythm Disorders in Persons with Dementia**

This project has three aims:

1. The immediate (at 1 month) and sustained (at 4 months) effect of the Healthy Patterns activity intervention on Persons with Dementia (PWD) quality of life and Circadian Rhythm Disorder (CRD) symptoms.

[Return to top of document](#)

Hypothesis 1a. Compared to control group participants, PWD receiving the intervention will demonstrate quality of life, total sleep time, nocturnal wake after sleep onset, day/night sleep ratio, and neuropsychiatric symptoms at 1 month.

Hypothesis 1b. Compared to control group participants, PWD subjects receiving the intervention will demonstrate quality of life, total sleep time, and neuropsychiatric symptoms at 4 months.

2. The immediate (1 month) and sustained (4 months) effect of the Health Patterns activity intervention on caregiver outcomes.

Hypothesis 2a. Compared to control group participants, caregivers who have received the intervention training will demonstrate quality of life, burden, confidence in using activities, and sleep disruption at 1 month.

Hypothesis 2b. Compared to control group participants, caregivers who have received the intervention training will demonstrate quality of life, burden, confidence in using activities, and sleep disruption at 4 months.

3. The mediating effect of neuroendocrine activity on changes in CRD symptoms.

Hypothesis 3. CRD symptoms will be mediated by changes in diurnal cortisol from baseline to 1 month.

The PURM fellow will learn the following skills: 1) completing training in human subjects research; 2) learn principles of clinical research; 3) learn to use data capture software (REDCap); 6) develop interpersonal skills with older adults suffering from dementia; 7) conduct literature reviews and contribute to grants and publications.

## **FAMILY & COMMUNITY HEALTH**

*Jose Bauermeister*

### **Project: LGBT Health Research Through mHealth Applications**

The Penn Program for Sexuality, Technology & Action Research (PSTAR) is looking for PURM research assistants interested in working in several technology-driven research projects focused on HIV prevention and LGBT health. Housed within the School of Nursing, our scholarship advances health promotion and disease prevention through technology-assisted research and intervention methods, and informs strategies to decrease sexuality-related disparities using community engagement principles. We integrate biomedical, behavioral and social science with culturally appropriate health promotion strategies to improve the health of diverse communities.

[Return to top of document](#)



[Return to top of document](#)

Research assistants will work under the guidance of PSTAR faculty and research personnel on several on-going research projects (see PSTAR website for details of different projects underway).

Mentored research tasks include, but not limited to:

- Assist with quantitative and qualitative data analyses from existing and on-going projects.
- Assist with data cleaning, organization, and generating data reports from survey and social media data.
- Assist in other research activities such as drafting study documents, conducting literature reviews, preparing presentation documents, and participating in team meetings and trainings.
- Participate in the development and user testing of the mHealth applications focused on HIV prevention and care,
- Collect, verify, and maintain accurate directory information via web, mailings, and phone calls to organizations providing mental health, sexual health, and social support services to sexual and gender minority young people which will be delivered via a mHealth intervention.

Qualifications:

- Strong interest in LGBTQ health and/or HIV prevention
- Reliable and responsible, with a sharp attention to detail
- Ability to work collaboratively and incorporate and translate feedback into their work products
- Interested in working with diverse experiences and backgrounds
- Able to communicate appropriately and effectively with team members

*Dalmacio Flores*

**Project: Sex Talk to Empower Parents: Parents as HIV/STI Prevention Agents for Gay, Bisexual, and Queer Adolescents Males**

Gay, bisexual, and queer (GBQ) adolescent males are disproportionately affected by negative sexual health outcomes such as HIV and STI infections compared to their heterosexual counterparts. Their sex education needs are not sufficiently addressed in the home and throughout the larger ecological systems. The omission of their sex education needs at a time when they are forming a sexual identity during adolescence compels GBQ males to seek information in unsupervised settings. Evidence-based interventions aimed at ensuring positive sexual health outcomes through sex communication cannot be carried out with GBQ youth as research on how parents and GBQ males discuss sex in the home has been largely uninvestigated. This naturalistic qualitative study will focus on the interpretive reports of parents of GBQ males' discussions about sex-related topics in the home. The study will provide the foundation for an intervention to help parent-child dyads to effectively inform their gay,

[\*Return to top of document\*](#)

bisexual, or queer sons about how to reduce their chances of being infected with HIV and other STIs.

Students will receive training in data clean-up and qualitative data analysis using the software NVIVO. Students will work closely with me to code interview transcripts and generate categories, study thematic patterns in parents' responses, and prepare manuscripts for publications. This summer research experience will familiarize the student with data management and conducting a literature review. This position provides an opportunity to prepare conference presentations and publish with the research team. There are also opportunities to assist/facilitate in focus groups involving parents of GBQ youth. Student applicants must be detail-oriented, highly organized, and proficient in MS WORD. Applicants with a commitment to health equity are encouraged to apply.

*Melanie Kornides*

**Project: Legislative changes in US states to increase HPV vaccination**

In this project, you will work with Dr. Kornides to create a data set of the state by state legislative policies enacted over time to increase HPV vaccination. Using information obtained from the National Conference of State Legislatures, you will extract and code data on different types of legislation passed in each state from 2006 to 2018. You will be included as a co-author on the paper produced from the data set. Academic and professional skills you will gain include experience in Microsoft Excel, data extraction, creating an analytic data set, as well as content expertise in HPV vaccination, and academic research experience in analysis, manuscript writing and publication. This project is ideal for a student interested in public health research, vaccination policy, reproductive health, cancer prevention, and/or adolescent health.

[\*Return to top of document\*](#)

## **Social Policy and Practice**

### **NONPROFIT MANAGEMENT AND LEADERSHIP**

*Femida Handy*

#### **Project: Exploring Volunteer Motivations in Vietnam**

The primary goal of this research project is to explore volunteer practices and motivations among individuals in Vietnam. Although many scholars have examined various aspects of volunteer motivation, few have looked at the phenomenon in Vietnam, and the majority of the literature focuses on western countries. Researchers are particularly interested in exploring how and why individuals choose to volunteer and what motivates them to continue to volunteer, given the high levels of government service provision that is present in Vietnam.

To begin to address this gap in the literature, the study aims to provide a clearer picture of volunteering in Vietnam through the implementation of an online survey of volunteers with the help and support of locally-based NGOs and other agencies. Translated to Vietnamese by a co-investigator, this survey will both strengthen the scholarship on this topic and inform future policy and decision-making with regard to international nonprofit and voluntary sector development. The survey contains standard questions about frequency and type of volunteering, motivations to volunteer, and basic demographic questions, such as age, gender, and household income. I have used a similar instrument in past research on volunteering in India and other contexts. The questions, however, are tailored to accommodate cultural differences.

The survey instrument includes a commonly used and widely validated scale to measure volunteer motivation known as the Volunteer Functions Inventory (VFI) (Clary and Snyder, 1999). The target population for the survey is adults (ages 18 and older) in Ho Chi Minh City who have participated in volunteer activities. Research team members have worked with local agencies to identify potential survey respondents who meet these criteria and shared access to the survey with these individuals. The sample size is 500 respondents. The survey received IRB approval and was administered online.

#### Student engagement

The student will review the initial literature survey done, and update it with missing sources. The student researcher will learn how raw data files must be transformed so that the data are in a form that can be used for presentation and analysis. The student will also gain hands-on experience with data analysis. In particular, s/he will work with survey data and become more comfortable with both quantitative and qualitative responses. This project will give the undergraduate a much-needed opportunity to learn how researchers conduct mixed-methods

research and analyze both types of data (qualitative and quantitative). In addition, I will involve the student with some of the writing up of the results.

If the student is interested in pursuing this project further after the end of the PURM, I will invite him or her to be a co-author of this paper. And, as I have done before with Mr. Calvin Jennings, who was assigned to me on a PURM when he was an undergraduate at Penn (Jul 2014) for the project entitled: Social innovation in nonprofit organizations, I will recognize the student's contribution as a co-author on the study.

## **SOCIAL WORK**

*Jacqueline Corcoran*

### **Project: Low-Income Women and Depression: 1. Prevalence in the U.S. and 2. Depression in African-Americans & Latinas**

Background:

According to the Substance Abuse and Mental Health Services Administration (2017), low-income women have the highest prevalence of depression at 19%. Depression is associated with increased risk for anxiety disorders, sleep disturbance, substance abuse, smoking, obesity, cardiovascular disease-related mortality, and suicide (CDC, 2016). Depression in mothers is also a risk mechanism for child depression and other mental health disorders (Goodman, 2007; Hammen, Brennan, & Keenan-Miller, 2008). Low-income mothers and especially African-American and Latina mothers are less likely to have treatment for depression (Kozhimannil, Trinacty, Busch, Huskamp, & Adams, 2011).

Rationale:

PROJECT 1: Systematic review and meta-analysis on prevalence of depression in low-income women.

Prevalence rates for low-income women in the U.S. are high and have ranged in studies from 15.5% to 25.1% (Corcoran, Danziger, & Tolman, 2004). A systematic review including meta-analysis (a statistical method used to quantitatively pool the results of studies) would be able to estimate with more accuracy the rate of depression in this population and along with it, sources of variance, such as ethnicity and region of the U.S.

PROJECT 2: Experience of depression and effectiveness of treatment for African-American and Latina low-income women: Systematic reviews separately conducted on the lived experience of

African-American and Latina low-income women's experience of depression will inform the field of each ethnic group's unique views on attributions for depression, coping mechanisms, and opinions and perspectives about treatment. Meta-synthesis, a qualitative methodology to synthesize results of qualitative studies, will be used. Additionally, meta-analysis will be used to understand the effectiveness of psychosocial depression treatment for these populations.

Student's Role:

A student's role would involve the following tasks:

PROJECT 1:

1. searching for studies in relevant library databases with a predetermined criteria
2. screening titles, abstracts, and full-text articles of studies located through the search and organizing them in an Excel spreadsheet
3. extracting relevant methodological characteristics, demographic characteristics, and statistical findings from studies that meet the criteria
4. entering statistical information in a meta-analysis computer program (Revman)
5. preparing tables for presentation of data

PROJECT 2:

1. Preparing tables of the methodological details of studies
2. Preparing tables of the qualitative analysis
3. Entering the statistical information from the treatment outcome studies in a meta-analytic computer program (Revman)
4. Preparing tables of the results

Students will gain knowledge and skills associated with conducting systematic reviews, which are considered the highest level of research evidence in medicine and related fields. More specific skills for the student will involve library search and retrieval skills and familiarity with meta-analysis and qualitative analysis. The student will also gain knowledge of the experience of depression and the effectiveness of depression treatment for low-income and ethnic minority women. Publication authorship is a possibility depending on the scope, duration, and quality of work.

Prerequisites:

Logical and detail orientation

Interest in topic area

Interest in learning how to read and understand academic studies

Able to work independently and to deadlines

[Return to top of document](#)

*Yin Ling Irene Wong*

**Project: HIV/AIDS Knowledge, Risks, and Stigma among People with Mental Disorders in Rural China**

Research across nations consistently found that persons with mental disorders are vulnerable to HIV infection. Although attention has focused on assessing HIV risk behaviors and implementation of prevention programs in various high-risk groups in China, no such effort is found in persons with mental disorders. This project seeks to: 1) assess knowledge and awareness of HIV/AIDS and HIV-related risk behaviors; 2) examine HIV-related stigma and discrimination, and internalized stigma of mental illness; 3) document the degree to which levels of knowledge and awareness of HIV/AIDS, HIV-related risk behaviors, HIV-related stigma and discrimination, and internalized stigma vary by psychiatric diagnosis; and 4) examine the association between HIV-related stigma and discrimination and internalized stigma of mental illness.

Data collection will take place in a rural county of Sichuan Province. The PURM student will engage in fieldwork in the study site for 1-2 weeks. During the fieldwork phase, the student will work as a member of an interdisciplinary team of researchers from Penn, The University of Hong Kong, and Icahn School of Medicine at Mount Sinai to conduct interviews using a standardized survey. After the fieldwork phase, the student will participate in analyzing and writing-up the study data.

The PURM student will learn the following knowledge and skills: 1) review of theoretical and empirical literature; 2) data collection; 3) collaboration with community stakeholders, including administrators and healthcare providers; and 4) data analysis using statistical software.

Fluency in written and spoken Chinese (Mandarin/Putonghua) is preferred, but not required for this project.

## **SOCIOLOGY**

*Pilar Gonalons-Pons*

**Project: The Persistent Feminization and Devaluation of Care Work**

This project proposes the first comprehensive and comparative analysis about the feminization and devaluation of caregiving across high-income countries and care domains –paid and unpaid caregiving for children and the elderly. Drawing on comparative gender regimes literature and bridging studies on unpaid caregiving and paid caregiving, this project proposes a new

[Return to top of document](#)

framework to study caregiving as a system. This includes a new set of harmonized indicators to measure the feminization and devaluation of caregiving across all care domains and across countries.

Students who have an interest in topics about social inequality, gender inequality, or family relations (gender pay gap, parental leave, economic inequality), this project is for you! I will set up two research teams, one focused on policy research and the other focused on quantitative research.

Students can become involved in different components of this project. Students who are beginning their research experience will be involved in tasks that include bibliographic review and policy research. Students with background in quantitative research (experience programming in STATA or R) will be involved in work with survey data to calculate feminization and devaluation indicators.

Students in each team will be expected to work together and to help one another. Because tasks at hand are complex and require multiple skills, students with varying and different strengths will be able to rely on and learn from each other.

We will meet weekly one hour with each team. Meetings will be devoted to revise work, answer questions and challenges, and set goals for the following week. I will advise both teams of undergraduate students with the help of a graduate student, who will provide special support to the quant team. Whenever possible, I will encourage students to set a schedule and work together in the same space (i.e. the social sciences computing lab).

Students will gain a unique experience that develops a set of highly valuable skills. The policy team will be able to obtain skills in policy analysis and archival research skills. Students will learn how to digest and synthesize key dimensions of policies. Students will learn work processes to record, store, and categorize information from multiple data sources; and to do so in a way that it is transferable to others. The quant team will obtain hands-on experience on data preparation and analysis, also expertise using statistical analysis software Stata and R. Both sets of skills will improve students' chances of getting into graduate school or getting jobs in data science.

## **Veterinary Medicine**

### **BIOMEDICAL SCIENCES**

*Montserrat Anguera*

#### **Project: Mechanisms of X-chromosome Inactivation in immune cells and stem cells**

Females mount stronger immune responses and clear pathogens faster than males, yet they are more susceptible to autoimmune and inflammatory disorders. One important biological factor underlying this sex bias is the X-chromosome, which is enriched for immunity-related genes. Female mammals use X-Chromosome Inactivation (XCI) to equalize gene expression between the sexes, which generates a transcriptionally silent inactive X-chromosome enriched with heterochromatic modifications and the long noncoding RNA Xist. We have discovered that mature naïve T cells are missing Xist RNA and heterochromatin marks on the inactive X (Xi), and these marks return to most cells with in vitro stimulation. We have a number of projects in the lab to investigate mechanisms of XCI in other immune cells besides lymphocytes, including adult stem cells. Students will learn how to isolate and culture distinct cell populations, and perform microscopy to image the long noncoding RNA XIST in nuclei.

*Frank Luca*

#### **Project: Investigating Ndr kinase function in retina and vascular development**

Ndr kinases are conserved subfamily of tumor suppressor protein kinases that function as important regulators of cell growth and cellular morphogenesis. Recently, a mutation in canine Ndr2 gene was shown to cause retinal degeneration and blindness in young dogs. Our lab developed Ndr1 and Ndr2 single knockout mice mouse to investigate the molecular mechanisms of Ndr kinases in retina development and maintenance. The project involves working closely with a postdoctoral associate to investigate how Ndr deletion affects retinal neuron and vasculature development and maintenance. The student will assist with mouse strain genotyping (via PCR strategies) and phenotype analysis via immunofluorescence microscopy and immunoblot methods. Candidates must have a basic knowledge of cell and molecular biology.



## CLINICAL STUDIES NEW BOLTON

*Bernd Driessen*

**Project: Effects of flumazenil on respiratory parameters and quality of recovery when administered to anesthetized horses**

Respiratory dysfunction and potentially fatal musculoskeletal injuries are serious complications in horses recovering from general anesthesia. In part, use of benzodiazepine-type centrally acting muscle relaxant drugs (e.g., valium) is responsible for these adverse outcomes. Flumazenil is a drug that can reverse benzodiazepine effects. The objectives of this project are to determine the effects of post-operative flumazenil administration on (1) inspiratory function and pulmonary gas exchange in horses waking up from anesthesia and on (2) the quality of recovery from anesthesia. This is a prospective, randomized, blinded, crossover study. Horses will be placed under general anesthesia, and the effects of flumazenil on breathing and recovery from general anesthesia will be analyzed. The purpose of this study is to justify the use of flumazenil as a tool for improving respiratory parameters and recovery quality of horses after general anesthesia.

The student will work under direct supervision of the primary investigator (Hope Douglas, VMD, DACVS and anesthesia resident) and the faculty mentor (Bernd Driessen, DVM, PhD, DACVAA). The student will participate in a live-animal study using the horse as study subject, thereby gaining valuable experience in experimental study design. The student will assist with preparing experimental animals for anesthesia, installing data collection devices, and setting up and function testing of other experimental equipment. S/he will also be involved in data collection with subsequent data processing including tabulation and basic statistical analysis, and eventually data preparation for publication.

By participating in this project, the student will be working directly with board-certified veterinary specialists. The position would be ideal for a student interested in pursuing a career in medicine/veterinary medicine. No previous research experience is required. The student would be responsible for his/or her own transportation to and from New Bolton Center.

*Kyla Ortved*

**Project: Investigation of the effects of AAV-mediated overexpression of IL-10 on the immunomodulatory properties of equine MSCs**

The objective of this proposal is to investigate the immunomodulatory properties of equine bone marrow-derived mesenchymal stem cells (eBM-MSCs) transduced with an adeno-associated

virus (AAV) that overexpresses interleukin-10 (IL-10). Following traumatic injury of articular cartilage, joint degeneration and subsequent cartilage breakdown occur resulting in post-traumatic osteoarthritis (PTOA). IL-10 is a potent immunomodulatory cytokine that displays wide-reaching anti-inflammatory effects that work to regulate the inflammatory cascade. Interestingly, IL-10 has also been shown to have protective effects on the extra-cellular matrix (ECM) of hyaline cartilage, mainly type II collagen. Mesenchymal stem cells (MSC) have been intensely investigated over the past decade as a potential cell-based therapeutic for treating focal cartilage lesions and generalized joint damage. MSCs modulate expression of pro-inflammatory cytokines, suppress T-cell proliferation, recruit endogenous progenitor cells and stimulate differentiation of these cells. In attempts to bolster the immunomodulatory properties of MSCs, researchers have used gene transfer of a variety of different genes. Adenoviral transduction of MSCs with overexpression of IL-10 in a murine model has shown promising results of improving the immunomodulatory properties of cells. Due to the possible synergistic effects of MSCs and IL-10, we seek to evaluate the immunomodulatory properties of equine MSCs transduced with an adeno-associated virus (AAV) vector overexpressing on joint inflammation. In order to address this objective, we propose two specific aims:

- 1) evaluate the immunomodulatory properties of eBM-MSCs overexpressing IL-10 using a T-cell proliferation assay and mixed leukocyte reaction
- 2) investigate the protective effects of eBM-MSC overexpression of IL-10 on cartilage explants stimulated with IL-1b/TNF-a in an in vitro model of OA.

We hypothesize that eBM-MSCs transduced with AAV overexpressing IL-10 will show superior suppression of T-cell proliferation compared to untransduced eBM-MSCs and that cartilage explants co-cultured with transduced eBM-MSCs will be protected from IL-1b induced degradation in an in vitro model of OA. This study holds great promise as the inherent immunomodulatory properties of eBM-MSCs could be significantly increased through vector-mediated overexpression of IL-10, thereby, creating an intra-articular therapy that could be used to effectively decrease posttraumatic inflammation and the development of PTOA.

The student would be involved in cell culture, viral vector transduction of cells and analysis of cartilage explant cultures including supernatant cytokine quantification using ELISA and histological evaluation of cartilage. Students interested in molecular biology, gene therapy, musculoskeletal research and cell culture would benefit greatly from this study. Students interested in veterinary medicine are also highly encouraged to apply. Students will be fully mentored by the PI and the lab manager, Renata Linardi, DVM, PhD. The student would be responsible for his/or her own transportation to and from New Bolton Center.

*Thomas Parsons*

**Project: Neonatal Piglet Behavior and Welfare Research**

The swine group at the School of Veterinary Medicine, University of Pennsylvania is seeking a highly motivated individual to join us for a summer research internship at the Penn Vet Swine Teaching and Research Center located on the New Bolton Center campus in nearby Kennett Square, PA. The internship position provides a unique opportunity for someone interested in animal behavior and welfare and working with animals to learn skills related to behavioral research. The behavior of neonatal piglets is being examined to identify opportunities for the improvement of animal welfare. During this internship the student will carry out in-depth studies of video recorded piglet behavior for subsequent quantitative analysis. The student will also have the opportunity for hands on work with pigs on our research farm as well as weekly journal clubs with the researchers on our team. These experiences promise to provide unique insight in to animal agriculture of today and tomorrow as Penn Vet Swine Group has been a leader in the establishment of on-farm welfare-friendly practices both here and abroad. The student would be responsible for his/or her own transportation to and from New Bolton Center.

*Dipti Pitta*

**Project: Understanding the role of archaea in methanogenesis across anoxic environments**

About 2% of net CO<sub>2</sub> that is fixed annually into biomass by photosynthesis ends up primarily as methane (CH<sub>4</sub>) that accounts for 14% of total global greenhouse gas (GHG) emissions and is 28 times more potent than CO<sub>2</sub> (IPCC, 2014). Approximately 1 billion tons of methane is formed per year globally by methanogenic archaea in anoxic environments such as freshwater sediments, swamps, paddy fields, landfills and the intestinal tracts of ruminants and termites. Methanogenic archaea account for only a small portion of the microbiota and are at the terminal end of the microbial chain serving as sinks for hydrogen that is released by anaerobic bacteria, protozoa and fungi during biomass fermentation indicating that syntrophic interactions between bacteria and archaea is fundamental to methanogenesis in anoxic environments. Knowledge on syntrophic interactions between bacteria and archaea leading to methanogenesis is sparse and is needed to develop novel methane mitigation strategies. In contrast, syntrophic associations between bacteria and archaea drive the conversion of biomass to biogas (CH<sub>4</sub> and H<sub>2</sub>) in anaerobic digestors (AD) that can be used as an alternative source of energy. Although, different substrates can be used in AD, energy generation is microbial driven and is dependent on methanogenesis revealing that syntrophic associations between bacteria-archaea are critical to enhancing methanogenesis and anaerobic digestion. The goal of this project is to determine methanogenesis

[Return to top of document](#)

pathways and identify the syntrophic bacteria-archaea cohorts and their contribution to methanogenesis using contrasting anoxic environments.

The student would be responsible for his/or her own transportation to and from New Bolton Center in Kennett Square, PA.

## **CLINICAL STUDIES PHILADELPHIA**

*Cynthia Otto*

### **Project: Canine Detection of Medical Conditions**

Dogs have an incredible sense of smell. That sense is being harnessed to help diagnose human disease, not only cancer but infections and hard to diagnose medical conditions. Students that will participate in this project will have the opportunity to learn all aspects of study design, data collection, data analysis and writing up reports. The students will assist the team (Dr. Essler - post doctoral fellow, Dr. Ramos - MTR fellow and Dr. Otto - director) in the canine detection program. This responsibility will include organizing and preparing samples for the dogs' training and testing. Recording results of the testing. Reviewing behavioral videos. There will be limited dog training involved, although depending on the interest and the skill of the student this could be increased. Students interested should be comfortable around big dogs, be detail oriented, work independently and reliably, be familiar with excel spreadsheets and data entry. A basic understanding of animal behavior is helpful but not necessary (you will be immersed in it). The student(s) who complete the experience will have learned how to design and trouble shoot basic olfactory research studies, they will learn about canine behavior and the medical conditions being studied. They will gain a sense of pride in advancing human health through the amazing talents of dogs.

*James Serpell*

### **Project: Determining the Reliability of a New Feline Behavioral Assessment Method**

The Fe-BARQ (Feline Behavioral Assessment and Research Questionnaire) is an online survey developed at Penn Vet that allows cat owners to provide quantitative evaluations of their cat's behavior in response to various common situations and stimuli (Duffy et al., 2016). It is designed to be used as a research tool and as a means of screening cats for the presence of major behavior problems, and can be accessed at: [www.febarq.org](http://www.febarq.org).

[Return to top of document](#)

### Goals of the study

1. Determine inter-rater reliability of the Fe-BARQ by asking pairs of cat owners (N=50) in the same household to independently assess the same cats. We will calculate the average percent agreement between raters for the different Fe-BARQ factors and items.
2. Determine test-retest (intra-rater) reliability of the Fe-BARQ by asking a sample of cat owners (N=50) to assess their cats on two separate occasions, one month apart. We will look at the level of consistency (correlation) between cats' Fe-BARQ scores on the two separate evaluations.

### Methods

Cat owners will be contacted via veterinary practices, and invited to participate in the study. All of the cat owners will be asked to complete an online survey describing their cat's behavior. Half of the original participants (one from each household) will be invited at random to complete the same survey again approximately 1 month after initially completing it.

### Timeline and outcomes

There is no specific timeline for the completion of the project, but ideally it should be completed over the Summer. The intent would be to publish the results in an appropriate scientific journal, in which case the student assistant would be included as an author (preferably as lead author depending on his/her contribution to the analysis of findings and to article preparation). In addition to having their name on a published paper, students will gain experience in behavioral research methods, basic statistical analysis, and the preparation of scientific publications.

### Prerequisites

Applicants for the position should be self-motivated, well-organized, and willing to interact with study participants via phone and email. Experience using Microsoft Excel and statistical software (JMP, SPSS, STATA, R or similar) would also be helpful.

## PATHOBIOLOGY

### *Molly Church*

#### **Project: Comparative pathology investigations**

Veterinary anatomic pathology is a discipline that bridges veterinary and human medicine through the study of diseases of companion animals, wildlife, livestock, and laboratory animal

models. Veterinary pathologists are at the forefront of disease surveillance and discovery, having been instrumental in detecting outbreaks of zoonotic diseases like West Nile virus. Furthermore, recent discoveries in comparative oncopathology have elucidated crucial therapeutic targets in many cancers occurring in human and canine patients. The PennVet Diagnostic Laboratory evaluates over 11,000 autopsy and biopsy cases per year. In addition to diagnostic casework, our faculty participate in collaborative and independent research projects that investigate the pathogenesis of neoplastic, genetic, infectious, and immune-mediated diseases.

The student will have the opportunity to be involved in autopsy and biopsy cases with faculty pathologists, pathology residents, and senior veterinary students, including referencing textbooks and current pathology literature to originate differential diagnoses. The student will participate in slide rounds, including ocular pathology, neuropathology, dermatopathology and weekly “unknown” cases. Additionally, the student will aid faculty and residents in ongoing research studies in the department by searching the pathology database, finding reports and slides, reviewing reports and compiling data, and processing tissue samples for molecular analyses. There will also be an opportunity for the student to participate in an independent research project with a faculty mentor and present data at the American College of Veterinary Pathologists meeting in the fall. Students from groups underrepresented in veterinary medicine are encouraged to apply.

Participating Faculty: Drs Molly Church, Amy Durham, Charles Bradley, Elizabeth Mauldin

### *Amy Durham*

#### **Project: Comparative Pathology Core at Penn Vet**

The use of mouse models of disease plays a crucial role in efforts to understand and treat disease. Assessment of experimental mouse pathology is an essential step in determining the relevance and translational potential of these animal models. At the Comparative Pathology Core (CPC), we provide expert pathological characterization and validation of mouse models used in biomedical research by offering the expertise of board-certified veterinary pathologists and access to state-of-the-art histology, immunohistochemistry, and digital pathology services.

In our project, students will have the unique opportunity to join Drs. Amy Durham, Enrico Radaelli and Charley Assenmacher of the CPC and actively take part in a variety of research activities with a focus on the pathological analysis of mouse models to study cancer and immune-related disorders. The ideal candidate should possess basic knowledge of animal biology and genuine interest for the field of biomedical research. The student will have the chance to train and work in close contact with experts in experimental pathology and engage in the following activities:

[Return to top of document](#)

- Mouse necropsy and sample preparation for pathological examination.
- Recognition and classification of fundamental pathological processes in mouse models.
- Use of molecular pathology techniques, such as immunohistochemistry and immunofluorescence.
- Application of digital pathology and software-assisted image analysis for a quantitative assessment.
- Acquisition of the basic principles for a responsible and ethical use of the mouse in the research setting.

These main goals are essential for individuals that wish to pursue a career or educational path that involves research with animal models.

*James Lok*

**Project: I've got you under my skin: molecular factors promoting invasiveness in parasitic nematode larvae**

In this project we will investigate the functions of insulin-like and steroid-nuclear hormone receptor signaling in the morphogenesis and development of infective larvae of soil-dwelling parasitic nematodes. We will do this by ablating, mutating or inhibiting two key elements in these molecular signaling pathways, the insulin-regulated transcription factor Ss-DAF-16 and the nuclear hormone receptor Ss-DAF-12 in the parasitic nematode *Strongyloides stercoralis*. Changes in behavior, development or morphology of the treated worms will provide clues to the specific functions of these elements and will help ascertain whether they are essential for invasiveness in infective parasite larvae and therefore potential targets for development of new drugs or vaccines.

Participation in this project will foster a number of professional scientific skills in our undergraduate student. These include basic laboratory methods such as pipetting and preparing molar solutions, sterile tissue culture methods, fluorescence microscopy, responsible data gathering and recording, computational statistical and graphic analysis of data, and written and oral communication of results and their interpretation. Our student would be encouraged to attend lab meetings, journal clubs, and to give a brief presentation of findings from the summer project in a joint lab meeting in Dr. Lok's department. Candidly, we hope to make a "convert"!

This project will be most appropriate for an undergraduate major in Biology or some other aspect of biomedical science. One crucial requirement will be for the student to complete online and live training in laboratory safety presented by EHRS, the Office of Environmental Health and Radiation Safety. In particular, the introductory session for EHRS lab safety training is only offered at certain times and students interested in this position must make a point of attending one of these before they can start work in the lab. Interested students should visit the EHRS

[Return to top of document](#)

training website <https://ehrs.upenn.edu/training/training-dates> and register for the Spring 2019 session of “Lab Safety Training for Summer Students” using the appropriate link.

*Jennifer Punt*

**Project: CANcer, ImmuNity and Education (CANINE): Understanding the role of IGF1 in immunity and cancer**

Companion dogs have become valuable collaborators in translational research. They share our home environments, our diseases and our responses to drugs. They also exhibit a variation in size that is largely due to differences in gene expression of the insulin like growth factor (IGF1). High levels of IGF1 not only correlate with size, but also with shorter life spans and, in some human studies, with cancer susceptibility. While the influence of IGF1 on health is likely to be complex, it appears to have direct effects on immune cell activity, a topic of interest to us.

Last summer our research team of undergraduates identified a novel subset of canine immune expressed receptors for IGF1 (IGF1R) and made the intriguing observation that this subset shared features with a potent immunosuppressive population of neutrophils known as PMN-MDSCs, whose frequency increases in cancer patients and is associated with poor prognoses.

Our PURM student will join our team to test the hypotheses that 1) IGF1R+ immune cells inhibit rather than activate the immune system and 2) IGF1R expression is a distinct feature of PMN-MDSCs which triggers the production of anti-inflammatory molecules. All students will have complete access to four color flow cytometer and the opportunity to develop an innovative gene expression assay. We anticipate that an understanding of this ‘new’ IGF1 responsive cell will clues to the susceptibility of large dog breeds and even tall humans to select cancers.

*Dieter Schifferli*

**Project: Bacterial exosomes**

We have identified a bacterial protein in Salmonella that is activated in an infected host and induces hypervesiculation of the bacteria. We have shown that the vesicles protect the bacteria against serum-mediated killing and induce an inflammatory response in hosts. In Salmonella-mediated typhoid fever, the vesicles participate in host septic shock and death. The current hypothesis is that these vesicles protect the bacteria by acting as decoy that bind antibacterial host molecules such as complement, antibodies and CAMPs (cationic antimicrobial peptides). In order to test our hypothesis, we need to dissect the role of this new protein in the context of other

[Return to top of document](#)



[\*Return to top of document\*](#)

Salmonella virulence factors. For this project, molecular and genetic engineering methods will be taught to and used by the student such as targeted mutagenesis as well as cloning approaches for complementation and antigen purification methods.

[\*Return to top of document\*](#)

## **Wharton**

### **ACCOUNTING**

*Cathy Schrand*

#### **Project: Study of Penn Undergraduate Career Exploration Programs**

The research question of this project is: what sorts of programs will help undergraduate students make the most of their undergraduate education and prepare them for a career that they are passionate about? Students interested in education research, or social science research more generally, are encouraged to apply. The project will start with exploration of existing social science studies on self-reflection activities and career exploration. The remainder of the project will involve structured interviewing and development of a survey to evaluate opportunities for program development at Penn. This research will not study what happens in Career Services and OCR. It will focus instead on what Penn is doing to help students decide what kind of careers they desire to pursue in the first place. Applicants should be able to critically evaluate social science research and have experience in survey development. The PURM student will work directly with both Dr. Cathy Schrand and Dr. Peter Struck of Classical Studies.

### **BUSINESS ECONOMICS & PUBLIC POLICY**

*Jose Miguel Abito*

#### **Project: The Infant Formula Market and the WIC Program**

The U.S. infant formula market is a \$2.3 billion market dominated by four manufacturing firms. Due to the high cost of infant formula and the still heavy dependence of U.S.-born infants on formula (only about 25% of infant exclusively breast-fed through 6 months), the federal government established the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). The WIC program provides grants to individual states that in turn distribute vouchers to qualifying households to receive WIC-designated infant formula from retailers. A single manufacturer is designated as a WIC supplier after winning an auction ran by the state, and the voucher can only be redeemed for the winning manufacturer's product. Existing research have documented that shares of infant formula brands switch from 5 to 95% upon winning the WIC contract. Since about 50% of the market is composed of WIC households, there remains a sizeable share of non-WIC households that purchase the new WIC brand even without actually

benefiting from the subsidy. This implies that winning the WIC contract endows a manufacturer a premium despite the fact that winning in the auction has nothing to do with the product's relative quality.

The goal of the project is to measure the WIC premium, analyze how the WIC premium influences pricing behavior of manufacturers, and finally assess the impact of the WIC premium and firm behavior on consumer welfare. I am seeking two students for the project. Ideally, each student will have some experience with Stata or similar statistical software. Knowledge of ArcGIS is also a plus.

## *Santosh Anagol*

### **Project: Emerging Markets Research**

I am recruiting PURM students for two related projects. I encourage students interested in emerging markets research to apply; we will discuss assignments to specific projects based on skills and interests.

The first student will contribute to my research agenda on understanding the development of household financial markets in India, potentially including real estate, mutual funds, stocks, credit, insurance and payments (e.g. paytm). Across these sectors I am studying regulatory and business developments in these markets. Likely topics are impacts of transparency initiatives in the Indian real estate sector (RERA 2016), digitization of gold market, and others. There may also be political economy related work, such as how household wealth inequality relates to politics.

This position would be a great fit for students interested in emerging markets, looking to get exposure to the basic process of research in economics (collecting data, programming, conducting literature reviews). Students will build their practical knowledge of the household financial markets listed above.

This position requires previous R and RStudio experience at the level of STAT 405 (or higher). The tasks will primarily involve data wrangling (using tidyverse/dplyr packages to wrangle data) and data visualization (ggplot2). Please note if you have taken other R related courses (STAT 405, STAT 470, STAT 480, BEPP 280, PSCI 107, PSCI 207). There may also be some data collection and other non-R research tasks (lit reviews, etc.).

The second project is specifically related to household formation in emerging markets and is joint with Iain Mathieson (Penn Genetics): (<https://www.med.upenn.edu/mathieson-lab/>).

[Return to top of document](#)

We are studying the long-run genetic consequences of cousin-marriage—a common phenomenon around the world. Social scientists have long tried to understand why some cultures continue cousin marriage (for example in South India), while others have developed cultural norms against the practice. Key to this question is an understanding of the costs and benefits of cousin marriage. One potential cost is a reduction of genetic diversity among future generations—however, in practice, the magnitude of this reduction is not clear. Little previous research has taken advantage of modern genomic data to estimate the genetic consequences of cousin marriage.

We have assembled a dataset consisting of genetic and cultural data for several hundred worldwide populations, which we are using to investigate the effect of cousin marriage on genetic diversity.

The student's main tasks will likely include:

- 1) Identifying additional populations where both genetic data and cousin marriage indicators are available.
- 2) Converting raw genetic data to variables for analysis.
- 3) Creating visualizations of relationships between genetics, cousin marriage, and other cultural variables.
- 4) Running simple statistical models.

This project is suitable for quantitative (economics, math, statistics, physics ,CS , etc...) students who want to learn about how their skills can be applied to biomedical and evolutionary questions. Also suitable would be students with interests in biology, evolution and anthropology who want to apply quantitative methods genetics or marriage issues. Because all of our work is computational, some prior experience with programming (e.g. R or python), and statistical analysis would be helpful.

## FINANCE

*Winston Dou*

### **Project: Misallocation in Innovation**

Resource misallocation negatively affects productivity and hence economic growth. Examining the magnitude of resource misallocation and its determinants will uncover frictions that hinder the economic growth. Previous studies have primarily focused on the resource misallocation in the capital and labor market. Surprisingly, the misallocation of innovation resources are largely neglected in the extant literature. In the proposed study, we plan to build a theoretical model in

[Return to top of document](#)

which the misallocation of innovation resource slows down economic growth through three channels or layers: (1) the misallocation can lead to inefficient technological frontier, (2) the misallocation can cause inefficient catching-up of the firms with the technological frontier, and (3) the misallocation can result in the inefficient reallocation of market shares in the imperfect product market, which further inefficiently restricts firms' productivity. The layer (3) will feedback to the layer (1), and the adverse effect of innovation misallocation is amplified. Our model will also explain how frictions such as imperfect product market competition and financial constraints lead to misallocation in innovation.

We also plan to conduct empirical analysis to test the predictions of our model. We will construct a set of innovation misallocation measures based on firms' inputs (i.e., R&D expenses) and outputs (i.e., patents) of innovative activities. We will then study how imperfect product market competition affects innovation misallocation both in time series and in the cross section, and how this relation is shaped by financial constraints.

Our study is closely related to Jacobs Levy Equity Management Center's research priorities. For example, our theoretical model and empirical findings can shed light on the factors that explain the heterogeneous innovation productivities in the economy. Moreover, by illustrating the frictions that lead to innovation misallocation, our research can help policy makers promote innovative activities and improve economic growth.

## **LEGAL STUDIES AND BUSINESS ETHICS**

*Peter Conti-Brown*

### **Project: The History of the US Federal Reserve System**

The American central bank, the US Federal Reserve System, sits at the global center of finance and politics. Professor Conti-Brown, a historian and legal scholar, is writing a comprehensive political history of the Fed. Students will write research memos about specific events in Fed history, travel to archives in the United States to gather primary documents, and assist with some of the quantitative historical aspects of this project (which requires some data entry and light coding that will be explained). Students should have an interest in politics, law, history, and finance.

*Philip Nichols*

**Project: Causes of Corruption**

Most of my research focuses on corruption in emerging economies, but I am writing a paper that examines the United States. I need research assistants who can look into theories of the causes of corruption. Students will find and read articles from fields such as criminology, sociology, and psychology, and will also search other fields for possible theories. Students will also search through news sources for reports of behaviors that fit the theories. By the end of the summer students will have produced easily understandable explications of theory, and real-life examples that illustrate those theories. There are three things that students will gain from this project. (1) An understanding and experience in literature research in the social sciences. (2) A cross-disciplinary introduction to theories of misbehavior. (3) A deep examination of corruption, one of the most troubling but least talked about phenomenon in governance today.

## MANAGEMENT

*Witold Henisz*

**Project: Environmental, Social and Governance (ESG) Integration by Asset Managers**

Using proprietary data from State Street and access to research and investment teams at Calvert, Morgan Stanley, Inherent Group, UBS, Alliance Bernstein, Citi and others, I will be working on a number of quantitative and qualitative research projects summarizing best practices in integrating ESG factors into investment strategies. How are firms using new and alternative data streams such as those provided by True Value Labs and Arabesque to supplement their forecasts of future cashflows and what is the evidence regarding the accuracy of such efforts? How are firms bringing what heretofore have been separate teams (i.e., industry analysts and ESG analysts) together?

*David Hsu*

**Project: Corporate Venture Capital and Technology Startups**

Corporations are increasingly acting as venture capitalists to technology-based startups. This project seeks to understand the consequences for both the corporate venture capitalists, as well as for the startups. I am recruiting for 1-2 people interested in this domain, and who have the

[Return to top of document](#)

following skills: computer programming experience to assist in extracting, manipulating, and organizing data from a range of sources to facilitate analysis. Please specify your skills and any related experience in your application materials. Attention to detail and a good work ethic are important for this position.

*Mary McDonnell*

**Project: Corporate Political Activity**

I am looking for some help ramping up an exciting new project exploring corporate political activity. Most specifically, I'm interested in exploring the predictors and consequences of increasing corporate spending on judicial elections (ie, the elections that decide who serve as judges on state appellate and supreme courts). The project would involve helping me to code up proprietary data that I have on corporate judicial election spending (which will require some familiarity with excel). I will also teach the research assistant to navigate and code legal cases against firms in Westlaw, the primary database that lawyers use for legal analysis. The project should be especially useful for students who are interested in corporate policy, corporate strategy, or business law.

## MARKETING

*Jonah Berger*

**Project: Why Do Some Things Become Popular? Natural Language Processing and Behavioral Insight**

Why do some songs, books and movies catch on and become popular while others fail? Why do some online articles suck us in and get lots of engagement while others don't? We're interested in using natural language processing, machine learning, and automated textual analysis to help answer these questions and related questions.

Ongoing projects involve analyzing song lyrics to predict Billboard rankings, analyzing movies scripts to plot the emotional arc of narratives and predict ratings and ticket sales, and analyzing online content to understand why certain articles get longer versus shorter reads. Students will work with Professor Jonah Berger and potentially some graduate students in our group. Ideal applicants will have strong programming skills, be highly motivated, and able to work independently as well as within a team.

[Return to top of document](#)

[Return to top of document](#)

While not required, ideal candidate will have some experience with at least some of the following: experience programming in Python and R, especially with processing large amounts of text data. Experience in one or more of the following packages: Pandas, seaborn, NLTK, spaCy, numpy, scipy, scikit-learn, and statsmodels or their R counterparts (dplyr, ggplot, tidytext, etc.). Coursework in one or more of the following, or similar courses: statistics (STAT 417, 476), machine learning (CIS 519, 520, 521), computational linguistics (CIS 530), linguistics (LING 449). Bonus if you have: Experience with jupyter notebooks, for prototyping, exploratory data analysis, and reporting; experience in sentiment analysis and/or automated assessment of text readability/quality; bash scripting (e.g., for computing on Wharton's High Performance Computing Cluster); Git for version control

*Pinar Yildirim*

**Project: Machine Learning, Economics and Marketing**

The nature of my research projects are generally highly informative for the students and provide a great learning experience. The ideal student should be computationally savvy and good in mathematics and economics. The student is expected to clean and analyze data, learn and practice econometric methods. Computational and statistical skills are required, such as knowledge of Python, R, Stata, or Matlab. Above all, excellent discipline is necessary.

## **OPERATIONS, INFORMATION AND DECISIONS**

*Gad Allon*

**Project: How do Delay Announcements Impact Customer Behavior: Experimental Study**

I have two projects and I am looking for two different students.

(1) How do Delay Announcements Impact Customer Behavior: Experimental Study

Delay announcements are prevalent in many service systems such as call centers, call centers, and retail store. This project is among the first experimental work studying how customers react to explicit and real-time waiting time information on anticipated delays. In particular, we are interested in studying how such announcements impact customers' beliefs about the anticipated waiting times. The goal of the project is to conduct several experiments either in the lab and on MTurk to better understand how customers make decisions based on this information.

[Return to top of document](#)



(2) Predicting firms mortality

A firm may disappear from the public marketplace for several reasons. We are going to try and create a model predicting such outcomes. We will look at different indicators, such as firm size, price, return, volatility and beta, as well as other operational factors to understand what explains scaling behavior and how these are related to mortality.

*Eric K Clemons*

**Project: Information System and Societal Disruption — Managing the Risks**

I have been writing about the business and social value of strategic information systems for 35 years. But for the past dozen years I have been more concerned about the downside and the risks:

- (1) Google has a stranglehold on search, and can demand enormous payments from companies that need to be found. Paradoxically, today's free search may be the most expensive way to provide search.
- (2) Google's Android gives it a stranglehold over the homescreen on phones and tablets. They can crush app developers who compete with them.
- (3) Facebook's support of fake news contributed to the election of President Trump and to Britain's Brexit Referendum, perhaps subverting the will of the majority of American and British voters. How severe is the threat that fake news presents to the future of democracy?
- (4) Giant platform operators have created the greatest wealth inequality in recent American history. How serious a problem is this, and how should it best be managed?
- (5) Uber and Airbnb produce great benefits, but they also produce significant externalities, altering entire communities? How should this be managed?
- (6) Perfect information leads to perfect pricing, in a range of industries. Protecting people with pre-existing medical conditions is an attempt to address the problems of differential pricing. How should society define fairness and efficiency in an era of perfect information?
- (7) The industrial revolution introduced engines driven by fossil fuels and reduced the value of human muscle power. This was a good thing, since it freed people up for more interesting and more valuable activities. Likewise, traditional automation freed up humans from tedious and repetitive clerical tasks, again freeing people up for more interesting and more valuable activities. However, AI may take over so many of the tasks presently performed by the least educated, least skilled, and least trained segments of the population. Can this lead to permanent

[Return to top of document](#)

structural unemployment? If so, what can be done to reduce the suffering caused by this disruption.

Social policy, monopoly law, privacy law, and a range of other aspects of our social protection have all failed to adapt as quickly as society has changed.

There are numerous research topics for any student who wants to understand fairness and efficiency in our information-based economy and information-based society.

***Katherine Milkman***

**Project: Behavior Change for Good**

The Behavior Change for Good (BCFG) Initiative at the University of Pennsylvania, led by Katherine Milkman and Angela Duckworth, is developing a digital platform to conduct largescale field experiments designed to promote sustained behavior change in education, health, and savings. Our world-class team of scientific experts will be able to continually test and improve a behavior change program by seamlessly incorporating the latest insights from their research into massive random-assignment experiments. We have formed partnerships with some of the world's largest organizations offering education, health, and savings products to reach millions of their students and customers. Learn more about BCFG at [bcfg.upenn.edu](http://bcfg.upenn.edu) or through this Freakonomics podcast describing BCFG's plans: <http://tinyurl.com/bcfg2017>.

The Research Assistant will contribute to research conducted on this platform by assisting with all aspects of the research process, which may include conducting literature reviews and power calculations, preparing research materials, performing data analysis, and preparing reports and presentations. The Research Assistant may also provide general assistance with the digital platform. Applicants should be familiar with social science research methods and data analysis (particularly in STATA and R). Familiarity with the Qualtrics survey platform is also helpful.

***Maurice Schweitzer***

**Project: When Organizational Rules Conflict with What is Best for Customers**

How do employees resolve conflict they feel at work? In this project, we collaborate with a large Philadelphia-based organization that employs over 1,000 people. Many of the employees interact with customers and wrestle with a conflict-- should they follow the organization's rules or should they do what is best for the customers. Our project involves several components: (1) Analyzing

[Return to top of document](#)

data the organization has collected on employee rule-breaking, (2) Analyzing survey data, and (3) Interviewing employees and customers.

## STATISTICS

*Edgar Dobriban*

### **Project: Research in artificial intelligence and deep learning**

In the last few years, deep learning has led to breakthroughs in computer vision, natural language processing, speech recognition, reinforcement learning (robotics, game playing), and several other areas. Deep learning, and more broadly machine learning, is viewed by several researchers as a promising path towards artificial intelligence.

There will be several research projects in Dr. Dobriban's group related to AI and deep learning. Some possible topics are listed below, however students are encouraged to suggest their own ideas, and those can be pursued as well.

1. Curiosity driven reinforcement learning: In classical reinforcement learning, the agent learns based on the rewards it obtains. However, in real problems rewards are sparse and unreliable. In this project we will explore the design of intrinsically curious agents, such as those from the well-known OpenAI project <https://pathak22.github.io/large-scale-curiosity/>. This can be viewed as an important step towards the more general applicability of AI.
2. Scalable deep learning: Deep learning is well known to be very resource intensive. Therefore, it is important to develop scalable deep learning methods, which can enable deep learning to scale up to truly massive datasets, or make it be fast enough to be run on edge devices such as cellphones. In this project, we will study and design scalable deep learning algorithms.
3. Other possible directions: Bandits and sequential decision-making, Data augmentation for deep learning and beyond, Uncertainty quantification, Adversarial examples, Generative models (GAN), Applications (eg visual question-answering systems), etc.

Qualifications: These projects require a full time commitment over the summer.

A minimal set of prerequisites includes (1) familiarity with probability, statistics, and machine learning at the undergraduate level, as demonstrated by excellent coursework performance in the area (2) knowledge of the Python programming language, (3) excellent communication and teamwork abilities, (4) strong independence and motivation to learn new areas.

[Return to top of document](#)

Desired qualifications include (A) some familiarity with deep learning (for instance through online courses, or Dr. Dobriban's course STAT 991) and associated software (PyTorch), (B) cloud computing (Amazon AWS, Google Cloud), (C) the LaTeX typesetting system, as well as (D) familiarity with the target area of application, if one exists.

The successful candidate may work in a team with other undergraduate or graduate students in Dr. Dobriban's group. There may also be an opportunity to be hired as a Research Assistant and continue the research project through the academic year, until completion.

*Dylan Small*

**Project: Effect of Playing on a Sports Team in High School on Later Life Outcomes**

Playing sports on a high school team has potential benefits including increasing fitness and promoting teamwork. There are also potential drawbacks including taking time away from academics and the risk of concussion. In a previous project, I and collaborators found that playing high school football was associated with less depression and was not associated with reduced cognition at age 65 in spite of the risk of concussion (Deshpande SK, Hasegawa RB, Rabinowitz AR, Whyte J, Roan CL, Tabatabaei A, Baiocchi M, Karlawish JH, Master CL and Small DS. Association of playing high school football with cognition and mental health later in life. JAMA neurology. 2017 Aug 1;74(8):909-18). In this previous project we considered only the effects of playing football but in this project we will study the effects of playing different sports and how they compare. Also in our previous project, we considered people who were in high school in the 1950s but in this project we will consider people who were in high school in the 1990s, making it more relevant to adolescents today. We will validate a survey of sports participation and analyze an available longitudinal study, the National Study of Youth and Religion. A student working on the project will gain knowledge and experience in statistical methods for data analysis and sample surveys as well as knowledge and experience in using the statistical computing software. It is hoped that the work will result in an academic publication and the student would be a co-author for the publication.

*Abraham Wyner*

**Project: Analysis of driving data in teenagers: Statistics saves lives!**

Motor vehicle crashes remain the leading cause of adolescent mortality and injury, making this one of the most significant public health threats facing US adolescents. Given that 95.6% of

[Return to top of document](#)

[\*Return to top of document\*](#)

novice driver crashes are due to driver error, improved skill should reduce crash incidence. Research supports this: novice driver crash rates peak immediately following licensure and decline steeply with experience gained over the months following licensure. However, it is not known which critical driving skill deficits present at licensure predict crashes. The goal of this research is to develop interventions prior to licensure that can lead to the safest independent driving post licensure. This is a data science/statistics research project. We plan to identify deficits in driving skills that are (a) associated with major predictors of early crash risk (age at licensure and sex) and that (b) can predict differences in crash rates within the first year of independent licensure. We have access to exclusive innovative, newly available data sources which will allow us to do groundbreaking research. Ideally, the student should have taken at least one class in statistics or data science and can program in either R, python or JMP. This is a great project for a student wishing to learn practical data science skills while helping to save lives!

[\*Return to top of document\*](#)