

# Penn Undergraduate Research Mentoring Program Project Descriptions Summer 2014

Application and instructions at <http://www.upenn.edu/curf/research/grants/purm>

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

*You are encouraged to learn more about faculty interests by reviewing faculty webpages and recent publications to determine your interest level in particular projects. To avoid confusion, students are asked not to contact faculty about their projects until you are contacted for an interview or the PURM selection process has been completed.*

*To maximize your chances of being selected for a PURM interview, apply for projects submitted by 3 different faculty mentors. If you are selected for an interview, you will be considered for any of that faculty member's projects.*

*Students currently engaged in programs that provide funded research opportunities such as University Scholars, Engineering's Rachleff Scholars, the Huntsman program, and the Vagelos family of programs are not eligible for PURM funding.*

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## **Arts and Sciences**

### **AFRICAN STUDIES**

*Matthew Winterton*

#### **Project 1: Development of Malagasy Language Resources (Language experience NOT necessary)**

I am currently developing new curriculum for courses here at Penn, including Canvas courses, textbooks, and other bilingual, English-Malagasy resources, a language indigenous to Madagascar. PRIOR MALAGASY EXPERIENCE IS NOT REQUIRED. A working knowledge of French or other foreign language may be helpful but again is not required. Students tasks vary on the project and experience of the student. Additionally, I am interested in the grammar, syntax, and corpus research on the Malagasy language. I use a large database I have generated to study Malagasy. I have authored several publications and students will be eligible for authorship. Current projects in the pipeline include: Grammar texts for Elementary and Intermediate Malagasy courses, bilingual dictionary development using linguistic corpora, website layout/design, programming, editing/proofreading, manuscript preparation and submission, and corpus analysis. In doing so, the student will learn about a simple and interesting language, techniques of linguistic analysis, and produce quality peer-reviewed literature. The dedicated student may be able to accompany me on a field excursion to Madagascar.

#### **Project 2: Understanding Biases in Expert Economists' Predictions (in conjunction with Wharton)**

The Philadelphia Federal Reserve Bank collects detailed predictions from expert economists about a variety of economic indicators. These experts predict trends for the five quarters subsequent to the polling date. Most experts are polled more than once a year for multiple years. Predictions by expert economists are used by government and industry to make a variety of important decisions. The purpose of this project is to detect and understand possible biases in these predictions. Understanding these biases can help leaders predict with greater accuracy and make better decisions. We will investigate different reactions to qualitatively good vs. qualitatively bad news. When the economy fares slightly better or slightly worse than predicted, how do experts revise their estimates? Is there a detectable difference between revision of over-estimates and revision of under-estimates? A large stream of psychology research on optimism suggests that people tend to be too optimistic, even when they are experts and there are high stakes. Our prediction is that people make large adjustments to their predictions after the economy fares better than predicted, but relatively small adjustments after the economy fares worse than predicted. In other words, they will take good news seriously and ignore or dismiss

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bad news. We will employ a regression discontinuity design (an econometric method for inferring causality) for our quantitative analysis. A secondary research question will concern the difference between predictions for the near future and the far future. Our prediction is that optimism causes large biases for predictions about the far future.

## ANTHROPOLOGY

*Lauren Ristvet*

### **Project 1: Naxcivan Archaeological Project**

The Naxcivan Archaeological Project is one of the only joint American-Azerbaijani scholarly initiatives. Since 2006, American and Azerbaijani students and researchers have excavated important sites across this area, particularly the Iron Age fortress, Oqlanqala. In summer 2014, we are beginning a new project to survey and excavate the city that once surrounded this fortress. I am looking for a student to assist with the excavations. The undergraduate student will work closely with a small group of graduate students and senior researchers in learning archaeological skills and developing their own research project. The student will be responsible for participating in both field work and lab processing and keeping detailed documentation. A background in archaeology or knowledge of scientific illustration is a plus, as is knowledge of Russian or Turkish. It is most important, however, that the student can work well with others, be open to new experiences and be able to enjoy the opportunities that come with living in a rural village in an area of the world that is truly off the beaten track.

## BIOLOGY

*Fevzi Daldal*

### **Project 1: Molecular Characterization of Cytochromes in Major Energy Production Pathways**

Our group is interested in the molecular characterization of the structure, function, regulation and biogenesis of cytochromes involved in major energy production pathways, such as photosynthesis and respiration. We use both microbial (facultative photosynthetic bacteria) and human mitochondrial (diseased patients derived cybrid cell cultures) systems as experimental models, and aim to increase our basic understanding of the underlying molecular bases of related diseases. Currently we pursue three integrated facets as ongoing projects: A- How do cells make cytochromes, which are proteins with covalently attached hemes? If cells do not make

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cytochromes properly then they produce disease states, extending from porphyremia to sideroblastic anemia. Cells contain an exquisite and complex machinery to carry out this process, and try to dissect the components of this machine and their specific functions. B- How do cells acquire copper, which is a micronutrient that is essential for, and also extremely toxic to, the cells? If cells do not manage properly copper acquisition, traffic and delivery to the user proteins, they develop disease states, including mitochondrial diseases, exercise intolerance, lactic acidosis, Menkes and Wilson, Alzheimer or Parkinson diseases. C- How do cells form and regulate respiratory and photosynthetic enzyme supercomplexes in bacteria and human mitochondria. These complexes are essential for natural energy transduction, extending from cellular ATP to biofuel production, and are organized as large supercomplexes, which are large macromolecular entities. How the formation of supercomplexes is regulated, and what are the components involved in their formation are not known, and yet both the absence or the overproduction of supercomplexes are very closely associated with human mitochondrial diseases, extending from myopathies to neuropathies and multisystem disorders. Elucidation of these regulatory mechanisms will lead to novel therapies for these diseases for which no cure is currently available. We routinely use molecular genetics, biochemistry, biophysics, cell culture, and genomic-RNAseq proteomic-mass spectrometry approaches. If you are interested in any aspect of these topics, you like to work independently and in collaboration and under supervision of an advanced postdoctoral fellow or a graduate student, then consider applying to our group. Chosen student will participate to all aspects of the projects, from bench work to conception and design of novel immediate steps of the work. She/he will be fully involved in hands on execution, data collection, analyses and interpretation, and conception/design of future approaches. This activity provides an excellent training opportunity for professional studies beyond the undergraduate level, including medical, veterinary, dental and graduate schools. If desired, the possibility to continue the project initiated in summer during the academic year is also possible. Basic 100 levels biology, and chemistry background, a keen interest to learn and a drive to accomplish something excellent are the only requirements. This summer activity is also an excellent possibility to find out if one is interested in research-related activities in life sciences.

*Tim Linksvayer*

### **Project 1: Behavioral and genetic basis of ant caste**

Ant societies are based on a division of labor among individuals into discrete castes. The caste fate of an individual depends on the quality and quantity of food it receives, as well as its physiological response to the nutritional environment. We will integrate behavioral and genetic approaches to understand the regulation of caste expression in ants.

### **Project 2: Behavioral and genetic basis of collective decision making in ants**

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Ant colonies must regulate worker activities to maximize colony productivity. We will use an integrative approach to study the behavioral and genetic mechanisms by which colonies regulate worker tasks.

### **Project 3: The genetic implications of social interactions in insect models**

With social interactions, an individual's traits depends on its own genes, but also on genes expressed in social partners. Even though social interactions are ubiquitous, the effects of socially-acting genes are largely unstudied. We will compare the relative importance of socially-acting genes in the well-established model system *Drosophila melanogaster* as well as an emerging ant model system.

*Mecky Pohlschroder*

### **Project 1: Characterization of novel membrane anchoring machinery for cell surface proteins**

Cell surfaces are decorated by a variety of proteins that play key roles in cellular processes such as acquiring nutrients, ensuring cell stability and mediating adhesion to biotic and abiotic surfaces. Secure cell surface anchoring of this large, diverse set of proteins is critical to many essential cell processes. As might be expected, a diverse array of strategies have evolved for anchoring proteins on the cell surface. Unfortunately, while the molecular mechanisms underlying several pathways involved in anchoring surface proteins of bacteria and eukaryotes have been delineated, for the most part, the molecular mechanisms of the pathways required to anchor proteins to the cell surfaces of archaea either remain elusive or have only been vaguely defined. Although best known for species that thrive in extreme environments, archaea are found in every conceivable niche, and play important roles in a variety of vital ecological processes of global importance, including the carbon and nitrogen cycles. The human microbiome also includes a variety of archaeal species, some of which have been correlated with disease. However, nothing is known about the reasons for this correlation, underscoring the importance of developing a better understanding of these poorly characterized organisms, including the mechanisms involved in anchoring their secreted proteins to the cell surface. Interestingly, recently published in silico analyses have suggested that the C-termini of a significant number of secreted archaeal proteins are proteolytically processed and that the C-termini of these mature substrates are covalently linked to the cell membrane. Using the model archaeon *Haloferax volcanii*, we have already confirmed that the involvement of a novel enzyme, the “archaeosortase”, ArtA, in C-terminal processing as well as lipid modification of the S-layer glycoprotein, the sole subunit of the *H. volcanii* cell wall. Using biochemical and molecular biological tools, the summer project would involve the characterization of additional putative components involved in this novel membrane-anchoring pathway. Knowledge of basic lab techniques are preferred - the student will learn to grow and genetically modify *Haloferax*

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volcanii. The student will also perform Western blots and use coomassie staining to analyze proteins.

### **Project 2: Identification of pilus-biosynthesis components using transposon mutagenesis**

Biofilms are diverse microbial communities containing members from both prokaryotic domains of life that can cause both chronic and persistent infections as well as antibiotic resistance. In order to initiate biofilm formation, bacteria use a variety of surface filaments, including type IV pili (TFP), to adhere to surfaces, which makes these surface-exposed virulence factors attractive drug targets. Although archaea are important members of the human microbiome, little is known about archaeal TFP, especially their roles in biofilm formation. We have recently shown that the model archaeon, *Haloferax volcanii*, attaches to surfaces in a TFP-dependent manner. While the TFP biosynthesis machinery in archaea, which lack an outer membrane, appears to be less complex than that of the well-studied gram-negative bacteria, thus, making them an excellent model in which to study these structures, we have preliminary data indicating the presence of novel TFP- biosynthesis components. The goal of the proposed summer project is to use transposon mutagenesis to identify these novel components. Time permitting, biochemical and molecular biological characterization of these components will be used to identify their roles in pilus biosynthesis and function. Investigating these structures in archaea will greatly expand our understanding of the cell biology of archaea, which have not been extensively studied and will likely reveal novel aspects of the biosynthesis and functions of their highly diverse, evolutionarily conserved TFP in bacteria. Knowledge of basic lab techniques are preferred but not required. The student will learn to grow and genetically modify *Haloferax volcanii*. Mutants will be screened for adhesion as well as motility defects.

*Paul Schmidt*

### **Project 1: Natural variation as a window into centromere function**

The centromere is the element of each chromosome that directs chromosome inheritance. The location and function of the centromere are defined epigenetically by nucleosomes containing a specialized variant of one of the core histone proteins. Although the importance of this epigenetic mark is well established, there are also long stretches of repetitive DNA sequence that occur at centromeres in mammals and many other species. Several lines of evidence indicate that these sequences are important, but their function is mysterious, in large part because their repetitive nature makes them difficult to manipulate experimentally. The goal of this project is to exploit natural variation in centromere sequences across multiple species of *Drosophila* to understand the relationship between sequence and function. The project will integrate multiple experimental approaches: genetics to test for variation in centromere function between species, genomics to understand the sequence variation, and cell biology to probe the molecular mechanisms by which sequence impacts function. We anticipate that the initial summer project

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will lead to a long-term commitment and ultimately authorship on a publication. Some background in biology, at least at the introductory level, is desirable.

### **Project 2: The evolution of ecological dynamics**

A long standing question in organismal biology is the extent to which evolutionary dynamics affect basic ecological dynamics. We have recently developed an experimental system in which the degree of adaptation can be manipulated in natural populations. Populations will be set up in our recently built experimental orchard on the Penn campus and level of environmental adaptation manipulated. The effects of evolution on population growth rates and other ecological factors will be assessed over the course of seasonal time as some populations are allowed to adapt and others are "frozen" in evolutionary time. This work will involve laboratory culture and genetics, field work and experimentation, high throughput genome sequencing of whole populations, and bioinformatic analysis. This work is collaborative with researchers at Stanford University and ETH Zurich and the student would be exposed to a variety of biological and experimental approaches. Authorship on resulting publications is expected. Basic background in biology, at the introductory level including genetics, is desirable.

## **CHEMISTRY**

*David Chenoweth*

### **Project 1: Strategies for Templated Nanoparticle Self-Assembly**

Organic synthesis and standard laboratory techniques

### **Project 2: Structure-Specific RNA Targeting**

Standard molecular biology techniques and computational techniques

### **Project 3: Peptide Self-Assembly**

Standard organic synthesis and solid-phase peptide synthesis techniques. Biophysical characterization techniques (CD spectroscopy, ITC, etc.).

*Ivan Dmochowski*

### **Project 1: Genetically encoded Xe-129 NMR contrast agents**

The student assigned to this project will be responsible for expressing, purifying, and characterizing proteins that have been determined in our lab to interact productively with xenon

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to produce magnetic resonance contrast. Strongest candidates will have taken introductory lecture and lab courses in Chemistry, and should ideally be majoring in Chemistry. No prior research experience is necessary, but applicants should have a strong interest in performing research leading to publication.

### **Project 2: Probing the Bio-Nano Interface in a model ferritin system**

The student assigned to this project will be responsible for expressing, purifying, and characterizing proteins that have been determined in our lab to encapsulate inorganic nanoparticles. Strongest candidates will have taken introductory lecture and lab courses in Chemistry, and should ideally be majoring in Chemistry. No prior research experience is necessary, but applicants should have a strong interest in performing research leading to publication.

*Zahra Fakhraai*

### **Project 1: The effect of substrate in self-assembly of amyloid peptides**

We have recently discovered that surfaces can increase the fibrilization rate of amyloid peptides such as A-beta by many orders of magnitude. The existence of a surface increase the local concentration and acts to align the peptides on the surface. As a result the fibril formation rate increases. In this project an undergraduate student will assist the graduate student by preparing surfaces with various functional groups to probe the role of surface chemistry in this process

### **Project 2: Spiky nanoparticle as index sensor**

We have recently shown that Spiky nanoparticles have an exceptional sensitivity for Surface Enhanced Raman Scattering. The rough surface of these particles and the existence of many sharp corners allows these nanoparticles to focus light in nanometer length scale and makes them potentially very sensitive to the changes in the dielectric properties of the environment. In this project we aim to examine whether the adsorption of biomaterials on the surface of these nanoparticles in small amounts would generate enough change in the dielectric properties to be observed by dark-field spectroscopy.

*Madeleine Joullie*

### **Project 1: Integration of fermentation and organic synthesis for elucidation of biosynthetic pathways**

The project integrates fermentation and synthetic organic chemistry. It involves the production of complex molecules by fermentation, their isolation and conversion into metabolites that are presumed intermediates in biosynthetic pathways and convert them to the final products by

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synthetic methods. The procedure would allow to investigate the validity of the proposed biosynthetic pathways. This is a new approach not only to investigate synthetic pathways but also to modify the activity of complex products. The project will require some laboratory experience and some knowledge of organic chemistry.

*Marisa Kozlowski*

### **Project 1: Selective Oxidative Coupling of Phenols**

This project focuses on the development of new synthetic reaction methods using high throughput microscale screening. Biomimetic oxidative process to rapidly assemble higher complexity systems of interest in drug development will be pursued using readily available phenolic starting materials. Completion of Chem 245 is preferred.

### **Project 2: Computation of Palladium and Nickel Catalyzed Reactions**

Using high level theoretical methods and supercomputing resources, calculations of reactive intermediates and transition states in key palladium and nickel catalyzed reactions will be undertaken with the aim of designing system to access new reactivity.

### **Project 3: Synthesis and Evaluation of New Ligands in Palladium Catalysis**

This project focuses on synthesis of a library of phosphine ligands using automated mass-directed liquid chromatography. Libraries will be tested in currently low-yielding/low-selectivity processes and the information gained will be used to iteratively evolve ligands to obtain high-yielding and highly selective processes.

*Gary Molander*

### **Project 1: Synthesis, Characterization, and Reactivity of Aromatic Borazines**

The creation of novel building blocks and their incorporation into unique substructural platforms present outstanding opportunities to explore and develop new chemical space. The overarching goal of the research being undertaken is to facilitate the efficient construction of a variety of novel borazines by developing effective routes to this family of molecules and subsequently to exploit the novel reactivity patterns of these platforms as a means to access new chemical architectures. Described are investigations that will serve to open vast new possibilities for novel molecular designs incorporating a variety of borazine subunits. Proposed are investigations of the various B-N isosteric platforms as alternatives to aromatic C=C bonded systems, focusing on approaches to and elaboration of borazarobenzenes and borazaronaphthalenes as models, but most importantly targeting B-N isosteres of nitrogen-containing heteroaromatics such as pyridine, indole, azaindole, benzimidazole, benzofuran, benzothiophene, quinoline, isoquinoline,

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isoxazoles, and related derivatives. As a consequence of this research, new chemical space will be created, bringing with it the ability to study ways to fine-tune hydrogen-bonding and electrostatic interactions, as well as other physicochemical characteristics of pharmacologically active materials, while still maintaining the same three-dimensional/structural footprint as in analogous C=C isosteric aromatic systems. The investigations proposed will enable access and exploration of fundamentally new chemical space by introducing novel atom arrangements/molecular groups, thereby delivering materials with unique properties into the hands of practitioners in the biomedical, agrochemical, and materials science fields. Nearly all of the substructures proposed are unique, and neither the reactivity nor the physicochemical properties of the compounds proposed have ever been studied in a systematic manner. In addition, this work will eventually provide novel bioisosteric solutions of broad use in the optimization of physicochemical, biological and ADME properties of drug candidates. Students will be involved in developing synthetic approaches to novel aromatic borazine core structures. These materials will be characterized by standard analytical techniques, including proton NMR, carbon-13 NMR, boron-11 NMR, IR, and mass spectrometry. Additionally, the photophysical properties of these materials will be measured. Prerequisites to undertake the research include satisfactory completion of CHEM 241 and CHEM 242, as well as CHEM 245.

*E. James Petersson*

### **Project 1: Understanding the mechanism of a potential tool for the rescue of Parkinson's disease**

Misfolding of the abundant neuronal protein  $\alpha$ -Synuclein ( $\alpha$ S) has been implicated in the pathogenesis of several debilitating neurodegenerative disorders, including Parkinson's disease. Upon an initial misfolding event, single monomers of  $\alpha$ S associate with each other to form oligomers in a self-templating fashion. These transiently formed oligomers eventually fold into degradation-resistant structures, known as amyloid fibrils, which ultimately cause plaque formation in the brain. Despite an increasing amount of research in this area, the structural details at the molecular level of these misfolded species remain elusive. A more thorough understanding of the misfolding events of  $\alpha$ S could ultimately result in the rational design of therapeutic strategies to combat the formation of toxic intermediates. Fluorescence spectroscopy is a powerful technique that can be used to study protein dynamics. Our laboratory uses a combination of synthetic chemistry and molecular biology methods to attach extremely small fluorescent labels to proteins to track their movement in real-time. Specifically, this project will entail using the spectroscopic tools that we have developed to elucidate the structural details underlying the misfolding of  $\alpha$ S. The student on this project will be trained by a graduate student mentor to gain experience in chemical synthesis, molecular biology, protein semi-synthesis and biophysical techniques. In addition to studying the misfolding of  $\alpha$ S, we will also investigate the mechanism of a molecular chaperone found in yeast, Hsp104. Hsp104 unravels aggregated  $\alpha$ S

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fibrils, whereas no known mammalian protein is capable of this feat. However, the detailed, molecular mechanism by which Hsp104 breaks down  $\alpha$ S fibrils into non-toxic species remains unclear. Knowledge of Hsp104's mechanism of action may help to discover novel strategies for treating Parkinson's and related amyloid diseases in humans. A more extensive description of the research project is available upon request.

*Jeffrey Winkler*

### **Project 1: Design and Synthesis of Helical Structures**

This project is directed toward the development of new spatially addressable helical compounds that will be used to interrupt protein-protein interactions that are critical to cell signaling. The application of these compounds to the preparation of viral entry inhibitors that will be of therapeutic utility for HIV treatment and prophylaxis will be examined. The student will have the opportunity to contribute to both chemical and biological aspects of this project and the completion of Chem 241, 242 and 245 is highly recommended.

### **Project 2: Design and Synthesis of New Therapeutics for Acute Lymphoblastic Leukemia**

In this collaborative project with the Felix Laboratory at CHOP, we will develop small molecule drug candidates for the treatment of ALL. The student will have the opportunity to contribute to both chemical and biological aspects of this project and the completion of Chem 241, 242 and 245 is highly recommended.

### **Project 3: Design, Synthesis and Biological Evaluation of Inhibitors of Autophagy**

This project, which represents a collaboration between our Laboratory and the Amaravadi Laboratory at the School of Medicine, is directed toward the development of more potent inhibitors of autophagy as a strategy for the treatment of human cancers, based on the lead structure Lys05 that we have recently disclosed (Proc. Natl. Acad. Sci. 2012, 109, 8253-8258). The student will have the opportunity to contribute to both chemical and biological aspects of this project and the completion of Chem 241, 242 and 245 is highly recommended.

## **CLASSICAL STUDIES**

*Cynthia Damon*

### **Project 1: Manuscript transcription for a digital edition**

Transcription and encoding of ancient manuscripts from page images using digital tools. This is the first stage of an eventual digital edition of a classical text from the Caesarian corpus, the

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Alexandrian War. Prerequisites are (1) knowledge of Latin. (2) a good eye, (3) enthusiasm for contributing to an entirely new editorial process. We will be learning as we go.

*Cam Grey*

### **Project 1: The Roman Peasant Project**

The Roman Peasant Project is the first systematic excavation and analysis of the lower stratum of Roman rural dwellers. Based in ancient Etruria (western Tuscany, Italy), the project aims to excavate the smallest rural sites and study their economies, resource base and micro-environments. The project draws on the combined disciplines of archaeology, history, zooarchaeology, archaeobotany, geophysics and geology to produce “thick descriptions” of peasants: their diet; exploitation of local resources; socio-economies; and above all, the diversity of what it meant to be “poor” in the Roman world. We encourage applications from students interested in any of the disciplines mentioned above, as well as classical studies, anthropology, and landscape studies. The successful applicant will participate in a summer field project, as well as various pre- and post-excavation activities, such as preliminary research; processing and cataloging of finds; and preparation of materials for storage, display, or publication. The field portion of the project will last approximately five weeks, during which time we will be excavating the site of what we believe to be a Roman-era village, while living in the town of Cinigiano in the provincia of Grosseto. Students will be taught all aspects of archaeological excavation, as well as the processing of ceramics, bone and other small finds. They will participate in an explicitly multi-disciplinary, international collaboration, learning techniques of archaeological excavation, paleobotanical and paleo-osteological analysis, geoarchaeological survey, and mobility studies.

## **CRIMINOLOGY**

*Charles Loeffler*

### **Project 1: Classification of Recoil-related Human Activity using Wearable Sensors** ***Rising Juniors only***

Wearable computers and sensors are becoming more and more common, but our ability to make sense of the mountains of data that they generate on human activities remains quite limited. Geolocation information provides detailed information on user location, but limited information on user-related activities. Other sensor information can provide insights into repeated user activities (e.g., walking or running), but is much less successful at identifying intermittent activities. In this project, our goal is to begin resolving this problem by studying the distinctiveness of certain

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measured intermittent behaviors. This project will explore the characteristics of human behavior during recoil events and the possibility that sensor information could be used to construct a classifier for these human activities. As part of this ongoing work, students will have three primary responsibilities--(1) arranging and gathering sensor data from research subjects in a variety of settings around Philadelphia, (2) labeling sensor data, and (3) writing python scripts to streamline the software and analysis pipeline. Working knowledge of Python is a requirement and familiarity with mechanics and acoustics will be helpful.

## CRITICAL WRITING PROGRAM

*Alison Traweek*

### **Project 1: Facing Medusa**

The figure that comes down to us as Medusa, the snake-haired monster who turns men to stone just by looking at them, began life in ancient Greece as the Gorgon, a fearsome, grinning head decorating temple antefixes and warriors' shields. Over time, mythology assigned her a body and a backstory, including the unhappy fortune of being the only divinity destined to die. I am currently working on a book exploring the figure of the Gorgon in ancient Greece and Rome, in both literature and the visual arts. Existing books on the Gorgon or Medusa are dominated by psychoanalytic theory and spend comparatively little time thinking about the mythical figure in her original context; my project will aim to understand how she developed and changed over time as a character of literature and art, and to explore what cultural anxieties and desires she represented or reflected for the artists and audiences that enjoyed her. The book is structured around a series of central questions such as where the Gorgon came from, who her victims were, what the significance of her particular power was, and why she was an immortal doomed to mortality. A student working on this project will primarily be tracking down the Gorgon's appearances in the ancient Greco-Roman literary and artistic records. The student will also be compiling a bibliography of relevant secondary sources. Most of the work can be accomplished online, although searching the collection of the Penn Museum in person may be necessary. Familiarity with ancient art and knowledge of Greek and/or Latin would be useful but are not required. The student can expect to gain greater facility with basic strategies of research in the humanities as well as competency with the major critical sources, databases, and tools of research specific to Classical Studies.

## **EARTH AND ENVIRONMENTAL SCIENCE**

*Jane Dmochowski*

### **Project 1: Remote Sensing of the Northwest Canadian Tree Line**

This research project will combine remote sensing and biomass data analysis along with field work to further our understanding of the effects of climate change on the tree line near Inuvik, in the Northwest Territories of Canada, located 2 degrees above the Arctic Circle near the Mackenzie River. The research will aim to determine a change in start of season for this tree line from SPOT, Landsat and other satellite and/or aircraft imagery (e.g., whether or not the early budding of the white spruce trees can be determined to occur earlier since data has first been collected in the 1980's, and if there have been any other identifiable differences since this time that can be linked to climate change). The student will be expected to work on campus over the summer as well as travel to the Northwest Territories for roughly two weeks. The ideal student will be comfortable analyzing large data sets, have excellent quantitative and computer skills, and be interested in and familiar with relevant aspects of earth and environmental science.

### **Project 2: Analyzing the Integrating Sustainability Across the Curriculum Program**

This research project will involve both a literature review within the fields of sustainability and higher education and conducting and analyzing interviews / surveys to assess and describe Penn's Integrating Sustainability Across the Curriculum program (ISAC), <http://www.upenn.edu/sustainability/programs/integrating-sustainability-across-curriculum>). The purpose of the study is to demonstrate Penn's novel approach of infusing sustainability into existing and new Penn courses and programs. The ISAC program, established in 2012, is designed to assist faculty interested in integrating sustainability into existing classes, or launch new classes where topics of sustainability are fully incorporated. The program begins with a faculty workshop where faculty first discuss sustainability concepts in general, and then focus on methods to improve existing courses or begin new courses. The program continues over the summer with student research assistants assigned to each participating faculty, vetting readings, creating new lecture topics, and writing assignments. The ideal student researcher for this assessment project will have interests in education and sustainability and excellent qualitative and quantitative research skills. The student will be expected to work on campus during the summer and their primary responsibility will be compiling a working bibliography for the project and assimilating data related to assessing the program.

### **Project 3: Incorporating Active Learning into College Courses**

This research project will involve a literature review within the field of earth science education in order to help me assess and describe my efforts to "flip" my Oceanography course. The ideal student researcher for this project will have interests in education and earth science, as well as

excellent qualitative and quantitative research skills. The student will be expected to work on campus during the summer and their primary responsibility will be compiling a working bibliography for the project and assimilating data related to the project.

*Irina Marinov*

### **Project 1: Southern Ocean in a warming climate**

Despite its absolutely critical importance for climate, the Southern Ocean is the least understood region of the world ocean, particularly because of the sparsity of observations and our incomplete understanding of high latitude processes (e.g., sea ice dynamics, deep water formation processes). Water moving poleward towards Antarctica becomes cold and salty and sinks at Antarctic bottom water (AABW), bringing with it heat and carbon from the atmosphere. The strength of AABW formation is critical for the ability of the deep ocean to absorb and store heat and carbon, and has been shown to be critically linked to global carbon uptake and atmospheric pCO<sub>2</sub> levels. Over the 21st century, we expect more precipitation in the Southern Ocean south of 60S, hence freshening of surface waters and a decrease in the formation and strength of AABW. The science objective of this project is to explore (a) physical mechanisms (freshening, winds, surface albedo) responsible for AABW formation and slowdown, and (b) evaluate the consequences of a slowdown in AABW for nutrients, carbon and oxygen storage in the ocean. The student will learn how to read and visualize gridded data fields in either MATLAB, Python or the oceanographic software Ferret and to independently write codes for the required computations, which will involve statistical techniques (such as linear regression, correlation analyses and hypothesis testing) and mapping of the results. Excellent Computational background and skills, and basic statistical skills necessary. More advanced statistical knowledge, some natural science background and interest in the topic would be ideal.

### **Project 2: Ocean Biology in a future climate**

Ocean Phytoplankton are responsible for 50% of photosynthesis on the planet and are the base of the food chain. The ocean contains hundreds of types of phytoplankton species, which can be characterized by their size and classified in phytoplankton functional types (PFTs). Spatio-temporal distributions of PFTs are expected to change with climate, with potentially significant impacts on ocean carbon cycling. In this project, the student will work with satellite remote sensing products to understand biodiversity of ocean phytoplankton and the response of the ocean biology to climate change on a NASA sponsored project. We will analyze the interannual variability and decadal trends in phytoplankton carbon biomass, and we will attempt to link changes in ocean biology to changes in other oceanic physical properties (light, surface to deep mixing, sea surface temperature) that are known to influence phytoplankton growth. The student is expected to learn how to read and visualize satellite imagery and other gridded data fields in MATLAB and to independently write codes for the required computations, which will involve

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statistical techniques (such as linear regression, correlation analyses and hypothesis testing) and mapping of the results. Excellent Computational background and skills, and basic statistical skills necessary. More advanced statistical knowledge, some natural science background and interest in the topic would be ideal.

*Stephen Phipps*

**Project 1: Proliferation of Invasive Vines in SE Pennsylvania Forests** ***Rising Juniors only***

Forest patches across southeastern Pennsylvania are being covered by dense growths of vines, many of them invasive. This vine growth may be radically changing the dynamics of forests in the region, competing with the trees that support them for sunlight and nutrients, and rendering the trees more susceptible to wind damage, among other effects. Similar vine growth is happening elsewhere in the eastern U.S. and in Texas. It is a little-studied phenomenon and represents an opportunity for an undergraduate to do important new science on a new problem. This project will (1) map areas and intensities of vine infestation; (2) count the number and measure the size of vines supported by trees, and the size of the trees; (3) determine the age of the vines and the supporting trees; and (4) relate vine growth and density to land-use history. Students working on this project should be interested in doing lots of field work (which may sometimes be difficult), have some background in science, with preference for those with some knowledge of botany or ecology. Students should plan on continuing the research into the fall, on a for-credit basis (enrollment in an independent study course). I am particularly interested in working with a student who would like to extend this project into a senior thesis. A student who is willing to do this and work hard may well become a co-author on a scientific paper.

*Alain Plante*

**Project 1: Iron-carbon interactions**

Tropical soils are a critical component of the global carbon cycle, yet research in tropical systems is historically scarce. Estimates are that the tropics store 30% of global carbon, 10% of global soil carbon and are sensitive to even small changes in climate. Much of the uncertainty in the behavior of soil organic matter in tropical ecosystems derives from an incomplete understanding of the processes that promote carbon storage in tropical soils. One of the goals of the recently funded renewal of the Luquillo Critical Zone Observatory is to understand how iron-carbon interactions in these Puerto Rican soils contribute to the long-term storage of soil organic matter. Long-term soil carbon stability is dominated by organo-mineral interactions, and while tropical soils are highly weathered, they contain an abundance of iron oxides available for organic carbon stabilization. We are seeking a motivated undergraduate researcher to contribute to experiments that seek to how mineral stabilization of carbon works in tropical soils. The

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candidate will work alongside postdocs and graduate students to perform several laboratory experiments and analyses. They will learn and perform physical, chemical, biological and thermal methods for isolating and characterizing iron and soil organic matter from a set of Puerto Rican soils from LCZO. Candidates should have a vested interest in the environmental, ecological or geosciences. Some laboratory experiences is preferred, but not required.

## **EAST ASIAN LANGUAGES AND CIVILIZATIONS**

*Ayako Kano*

### **Project 1: Global Comparisons of Policies on Gender and Sexuality**

Seeking students interested in issues related to gender, sexuality, feminism, and social policy. I am a specialist in Japanese gender policy; I am looking forward to in working with students with expertise/intellectual interest in these policy areas in the U.S., Europe, and/or East Asia, but students interested in other geographic areas are also encouraged to apply. Your responsibilities include reading, summarizing and evaluating recent scholarship. You will learn how to conduct efficient online database searches, use digital tools to organize your research, to analyze and evaluate relevant scholarship, and and to write effective summaries and position papers. Ideally, you have taken at least one course on gender/sexuality, and are interested in international as well as historical comparisons.

### **Project 2: East Asian Policies for Gender Equality**

I am looking for students who can read, analyze, and summarize research on gender equality in East Asia, especially Korea, Singapore, P.R.C., Hong Kong, and Taiwan. Responsibilities are the same as in Project 1. Requires some knowledge of of gender/sexuality issues. Advanced research ability in relevant languages highly desirable.

## **ECONOMICS**

*Francis Diebold*

### **Project 1: Non-Normality and Outliers in Empirical Economics and Finance**

We will research the role of non-normality and outliers in empirical economics and finance, with emphasis on econometric methods for detection and achieving robustness. Duties may include Eviews programming, R programming and LaTeX report writing. Some experience in those environments is desirable but not strictly necessary.

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### **Project 2: Nonparametric Methods for Nonlinear Economic and Financial Relationships**

We will compare and contrast various nonparametric regression approaches in several economic and financial contexts. Duties may include Eviews programming, R programming and LaTeX report writing. Some experience in those environments is desirable but not strictly necessary.

### **Project 3: Big Data in Economics and Finance**

We will examine various statistical/econometric methods for confronting "Big Data" in economic and financial contexts, including selection, shrinkage, and combinations. Duties may include Eviews programming, R programming and LaTeX report writing. Some experience in those environments is desirable but not strictly necessary.

*Jesus Fernandez-Villaverde*

### **Project 1: Global Economic History**

I am currently writing a very innovative book on global economic history. I need help with gathering data, fact checks, etc. It would be both interesting and educative. I am looking for dynamic, entrepreneurial students.

## **ENGLISH**

*Max Cavitch*

### **Project 1: Dogs, Disability, and Conflict Zones in New-Media Contexts**

I seek research assistance for the second and third parts of a three-part project on what I call "interspecies mediality." This term refers both to media representations of interspecies encounters and to the complex psychosocial dynamics of those encounters themselves. My particular focus is on human-canine relations, and on the ways in which media--chiefly new and accelerated forms of mediatized sociability, such as Twitter, YouTube, and gaming--enhance and impede intersubjective encounters within and across the species divide. In part 2, I focus on disabled dogs. In part 3, I focus on dogs in conflict zones (such as parts of India, Chechnya, Afghanistan, and Iraq). For help with this project, I need more than someone who simply "likes dogs." You should have some extensive experience raising and living with dogs, even if that's only been in the home environment. And you should have a more than rudimentary familiarity with new-media forms. Your tasks would include: reading and reporting on recent published research; interviewing people with disabled dogs; and searching for and helping to interpret representations of human-canine encounters in new-media forms. A short version of the first part

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of this project has been published as the article "Curbside Quarantine," which you should read before applying to work on this project. It can be found at the following url:  
[http://muse.jhu.edu/login?auth=0&type=summary&url=/journals/postmodern\\_culture/v022/22.2.cavitch.html](http://muse.jhu.edu/login?auth=0&type=summary&url=/journals/postmodern_culture/v022/22.2.cavitch.html)

***Peter Conn***

### **Project 1: 1936: Under the Volcano**

The student would assist in doing primary research, both in libraries and (via email) in archives, and would be encouraged to make judgments about the quality and relevance of the materials s/he discovers. 1936: Under the Volcano I am writing a global history of 1936, in which the military and political events of that tumultuous year will alternate with the cultural history and the personal experiences of individual men and women around the world. I will reconstruct, among other episodes, Hitler's occupation of the Rhineland, the fateful mutiny of Japanese army officers, Mussolini's conquest of Ethiopia, Franco's revolt against the elected Republican government in Spain, Franklin Roosevelt's re-election, Agustin Somoza's coup in Nicaragua, the installation of Ioannis Metaxas as dictator in Greece, the abdication of England's King Henry VIII, and the beginning of Joseph Stalin's murderous purges. At the same time, these events will share space with the intellectual, cultural and personal histories that were enacted in the midst of increasing turmoil. In 1936, John Maynard Keynes published his General Theory of Employment, Interest and Money, and Walter Benjamin his classic analysis, "The Work of Art in the Age of Mechanical Reproduction." Charlie Chaplin's Modern Times was released in that year, and so was the Polish production Yidl Mitn Fidl, the most successful Yiddish film of all time, the hyper-patriotic Russian movie, The Fatherland Calls, Blood on Wolf Mountain, an anti-Japanese film produced in Shanghai, and Jean Renoir's landmark The Crime of Monsieur Lange. A few weeks after Max Schmeling knocked out Joe Louis to win the world heavyweight boxing title, the notorious Berlin Olympics brought Jesse Owens to world prominence. Winter festivals took place in Moscow and literary debates rocked Chinese intellectuals. An international eugenics conference in New York was followed by an exhibition of Surrealist art in London, and late in the year the Supreme Court announced a major decision on presidential powers. Political figures such as Roosevelt, Stalin, Mao Zedong and Haile Selassie will share space with writers, composers and artists, including Joseph Roth, George Orwell, Lu Xun, James Agee, Albert Camus, Pearl S. Buck, Pablo Picasso, Salvador Dali, Arnold Schoenberg, Dmitri Shostakovich, and George Gershwin. Finally, the narrative will be punctuated by excerpts from the large number of published and unpublished diaries and letters that document the personal and domestic lives of men and women around the world. Some are well known: a nineteen-year-old Indira Gandhi, enrolled in a London college, wrote long letters to her father, Jawaharlal Nehru. In addition, the neglected voices of ordinary citizens, from California to Italy, from New Zealand to Argentina, will be incorporated into the story of this remarkable year. Olga Adamova wrote

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from inside the walls of a Soviet prison, Don Hartwell kept a Dust Bowl diary, Thomas Hodgkin wrote to his family of his experiences in Palestine.

*James English*

**Project 1: CFDP: The Contemporary Fiction Database Project**

This is a great research project for a student who is interested in learning something about the digital humanities, where traditional study of literature joins up with data gathering and analysis. The aim of the project is to express the field of contemporary English-language fiction in the form of a database. We are using relatively small and carefully defined datasets of 500 to 2000 novels, gathering information about their authors, narrators, settings, styles, and genres. We then make statistical comparisons between the sets, and trace these comparative relationships over time, revealing the important moments and key trends that constitute the "contemporary" period for literary study. A first phase of the project has been well received at Yale, Duke, Heidelberg, and the Stanford Literary Lab. A second phase, to be begun this summer, will be presented next year at the University of Washington and published in a special journal issue, organized around this project, on scale and value in literary studies. The PURM-funded student who assists this summer need not be an English major, but should be someone who is a comfortable reader of novels and does reasonably well in English classes. Good working knowledge of Excel or willingness to complete Excel tutorials as part of the paid research is essential. The faculty mentor will be in regular contact with the student via Skype, email, and campus meetings, but the student must be an independent and motivated worker.

*Jed Esty*

**Project 1: British Children's Literature in the US, Peter Pan to Harry Potter**

The project involves an historical analysis of the role and influence of British children's writing, from the so-called Golden Age (of the late Victorian and Edwardian periods) to the present. Student will assist in three primary areas: 1) sales and statistical analysis of penetration by British children's works of the American market over time; 2) critical and popular reception of landmark British titles (up to and including JK Rowling); and 3) primary analysis of governing tropes and themes that seem to motivate the prestige and popularity of British writing for young people, likely including class and educational hierarchy, nostalgia for monocultural societies, and the glamor of world empire rendered in romantic or magical subplots.

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*Tsitsi Jaji*

**Project 1: Westerns in the Global South**

This project involves research for a book I am writing, *Cassava Westerns: Black Reimaginings of the American Frontier Myth*. I'm looking for an energetic and detail-oriented assistant, someone who will act as a partner in the research process. You will view and summarize classic westerns and spaghetti westerns; locate articles in history, anthropology, film studies and literature related to this project; review archives of newspapers and popular magazines from Africa and the Caribbean; and help search for a mysterious country and western musician from Zimbabwe, Josiah Hadebe. You will also need to become an expert in effective use of digital research tools, and will be responsible for learning how to use Zotero, Prezi, and film-clip editing and then *teaching me* how to use these. The ideal candidate will be able to read French but this is not required. I am looking for a student who already has strong research skills, or is motivated to learn in the first week or two through appointments with the library staff.

**Project 2: Classic Black: Piano Parts in Art Songs by Composers of Color**

I seek an assistant for a new book project about musical settings of poetry by classical composers of African heritage (African American, Afro-European, Caribbean and African). The music I am researching ranges from 1760s to contemporary. The ideal candidate for this project will be a *pianist* who would like to learn the accompaniment for 10-15 songs for solo voice and piano. You will research the poetry and composers' biographies for these songs, and assist in locating information on first performances, reviews, copyright, performance rights, and recording rights. My research involves performance, and so I am learning the vocal part for the songs and as my research assistant you will play the piano part, and we will record those songs for which we can obtain recording clearance. This will give you a great opportunity to combine performance and research skills, and to learn about the complicated world of music copyright. You will use the Marian Anderson collection in the library's special collections extensively. An example of the kind of work you will do can be found at: <http://pennpress.typepad.com/pennpresslog/2013/04/a-corn-song.html>

**Project 3: Classic Black: Researching Poetry and Musicology**

I seek an assistant for a new book project about musical settings of poetry by classical composers of African heritage (African American, Afro-European, Caribbean and African). The music I am researching ranges from 1760s to contemporary. The ideal candidate for this project will have a) a strong interest in the study of poetry and/or b) a background in music theory (i.e. you need to not only know how to read musical notation but be able to do harmonic analysis), although no performance skills are required. If you know any Reimann music theory so much the better! Reading knowledge of French is also a plus. I am looking for a student who has experience with or interest in learning how to use humanities databases like WorldCat; RILM; American Song

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Collection etc. In addition to helping me with the research process, over the summer you will be responsible for learning how to use Zotero, Prezi, and selected audio editing apps and then \*teaching me\* how to use these. If you do not already have experience with research, you will be responsible for learning some basic skills through appointments with the library staff in addition to gaining experience with me. The highlight of this project will be the opportunity to work with the Marian Anderson collection in the library's Special Collections and 2-3 day trips to New York City to work in the Schomburg Collection at NYPL. As part of your research you will assemble a dossier on either a) one poet whose poems have been set to music by several composers or b) one composer whose music you find particularly compelling. If you would like to see an example of the research this project involves check out this link:  
<http://pennpress.typepad.com/pennpresslog/2013/04/a-corn-song.html>

*Zachary Lesser*

### **Project 1: Mapping the Publication of Renaissance Drama**

This project forms the basis of a chapter of a book I am co-writing with a colleague at Ohio State, on the printing, publishing, and reading of English Renaissance drama in print (the plays of Shakespeare and his contemporaries). Part of what we want to do is create a cultural geography of the London book trade by tracing the locations of bookshops from which the plays were published. Did the publication of certain playwrights tend to cluster in certain areas, for instance, or the publication of plays from certain theaters? Can we find any patterns that might suggest that certain areas of London were associated with particular kinds of cultural production? And what (if anything) can this mapping tell us about the plays themselves that we have not been able to see through more traditional literary criticism? As part of this project, the student's responsibilities would include gathering the primary data (locations of bookshops, names of publishers associated with each play) through a database we have already created; researching available Digital Humanities tools for this kind of work, and helping us to determine the most appropriate tools to use; assistance with the actual inputting of data and programming; and analysis of the results. Some experience with and knowledge of GIS would certainly be very helpful.

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## ENGLISH/CENTER FOR PROGRAMS IN CONTEMPORARY WRITING

*Stephen Fried*

### **Project 1: Dr Rush: Blood, Revolution, Friendship, Madness and the Secret History of "the American Hippocrates"**

I am writing the first modern, narrative biography of Dr. Benjamin Rush, the founding father of American medicine, which is due in the fall of 2015. I am looking for one or two students to work intensely with me on this over the summer (in the hope that one or both might want to remain with the project into the 2014-15 academic year.) The story of Dr. Benjamin Rush is a fascinating one that has never been told properly—allowing a fresh, modern perspective on the American revolution from a young physician who was a signer of the Declaration of Independence but also doctor, friend and confidante to the other founding fathers throughout his career. He also became the most important (and most controversial) doctor and teacher of medicine in the United States, and the hero of the worst epidemic in US history, but his lasting contribution—on which much of the book will focus—is his role in all but inventing compassionate and medical mental health care, in part because his own son became mentally ill. And all this took place in Philadelphia, largely at Pennsylvania Hospital and what became Penn. The project offers opportunities to do unique and ambitious academic research on Rush, the time period, and the history of medicine and public health, as well as challenging work with original writings of Rush, his family, and his founding father friends (he was close to Adams and Jefferson, and responsible for healing the long rift in their friendship). It is also a chance to be involved in the writing, fact-checking and publishing of a book by a major publisher (Crown/Random House.) On this book and my previous five nonfiction books, I have worked with students from the English department and the Center for Programs in Contemporary Writing (where I teach advanced nonfiction writing), the history department and HHS.

### **Project 2: A Common Struggle: Patrick Kennedy and the politics and personal challenges of mental health**

I am co-writing, with Patrick Kennedy—the author of the Mental Health Parity and Addiction Equity Act during his time in Congress, and arguably the best-known mental health advocate in the nation—a book that is partly his medical memoir and partly a history of the modern politics and challenges of mental healthcare. I am looking for a student who might be interested in assisting on this project, which will involve research on mental health care and the Kennedys, some interview transcription and participation in editing and creating social media support for the project.

## HISTORY

*Tamara Walker*

### **Project 1: Slavery and Seafaring in the South Sea, 1565-1815**

My current book project maps the study of slavery onto the study of the South Sea, or the part of the Pacific Ocean that connected East Asia to Central and South America. For nearly three centuries, during the age of the Manila galleon trade (1565-1815), the South Sea was one of the busiest, most lucrative trade hubs in the world. Its currents carried ships authorized by Spain to transport porcelain, spices, and other merchandise from Manila to Mexico and Peru, and American bullion upon their return. In addition to these trans-pacific voyages were numerous short-haul transfers of slaves, wine, and textiles along the western coastline of Spanish America. Consequently, the South Sea was an alluring target for the British and French, whose incursions into the region forced Spain to form an armada fleet to protect it. African slaves played decisive roles in this landscape: they served as deckhands on armada ships, interpreters on behalf of foreign captors, and in myriad other capacities on land and at sea. Nonetheless, they remain at the margins of scholarship on the region. To assist my efforts to re-center African slaves in the early history of the South Sea, I am seeking an intellectually curious, detail-oriented, and Spanish-speaking undergraduate who can take on two major tasks. The first is to transcribe, convert, and organize archival research materials. At this stage, the bulk of those materials were gathered during my 2012-2013 sabbatical. I spent part of this time working in archives in Peru and Providence, Rhode Island, and collected a total of over 50 multi-page photocopies, photo sets, and microfilm reels representing materials from the sixteenth to the nineteenth centuries. The student who will work on this aspect of the project will primarily focus on: transcribing photocopied documents, converting photo sets (currently in JPEG format) and scanning microfilm materials to create searchable PDF files with optical character recognition (OCR); and organizing these archival materials according to their type, date of production, and region of origin, along with brief content summaries, relevant key words, and themes. The second major task is to seek out, analyze, and organize relevant secondary literature related to my research. I have already begun laying the groundwork for this aspect of the project, which will provide the student with a baseline set of materials, guidelines, and conceptual methods to work with. The student's primary focus will be on: conducting library database searches for relevant scholarship and requesting relevant materials; compiling a literature review that evaluates the relative strengths and weaknesses of the literature; and creating an organized bibliography according to source type and subject area, along with brief content summaries. These tasks will provide an enterprising student with several valuable skills, including the ability to read and interpret centuries-old paleography, analyze archival records for scholarly use, operate research management programs, and to hone writing and analytical skills.

## LINGUISTICS

*Eugene Buckley*

### **Project 1: Kashaya Dictionary**

I am currently working on the completion of a comprehensive dictionary of Kashaya, an endangered Native American language of northern California. I am looking for a research assistant this summer to help with various aspects of the final editing of the database on which the dictionary is based. Depending on the student's background and interests, this could include checking the English translations for coherence and consistency; classifying entries according to their semantic category; 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. Previous knowledge of linguistics from at least one course is ideal, but relevant experience could come from language study or other sources as well.

*David Embick*

### **Project 1: Understanding language processing through large-scale study** [\*Rising Juniors\*](#) [\*only\*](#)

Some words are easier for us to recognize when we hear than others. For example, when we hear "ca-" we could be hearing the word cat, cab, category, or cabbage, etc. But when we hear "scre-" it might be scream or screen, but the number of possibilities is much lower. We might quantify this uncertainty statistically to determine how unexpected words are given what we've heard so far, and might predict that we have an easier time recognizing words that create less uncertainty as we hear them. While this concept is simple, there's little agreement regarding what cognitive processes lead to these kind of phenomena. To study this topic, we need to run experiments at a larger scale than anyone has previously done. Our goal is to deploy this study using an internet application to get to the largest audience possible. The student working on this will: (1) Work with other members of the lab to prepare lists of stimuli and make sure that the experiment is working as-designed. (2) Coordinate participants taking the experiment data and monitor the data quality. (3) Assist in the analysis of the data. The student should have taken coursework in cognitive science or linguistics and would preferably have taken at least one course in computer programming (e.g., Java, Python). The student will gain experience in designing and analyzing psycholinguistic studies and become a pioneer in executing the large-scale study of these phenomena.

## NEAR EASTERN LANGUAGES AND CIVILIZATIONS

*Heather Sharkey*

### **Project 1: Here and Over There: Penn, Philadelphia, and the Middle East**

The Position and Required Background: I am developing a new freshman seminar to be taught in Fall 2014, on the historic engagement of the University of Pennsylvania and its scholars in the Near and Middle East. The course is called, “Here and Over There: Penn, Philadelphia, and the Middle East” (NELC 133). At this juncture, I seek an undergraduate researcher who can work this summer to help me in locating relevant archival materials, rare books, and objects that are now preserved in the University Archives, the Penn Museum, and the Penn Libraries (including Van Pelt’s Rare Books and Manuscripts section and the Katz Center for Advanced Judaic Studies). The PURM student researcher must have an academic background in Middle Eastern studies. Responsibilities: The student researcher will be responsible for (1) helping to identify compelling items in Penn collections that students can investigate and write about for class projects; (2) arranging to have targeted materials scanned or photographed for use in this class, and (3) developing the outlines of an online exhibit, in an interface called Omeka, for which the enrolled freshman will later write content during the Fall 2014 semester. (Certain librarians in Van Pelt will be able to offer some nuts-and-bolts advice on developing an Omeka site.) Here is the course description: This seminar explores the historic engagement of the University of Pennsylvania and its faculty, students, and graduates in the Near and Middle East. It does so while drawing on archives, rare books and manuscripts, and artifacts that are now preserved in the University Archives, the Penn Museum, and the Penn Libraries. Together we will consider how, beginning in the late nineteenth century, Penn scholars engaged in archaeological expeditions to celebrated sites like Ur (in what is now Iraq) and Memphis (in Egypt) – and how some of these efforts influenced the late Ottoman Empire’s policies towards antiquities and museums. We will examine how Penn’s curriculum changed over time to accommodate “Semitics”, including the study of languages and biblical traditions, in light of – or in spite of – historic tensions at the university between secular and religious learning. We will assess how Penn responded to changing American popular attitudes and U.S. foreign policy concerns relative to the Middle East, including during the Cold War and post-2001 (“post-9/11”) eras. Finally, we will trace the stories or “biographies” of some individual objects in Penn collections in order to appreciate the university’s roles in collecting, preserving, analyzing, and disseminating knowledge about the region’s deep cultural heritage. Ultimately, by investigating and writing about what we learn, our goal in the class will be to produce collaborative research on the history of “here” – the very local context of Penn and its environs – as it has tied into the history of the “over there” in the modern Middle East.

## PHYSICS AND ASTRONOMY

*James Aguirre*

### **Project 1: Searching for Signals of Dark Matter Annihilation**

Some 30% of the total mass density of the universe, and more than 80% of the gravitating mass is thought to be in the form of dark matter, a form of matter which does not interact electromagnetically. Most theories of dark matter posit that it is in the form of a neutral particle which may interact via the weak force and gravity: a so-called weakly interacting massive particle, or WIMP. Certain theories suggest that the WIMP could be its own antiparticle, and thus self-annihilate in sufficiently dense environments, producing an observable electromagnetic signal, including radio emission. I and collaborators have obtained deep radio maps of six of the nearest, most heavily dark-matter-dominated dwarf galaxies where other astrophysical sources of radio emission are thought to be negligible. This project will require the reduction of those maps in both continuum emission and the neutral hydrogen line at 21 cm. Once maps are made, the student will identify and remove sources of radio emission not associated with the dwarf galaxies, including distant radio-emitting galaxies and nearby emission from our own Galaxy, using models of this emission based on both our data and ancillary data. Finally, any residual emission will be used to place limits on the annihilation of a WIMP particle, in particle rest mass and annihilation cross-section. The data reduction software is written in IDL, and experience with this language is a plus. Experience with some data-oriented programming language (e.g. MATLAB, python) is strongly preferred.

### **Project 2: Astronomical Imaging of the Southern Sky in Low-Frequency Radio Waves**

The radio portion of the electromagnetic spectrum is sensitive to a host of high-energy astrophysical processes. Electrons accelerated by accretion onto black holes or ejection from a supernova explosion produce copious low-frequency radio waves. Penn is involved in the Precision Array for Probing the Epoch of Reionization (PAPER), a 128-antenna radio interferometer operating in South Africa observing between 100 and 200 MHz. This array is currently producing high-quality data of about a quarter of the entire sky each day, and the entire southern hemisphere over the course of its six month observing season. This project would investigate a new approach to quickly and robustly making wide-field images from PAPER, and use them to investigate the properties of radio sources both in and beyond our Galaxy. Of potential interest is the variability of extragalactic sources, which may be indications of exotic processes, and also a thorough survey of supernova remnants in our Galaxy. Both searches have the potential for new discoveries of previously unknown sources. The data reduction software is written in Python, and experience with this language is a plus. Previous experience with some data-oriented programming language (e.g. MATLAB, IDL) is strongly preferred. Some knowledge of astronomy and astrophysics is also a plus.

### **Project 3: Readout of Superconducting Submillimeter-Wave Detectors Using High-speed Digital Electronics**

An important ingredient of advances in cosmology and astrophysics over the last 20 years has been the development of detectors and telescopes capable of operating at electromagnetic wavelengths from a few hundred microns to a few millimeters. While megapixel detector arrays are routinely available for optical cameras and spectrometers, current instruments at submillimeter and millimeter wavelengths have been limited to at most a few thousand detectors. Detectors at submillimeter wavelengths must be held at temperatures of a fraction of degree above absolute zero to achieve performance limited by intrinsic photon noise. A particular challenge for creating such arrays is the necessity of reading out large numbers of detectors with the smallest number of wires to reduce thermal loading on the cold detectors and optics. A promising new detector type for large arrays, the kinetic inductance detector (KID) relies on the change in inductance of a bulk superconductor when light shines on it. When combined with a capacitor to make an LC circuit, such detectors can be read out with a comb of radio frequency tones in the range of 100 MHz. Flexible high-speed computation based around the field-programmable gate array (FPGA) allows the digital generation and processing of these signals. The student develop the software for the FPGA readout and will aid in the testing of a test array KIDs at temperatures of 250 mK to determine the noise and reliability of the readout circuit.

*Mark Devlin*

### **Project 1: The Balloon-borne Large Aperture Submillimeter Telescope**

We are building a new balloon-borne telescope to study star formation in our galaxy. This NASA funded project involves a large mirror, attitude control systems, ultra-low temperature cryogenics, electronics, software....and a whole bunch more! When completed, the telescope will fly at 135,000 ft above Antarctica for 28 days. We will study the role that magnetic fields play in regulating the rate of star formation in the Milky Way.

*A.T. Charlie Johnson*

### **Project 1: Synthesis and properties of large-area monolayer materials**

The Johnson group has developed methods to grow single-atomic layer thick materials with lateral dimensions as large as one foot. The goal of this project is to optimize the existing growth method for molybdenum disulfide and develop approaches to grow related materials such as tungsten disulfide. Electrical devices will be made from the materials and their properties measured. Optical properties of the materials will be measured in collaboration with other Penn faculty. Course work or experience in Physics or Chemistry, is very desirable but not essential for participation in this project.

## **Project 2: Graphene-enabled nanosensors for multiplexed detection of disease biomarkers**

Graphene, a honeycomb sheet of sp<sup>2</sup>-bonded carbon atoms, and nanotubes, possesses a set of remarkable electronic properties making it ideal for use in nanosensor applications: tunable carrier type and density, exceptionally high carrier mobility, and our lab's demonstrated ability to sensitize its surface with bioreceptors for particular targets. In this project we will develop approaches to create large arrays of graphene-enabled sensors for detection of multiple biomarkers in parallel. Course work or experience in Physics or Chemistry, is very desirable but not essential for participation in this project.

*Eugene Mele*

## **Project 1: Stacking textures in multilayer graphene**

Graphene is an atomically thin single sheet of carbon atoms, renowned for its exceptional mechanical and electronic properties. The related physical properties of few-layer graphenes are exquisitely sensitive to the atomic registry between its neighboring planes. In work carried out in 2013-2014 with Xingting Gong (Penn Junior, Physics Major, Vagelos Program) we studied graphene stacking motifs and discovered that they support a class of optimal spatially varying stacking patterns: textures which can be mathematically represented as complex analytic functions. This opens up the question of the interactions and assembly of these textures to form generic stacking patterns and networks in two dimensional layered materials. This project engages an eclectic mix of topics from physics, mathematics and materials science. PURM support for one additional undergraduate will be leveraged in a group collaboration with Gong, one graduate student and myself to further explore the elastic and electronic properties of graphene stacking textures. The PURM student will contribute to analytical and numerical modeling of elastic interactions in graphene stacking textures.

*Masao Sako*

## **Project 1: The Dark Energy Survey Supernova Survey**

Penn is involved in an exciting cosmology project called the Dark Energy Survey (DES), which will make precision measurements of the expansion history of the Universe and help understand the mysterious cosmic acceleration and the nature of dark energy. Using a new massive 520-Megapixel camera on the Blanco 4m telescope in Chile, this 5-year project will measure the detailed properties of over 300 million galaxies and discover thousands of supernova explosions billions of light years away. The PURM student will help search the imaging data for a wide variety of astronomical objects including new nearby and distant supernovae, gravitationally lensed galaxies, erupting stars, as well as previously unknown objects in our own solar system. Motivated students who wish to continue beyond the summer will have the opportunity to visit

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observatories. More information about the project can be found here --  
<http://www.darkenergysurvey.org/>

## **POLITICAL SCIENCE**

*Daniel Gillion*

### **Project 1: Have the Lives of Racial and Ethnic Minority Improved Under President Obama?**

Has the election of a black president led to more favorable executive policies for the racial and ethnic minority community? In addition, has President Obama's attention to minority concerns differed from previous presidents such as Clinton, Kennedy, or even Reagan. This question is discussed in informal conversations and on popular media outlets but is rarely explored in the scholarly world. In our project, we will examine whether President Obama has ushered in a new era of change for the minority community. In tackling this question, we will also address misconceptions that have become prevalent in the political discourse on black presidential representation. Thus, this project will require us to examine media sources (such as MSNBC, Fox News, and the Daily Show), review official transcript documents found in the Presidential Public Papers, and explore Census reports for information on African American, Latino, and Asian American communities. No prior background knowledge of these topics is needed. Students who engage in this project will only be required to think critically about contemporary events and be willing to examine issues of race that have arisen in Obama's administration. Moreover, students will pick up some helpful skills that will aid them in data coding, regression analysis, and text analysis. However, having any of these skills in advance is not a prerequisite for this project.

*Julia Gray*

### **Project 1: How Do International Organizations Actually Work? Power and Implementation**

This project asks students to explore the extent to which international organizations (IOs) such as the European Union (EU), the North American Free Trade Agreement (NAFTA) implement their mandates. Students will go through news articles on various international organizations to create detailed timelines for the activities, successes, achievements, and failures of that organization on an annual basis. This will help us understand how international organizations actually once they are formed; how countries influence the inner workings of IOs; and whether IOs actually matter for international cooperation. Students will need good writing skills and use of Excel.

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### **Project 2: Beware of Greeks Bearing Gifts: Presidential Giftgiving and Interstate Relations.**

How can we measure alliances between states, or the influence -- both intended and actual -- that one country has on another? This project centers on a novel way of quantifying relations between states, through the gathering of a dataset of gifts given to US presidents and state dinners held at the White House. These gifts can serve as a potential proxy for the relationship dynamics between a given pair of leaders. US presidential libraries contain extensive details on these gifts (Theodore Roosevelt once received a coyote and two Nubian lions from Ethiopia, for example). Researchers will be asked to contact presidential libraries and create a database of the gifts received by US presidents and the details of state dinners across time. This data will then be used to see if gifts indeed helped strengthen alliances or increase influence.

### **Project 3: Are Trade Agreements and Economic Organizations Good for Countries?**

Many countries sign economic agreements and belong to economic organizations such as the World Trade Organization (WTO), but do those agreements actually promote trade and make countries richer? Because countries usually sign multiple economic agreements -- for example, the United States is a member of the WTO and NAFTA and is also currently negotiating other agreements, such as a trade pact with the EU and the Trans-Pacific Partnership. In this project, researchers will be asked to examine the scope of trade commitments in various agreements and then to see if the countries in question have actually enacted those conditions into their own domestic laws. This will enable us to see the degree to which countries actually comply with economic agreements -- and in turn whether those agreements have any impact on trade and welfare.

*Nancy Hirschmann*

### **Project 1: The Body and the Will**

In this project I am exploring the notion of the will as illustrated in disability. The history of Western philosophy has posited the mind as the repository of the will. Philosophers since Aristotle have maintained that we have a lower or “animal” self that expresses brute desires through the body, and a mind or will that expresses “higher” desires for abstract ideals, as well as “second order” desires, or desires about desires (such as the desire to resist an impulse to eat). This has resulted in an elevation of mind and will over the body. But recent studies in neuroscience challenge that claim, holding that there is no “free will” as typically imagined by philosophers; that by the time we are conscious of a decision to act, our brain has already made that decision for us. I want to explore this issue from a theoretical perspective to inquire into the possibility of the will lying in the body to the end of examining how these new scientific findings can affect our understanding of the concept of “freedom.” I want a student assistant to research

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into the neuroscience literature on this topic. He or she will be expected to do a thorough bibliographic search and write up short (250 word) summaries of the findings of relevant articles. In effect, I want to learn about this field together with a student who has an interest in philosophical or theoretical questions. However, I am also looking for a student who has some scientific background, which I lack, to help me sift through, analyze, and evaluate the neuroscience literature.

### **Project 2: The Market versus Merit: A Study of the Possibility that the Market is Biased Against Achievement**

Commonly accepted wisdom among enterprises ranging from multi-national corporations to universities is that the market is the best measure of talent: skilled and talented workers are in demand, and are recruited by other companies, which results in competitive counter-offers that provide increases to salary and work benefits. However, does this model work equally well for men and women? Women are generally thought to be paid less and be promoted less in a variety of professional fields; often explanations are offered the women have a different professional “style” (viz. less competitive, more nurturant), that they lose competitive edge when they take time off to have and raise children, or that they are less skilled than men at negotiating. But what if the market is biased against women, such that women are seen as less competitive, resulting in fewer competitive offers and therefore fewer opportunities for increases in salary and benefits? Is the market really a gender-neutral measure of merit? In this study I want to examine the correlation between merit and market success. Taking public universities as my case study (because of greater availability of data), I want to compare objective measures of merit and success—measured primarily by publications—against market success—measured against salary. In the event that no gender bias is found, a different study may unfold; it may simply be possible that the market model of reward is not suited to the university, which has traditionally been based on merit as a marker of achievement and success. The student will be responsible for compiling some background research, gathering relevant data and helping me develop the analysis. Co-authorship of article is possible depending on the amount of work and level of analysis contributed.

### **Project 3: Examining the Relationship Between Online Culture and Course Evaluations**

In an age where anonymous Facebook postings can be so mean and thoughtless that they drive young people to harm themselves, is it possible that this culture of anonymous hostility has affected the university system of online course evaluations? Anecdotal evidence suggests a considerable increase in the number of "zeros" entered into course evaluations for large lecture courses compared to when evaluations were conducted in class on the last day of the semester. There is further anecdotal evidence that this is happening more frequently to women, who are generally proven to have overall lower course evaluation scores in large lecture courses. Is this coincidence or does it result from a hostility that a general climate of online anonymity fosters? This study seeks to examine that question by conducting comparative evaluation scores

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before and after the initiation of the online course evaluation survey. Students who have had experience doing survey research data are welcome to apply, and co-authorship is a possibility depending on the quality and amount of work done.

*Michael Horowitz*

### **Project 1: Forecasting International Political Events**

Professor Horowitz seeks undergraduate researchers help with research and analysis on international security, international economic, and international political questions. Students will work to track and report on events around the world and support the efforts of the project to forecast international events. The project utilizes a variety of social science methods to conduct forecasting, including prediction markets, the wisdom of crowds, teams, and algorithms. Interested students will play an essential role in helping the project directors design questions for over 2000 forecasters around the country to answer, along with tracking the outcome of those questions. We are especially interested in candidates with substantive interest and expertise from coursework in international relations and political science, but Professor Horowitz encourages all interested applicants to apply. If you want to learn more about the overall project, go to <http://www.goodjudgmentproject.com/>.

*Matthew Levendusky*

### **Project 1: The Polarizing Effects of Partisan Media**

This project looks to explore how Fox News, MSNBC and other partisan outlets shape political discourse and agendas. Do the frames used on Fox and MSNBC spread to other media outlets and political elites, or do they instead exist only in the partisan echo chamber? The project aims to answer this question. Working collaboratively, we will gather transcripts of programs from Fox and MSNBC and determine the issues discussed on these shows, and also how they are discussed (i.e., how they frame the issues). We will then see if these issues and frames spread to other media outlets and political actors. To do this, we will use a variety of text analytics techniques from computer science and linguistics. Students for this project should have strong computer programming and technical skills. In particular, students should have background in a text-processing language, in particular either Python or Perl. Other computing skills (in R, Stata, etc.) are preferable, but not required. Students without these technical skills can still be considered for non-PURM positions related to the project.

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*Marc Meredith*

**Project 1: Does Money Buy Elections?**

Do you enjoy using data to understand how the world works? Are you interested in understanding how the role of money that money plays in American Politics. If so, you may be interested in the PURM project. My research focuses on using data to try and understand why people vote and who they vote for if they do vote? I am looking for students to assist me over the summer in collecting data and building models that try improve our understanding of how campaign donations influence elections. I am particularly interested in candidates who are organized and who are willing to learn new computing skills to automatically pull off data that is currently sitting on the Internet.

**Project 2: The Causes and Consequences of Felon Disenfranchisement**

More than two hundred years after this country was founded on the principle of equality, felons are the only class of citizens still disenfranchised from the vote. Felon disenfranchisement has become a contentious and significant public policy issue as of late, a response to both the unprecedented rise of the carceral state and mounting questions of fairness in American democracy. Recent estimates by the Sentencing Project suggest that over five million citizens are ineligible to vote on the basis of a criminal conviction. I am looking for a student who is interested in helping me with a book that I am writing on this topic. I am particularly looking for someone who is willing to get their hands dirty in data.

*Brendan O'Leary*

**Project 1: Political Violence in Ireland in the Twentieth Century**

I will be in Ireland (North and South) in the summer. The successful student will asked to assist me in the conduct archival research at public records offices in either Belfast or Dublin or both. Provided CURF can fund the student's travel and aid them in accommodation I will be available for a weekly meeting. I will be able to get them visiting status at Queen's Belfast from mid-May to end of June, or at NUI (Galway) in July and August.

*Yuhua Wang*

**Project 1: Pollution in China**

The project uses firm-level emission data to examine the relationship between corruption and pollution in contemporary China. The student's responsibilities include collecting emission and inspection data from Chinese sources. A medium level of Chinese is required.

## PSYCHOLOGY

*David Brainard*

### **Project 1: Color Perception in Natural Tasks**

Color provides information about object identity and physical properties. For color to be useful, it needs to correspond to stable properties of objects and should not change when the conditions under which we see the objects changes. For example, it should be equally easy recognize whether an apple is ripe when we see it on a sunlit tree in the orchard or under fluorescent supermarket lights. How the visual system extracts information about object color from the light that enters our eye is a fundamental open question. We designed a task in which we ask the observers to recreate an arrangement of colored blocks by choosing matching blocks from a set of test blocks presented under a different illumination. This task captures the way color is used in everyday tasks, in which we use color information to guide our choices and shape our interactions with the objects around us. In this project we will study how observers' performance in our natural task varies across a series of stimulus manipulations (changes in color and intensity of the illumination, background or object color and shape). This will allow us to gain insight about the processes that enable stable perception of object color in natural viewing. Student duties include recruiting subjects, administering vision tests, conducting behavioral experiments and assistance with data analysis. The student will learn how to control and display experimental stimuli and analyze data using appropriate statistical methods (via Matlab or Excel). The student will gain in-depth understanding of the theoretical background of the project and an insight into all stages of the research process - from hypotheses generation to interpretation of results. Applicants should have completed introductory courses in i) cognitive psychology or neuroscience and ii) statistics

### **Project 2: Color constancy and sensitivity to changes in illumination**

While perception of object color has been studied extensively in vision literature, little is known about our ability to perceive illumination — how sensitive are we to changes in illumination and is this sensitivity related to our ability to maintain stable perception of object color across changes in illumination? In this project, we will test a hypothesis that good constancy of object color across a change in illumination is accompanied by relatively poor ability to detect this illumination change. Further, we will ask whether the ability to discriminate changes in illumination depends on the color of the illuminant. Our vision evolved in the environment in which illumination typically changes from yellowish (of a sunset sky) to bluish (on a cloudy day), while changes from reddish to greenish are far less pervasive. It is therefore reasonable to assume that our visual system would be more sensitive to “atypical” changes in illumination (red and green direction) when compared to more typical changes (blue and yellow direction). Student duties include recruiting subjects, administering vision tests, conducting behavioral

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experiments and assistance with data analysis. The student will learn how to control and display experimental stimuli and analyze data using appropriate statistical methods (via Matlab or Excel). The student will gain in-depth understanding of the theoretical background of the project and an insight into all stages of the research process - from hypotheses generation to interpretation of results. Applicants should have completed introductory courses in i) cognitive psychology or neuroscience and ii) statistics.

### **Project 3: Color Perception in Real and Simulated Scenes**

To study color perception one can create experimental stimuli using real objects and illumination or, with the aid of computer graphics programs, simulate scenes consisting of illuminated objects that observers view on a computer screen. While real objects are more natural stimuli for the visual system, computer simulated scenes allow for careful experimental control and easy stimulus manipulation. However, few studies have carefully explored whether there is a difference in observers' performance in perceptual tasks that involve real vs. simulated stimuli. To explore whether there are systematic differences between real and simulated stimuli, we will create a series of real stimuli and computer simulations of these same stimuli, and compare performance across the two. Our preliminary results suggest that perceptual effects for a simple two-dimensional stimulus — the famous simultaneous lightness contrast illusion— are roughly the same when the stimuli are closely matched. In the continuation of the project, we will compare lightness perception in real and the simulated three-dimensional scenes as they gradually increase in complexity. Student duties include recruiting subjects, administering vision tests, conducting behavioral experiments and assistance with data analysis. The student will learn how to control and display experimental stimuli and analyze data using appropriate statistical methods (via Matlab or Excel). The student will gain in-depth understanding of the theoretical background of the project and an insight into all stages of the research process - from hypotheses generation to interpretation of results. Applicants should have completed introductory courses in i) cognitive psychology or neuroscience and ii) statistics.

***Robert DeRubeis***

### **Project 1: Analysis of patients' understanding of gains made during psychotherapy**

This project involves the analysis of data collected for a large randomized clinical trial on the use of combined medication and cognitive behavioral therapy for the treatment of depression. For this particular project, we are interested in exploring participants' understandings about the causes of large and sudden between-session symptom improvements during psychotherapy. We are also interested in exploring the relations between these responses and how well the patients do after the gain they experienced. The main responsibilities of the student involve assistance with the coding of patients' responses, data cleaning, and data analysis. Prerequisites include familiarity with Excel. Successful completion of Statistics 101 or 111, or equivalent, preferred.

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### **Project 2: Testing a new and powerful approach to personalized medicine**

How do medical professionals decide which of two equally good treatments would be better for their patient? What if a genetic test would clarify the picture? “Personalized medicine” is the term for using such information to guide treatment decisions. But personalized medicine has been hamstrung by the idea that one variable – a gene, a gender, or an age group – will lead to optimal decision-making. What if there are two, three, or even more variables that could provide the kind of predictive information that would truly optimize a patient’s treatment? Our lab has developed one of the first systematic approaches that can take advantage of a variety of information to facilitate such decisions. Termed the Personalized Advantage Index (PAI), multiple variables are weighed in the prediction of what would be, for a patient with features, X, Y, Z, etc., the treatment most likely to benefit him or her. The first demonstration of our approach was published recently in the online journal PLOS One. We are now conducting tests in a variety of fields, from depression to PTSD to insomnia to cancer. Collaborating with statisticians and programmers from the Wharton School, we are now employing machine learning approaches to boost the power of our approach even further. Students will facilitate progress on this exciting venture by assisting with: data collection and preparation, statistical analysis, computer programming, literature reviews, and scientific reporting. A background in elementary statistics or computer programming preferred, but training will be provided in these aspects of the work.

### **Project 3: Empirically-derived personalized treatment plans for maximizing symptomatic change in cognitive therapy of depression and personality disorders**

Increasingly, the medical field recognizes the need for personalized medicine--empirically-determined algorithms for tailoring treatment to the specific pathology of particular patients within a disease category. Yet, this ideal of personalized medicine has yet to be applied to the practice of psychotherapy, especially in guiding the types of interventions that are most appropriate for a particular patient. Our project focuses on differentiating specific types of techniques used in cognitive therapy for depression that are most associated with long-lasting change for patients with co-morbid personality disorders, who are a high-risk group known to have poorer prognoses in psychiatric treatment. Students will receive didactic instruction as to the theory and practice of cognitive therapy for depression and the literature on personality disorders. Students will be responsible for coding psychotherapy tapes for technique usage, patient responses, and therapist-patient interactions. They will gain exposure to the practice of an empirically supported psychotherapy for patients with depression, hone their ability to quantitatively code qualitative phenomena, and critically evaluate processes of change in psychotherapy. Students will also be exposed and be encouraged to learn statistical analyses appropriate to the analysis of our data (e.g., multiple regression, logistic regression, hierarchical linear and nonlinear models), and to machine learning methods for predicting differential treatment response. No prior exposure to psychotherapy research is necessary, though possessing prior statistical and clinical/social psychological coursework is strongly preferred. Depending on

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the degree and quality of involvement, the student's work may culminate in a scientific poster presentation at a conference.

*Lori Flanagan-Cato*

**Project 1: The effect of estrogen on specific cell types in the amygdala**

A student involved in the project will be involved in immunohistochemistry, image analysis of brain sections, and data analysis. We will be testing the hypothesis that estrogen affects specific components of the circuitry within the amygdala to modulate anxiety in female rats. These tasks require basic chemistry background and attention to detail. Previous course work in biology, chemistry and/or BBB would be helpful.

**Project 2: The brain pathways that control sodium appetite**

A student involved in the project will be involved in behavioral pharmacology studies. We will be testing the hypothesis that neural activity in specific brain regions determines whether male rats prefer to consume water or salt. These tasks require basic chemistry background and attention to detail. Previous course work in biology, chemistry and/or BBB would be helpful.

*Sara Jaffee*

**Project 1: A Pilot Study of Stability in Risk and Protective Factors in Adolescents' Lives**

Youth exposed to adversity (e.g., abuse, neglect, having a parent in prison, exposure to violence) are at risk for emotional and behavioral problems, substance use problems, and low academic achievement. The goal of the current project is to examine whether exposure to risk factors is more stable and access to protective factors is less stable for adversity-exposed versus non-exposed youth. We are currently recruiting 100 14- to 16-year-olds from The Children's Hospital of Philadelphia pediatric practices in urban and suburban Philadelphia. Adolescents are interviewed to assess their exposure to adversity and protective factors (e.g., socially supportive relationships, optimism, role models) as well as family, neighborhood, and school factors. To enrich our understanding of protective factors, a representative sub-set of adolescents will participate in focus groups to assess their perceptions of factors that promote positive outcomes for youth in their communities. A summer undergraduate research assistant (RA) will coordinate recruitment and scheduling of adolescent participants. This will involve calling parent/guardians to ask permission to invite their adolescent to participate in an interview, and subsequently discussing the study with the adolescent. The RA will have opportunities to administer in-person psychosocial interviews with adolescents. In the later portion of the summer, the RA will assist with scheduling adolescents for focus groups. The RA will take notes during focus groups and have opportunities to train in qualitative data analysis. The RA will work closely with Sara

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Jaffee, PhD, a faculty member in the Psychology Department, in addition to a graduate student in clinical psychology.

## *Deena Weisberg*

### **Project 1: What do children know about science?**

On the one hand, children are notoriously bad at science: They don't know how to form hypotheses, manipulate variables, or draw conclusions from data. But on the other hand, children are extremely good at science: They're curious about the natural world, they know a bit about how various aspects of the world work, and they can make accurate causal inferences. What can we conclude from these two opposing observations, and what do children actually know about science? This project addresses these questions by interviewing 6- to 8-year-olds to discover what they know about doing science and what they believe science is. For example, we tell children brief stories about characters who investigate questions in various ways. We ask the children to report whether they think these characters are really doing science, and why. Creating an age-appropriate measure of children's understanding of science and their abilities to reason scientifically can help researchers and educators improve these skills in children. The student will assist the professor in all aspects of conducting and running psychological studies on this topic. Duties will include creating stimuli, recruiting subjects, interviewing subjects, compiling subjects' responses, and managing and analyzing data. Applicants should have completed some coursework in psychology, cognitive science, and/or neuroscience. Previous experience with children is desirable but not required.

### **Project 2: How do children think about reality and fantasy?**

Most people think of children as being wildly imaginative, fantasy-prone, and lost in the worlds of stories and pretend play. But recent research in my lab has discovered that children's understanding of stories is tightly constrained by reality, and that children are actually less fantasy-prone than adults. Why is this the case? How do children think about stories? Does their understanding of a story differ depending on how realistic that story is? In this study, I plan to answer that question by presenting preschool-aged children (4- and 5-year-olds) with a variety of different kinds of stories and probing what they think about the events in these stories. If a story is generally fantastical, does that mean that any fantastical event can occur in the story, or are there limits? What might these limits be? If a story is generally realistic, but contains a single fantastical element, does that element change the structure of the rest of the story world? If so, how and why? Learning more about children's imaginations and their interactions with stories can help us to understand how they think about the structure of reality and how their reasoning capacities work in general. The student will assist the professor in all aspects of conducting and running psychological studies on this topic. Duties will include creating stimuli, recruiting subjects, interviewing subjects, compiling subjects' responses, and managing and analyzing data.

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Applicants should have completed some coursework in psychology, cognitive science, and/or neuroscience. Previous experience with children is desirable but not required.

## RELIGIOUS STUDIES

*Justin McDaniel*

**Project 1: Thailand, Laos, Cambodia Studies Website Development** *Rising Sophomores only*

The student will be responsible for researching (on-line and in the library) resources for the study of Thailand, Laos, and Cambodia. These resources are lacking at Penn and so she will create lists of bibliographic courses, films, websites, and the like for students interested in this area of the world. This region has been largely absent from the curriculum at Penn and this website will give interested students resources from which they can construct independent research projects.

## SLAVIC LANGUAGES AND LITERATURES

*Julia Verkholtantsev*

**Project 1: Myths of Origin and the Art of Etymology in Medieval Chronicles** *Rising Juniors only*

This project deals with the analysis of myths of origin recorded in medieval and early modern chronicles and historiographic sources. “Myths of origin” are stories that describe the origin of ethnic groups, their names, and the names of the places that they inhabit. Many of these myths are supported by etymological interpretations of these names. I am thus interested in why language is given the super power of explaining the ethnogenesis of the people who speak it and even establishing the legitimacy of their leaders. I am currently working on Czech, Polish, and Hungarian chronicles, but I plan to expand this project to include all European sources. This project would be appropriate for a student with particular interest in history, linguistics, and working with primary sources. The student will assist in the collection and analysis of data for this project: research and compile lists of sources to be examined; identify suitable narratives, and engage in preliminary analysis. To work on this project, the student needs to possess good analytical skills, library research skills (i.e., know how to work with library catalogs and conduct thematic searches), and be attentive to detail. Knowledge of languages (e.g., French, German, Latin, Spanish, Italian, etc.) is desirable.

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## SOCIOLOGY

*Jerry Jacobs*

### **Project 1: Disruptive Technologies and Employment Opportunities**

I propose to conduct a set of case studies of labor displacement due to technological change in order to better understand the long-term prospects for employment of workers at various skill levels. While the specter of jobless growth or even a jobless future is posited by some observers, there are good reasons to believe that these arguments are too sweeping and too general. A more detailed analysis of particular cases will distinguish those where innovation tends to contribute to job displacement from those that tend to generate new employment opportunities, and finally those which have complex, contradictory and transitory effects. No prerequisites. Student responsibilities will vary depending on the state of the research, beginning with library research, organizing data in spreadsheets, and assisting with case studies.

*Grace Kao*

### **Project 1: Interracial Romance and Friendship in Adolescence and Adulthood**

The student will help Dr. Kao work on a book on interracial romance and friendship. S/he will work on updating a bibliography and writing short summaries of books and articles. The student will also be able to participate in the framing of specific chapters and help make tables and charts using excel. The student should have taken at least one social science class and one statistics course.

## SOUTH ASIA STUDIES

*Deven Patel*

### **Project 1: Text and Textile: Literature and Art as Singular Material Objects**

Research (library and on-line) of relevant studies on textual objects or material culture that relate to both text (literature) and painting (art) globally. Some collating, scanning, copying.  
Prerequisites: an interest in art and literature or art or literature.

### **Project 2: Virtual Literary Worlds**

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Research (library and on-line) of relevant studies on the "virtual," including recombinative poetics, the remix, Oulipo and avant-garde poetry, technology, philosophy of the virtual, etc. Some collating, scanning, copying. Prerequisites: interest in literature, music, or "virtual reality"

## **THEATRE ARTS**

*Marcia Ferguson*

### **Project 1: Patience in the Arts**

Patience in the Arts: I would be grateful for help researching an article I am writing on the role of patience in performance, both in the viewer's experience, and in the performer's technique. An actor's layering of expression, the timing in its delivery, and the juxtaposition of subtext with text – in the dialogue and in the silences between it – is a key ability of great actors. On the other hand, audiences must wait for a plot to thicken, or a turning point to be reached, and the quality of that waiting – with bated breath, or a yawn? – determines the viewer experience. Through research, interviews, and watching performances, I hope to develop a theory about the role of patience in the reception and production of a performance, and in the exchange of emotion between actors and audiences. Performances that move audiences can be analyzed in terms of their pace, and the velocity with which emotion is expressed (by the performer) and felt (by the viewer). Like a classic well-made play, the ways in which exposition and theme are layered, and the pace at which they unfold in any given performance, have a role in determining how audiences react. How performances embody space and time, pattern and rhythm, and how they cultivate and disperse suspense, are techniques at the heart of my inquiry. Student duties will include gathering materials for viewing, reading original texts and interviews by artists and critics in their descriptions of this phenomenon, and analyzing results. Our goal will be to come to some conclusions regarding the role and function of patience in the arts.

*Rosemary Malague*

### **Project 1: Book Project: Empowering Scenes for Women**

For a planned anthology of acting scenes that I am compiling with a colleague from Davidson College (that already has interest from an academic publisher), I am seeking a student to read contemporary plays by women, seeking scenes for women. The task will likely involve summarizing the action of the play, and identifying possible scenes for the anthology; depending upon how quickly we move, it may also involve securing permissions from publishers for reprinting this material in a collection. Students from Gender Studies, Cinema Studies, English,

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Writing, and/or Comp Lit might find their interests align with this project. (Note: This work expands on my recent book, AN ACTRESS PREPARES: WOMEN AND "THE METHOD.")

### **Project 2: Feminist Theatre Biography: Stella Adler**

I am working on a biographical study of the highly influential American acting teacher, Stella Adler, also a member of a famous family of the Yiddish stage. I am interested in the impact of her gender and Jewish identity on her career. A student who chooses this project will aid me by conducting newspaper searches from the date of her birth, 1901, to approximately 1961. (I am most interested in the period of 1941 - 1951, but am charting the trajectory of her career.) I also have compiled photographs of her correspondence from this period, and could use assistance organizing and digesting it. Students interested in mid-twentieth century American History, Women's Studies, Jewish Studies, and the theatre might find that this project aligns with their interests.

## **URBAN STUDIES**

*Andrew Lamas*

### **Project 1: One-Dimensionality: Critical Theory Project**

This year—2014—is the fiftieth anniversary of one of the twentieth century's most provocative and widely read books of radical theory—Herbert Marcuse's *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society* (Boston: Beacon Press, 1964). I will be the editor of a special issue in *Radical Philosophy Review* (scheduled for publication in 2015) that will feature articles from some of the world's most important scholars and activists working on critical theories, liberation philosophies, social movements, and other politically engaged projects in the social sciences, humanities, and other disciplines. We will be exploring, critiquing, assessing, and extending the critical legacy of this important book—in the wake of the Tunisian revolt, Tahrir Square, Occupy, and other contemporary social movements, and amidst rising inequality, automation and unemployment, global land grabs, authoritarianism, surveillance, the criminalization of everyday life, global Terror wars, a “money-is-speech” US Supreme Court, ecological destruction, and austerity amidst record corporate profits. The student selected for this summer research project will work with me (and a team of scholars around the world) to publish this special journal issue. The student's name will appear in the published journal. The ideal student for this project is someone who: (a) is interested in theoretical and political questions across a wide range of disciplines, (b) is committed to thinking deeply and critically about capitalism, and (c) enjoys—and excels in—research, editing, and writing.

### **Project 2: Critical Refusals: Radical Video Project**

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A major conference took place at Penn—sponsored by the International Herbert Marcuse Society—in Fall 2011. Featured speakers included some of the world’s most important scholars and activists working on critical theories, liberation philosophies, and other socially engaged projects in the social sciences, humanities, and other disciplines. All of the conference lectures, presentations, and workshops were digitally videotaped. In connection with the conference, hundreds of people marched—with Angela Davis—to the OCCUPY PHILLY encampment at City Hall. This protest march and Angela Davis' speeches (in Irvine Auditorium and at City Hall) were also videotaped. The student selected for this summer research project will work with me to edit these videos for worldwide distribution. The student's name will appear on these videos. The ideal student for this project is someone who: (a) is interested in theoretical and political questions across a wide range of disciplines and (b) has an interest in—and a demonstrated capacity for—digital video editing. The project requires a student with aesthetic sensibilities, a good sense of design, and some experience editing videos—for example, with iMovie or Final Cut Pro—for personal, academic, or other projects. We would like the videos to be edited in Final Cut Pro X or Adobe Premiere CC (Creative Cloud). If you have not used either of these programs, but you are committed to learning one of them, then you are still eligible to apply for this project.

### **Project 3: Protest & Political Economy Project: Documenting Discourses of Inequality**

From the Arab Spring to Wisconsin, from the Tea Party to Occupy, from Madrid to Athens, from Santiago to Jerusalem, from Johannesburg to Beijing, from Toronto to London, and elsewhere across the globe, political and economic power was challenged in significant ways in 2011. Contending discourses about inequality were important features of the protests—and of the counter responses. One part of this project will document the critiques and defenses of inequality as well as the proposed responses to inequality. A second part of this project will document the development of cooperatives and alternative local currencies in the wake of the 2011 movements. The ideal student for this project is someone who: (a) is interested in learning about ways of framing and addressing the problem of inequality and (b) enjoys—and excels in—research across a range of sources (e.g., speeches, YouTube videos, protest signs and posters, songs and chants, slogans, religious sermons, news articles and editorials, blogs, official statistical reports, policy statements by think tanks, analyses by public intellectuals, campaign rhetoric, legislative proposals). This project may involve some travel—during the summer of 2014—throughout the US and the world to document various local initiatives.

## **Dental Medicine**

### **ORAL MEDICINE**

*Sunday Akintoye*

#### **Project 1: Role of Orofacial Mesenchymal Stem Cells in Oral Cancer Complications.**

Current research in our laboratory is focused on bone mesenchymal stem cells, dental pulp stem cells, dental manifestations of metabolic bone diseases and tissue regeneration. Bone mesenchymal stem cells are putative population of post natal stem cells within the bone marrow organ that have the ability to form different connective tissues. Bone mesenchymal stem cells have skeletal site-specific properties that affect bone regeneration both physiologically and clinically. Our goal is to understand these differences at the cellular and molecular levels and apply them therapeutically to bone and dental tissue regeneration. Students will work on projects designed to evaluate and compare phenotypic and functional properties of maxilla and mandible (orofacial bones) bone mesenchymal stem cells (OFMSCs) with those of iliac crest (axial bone). Another project is focused on osteoradionecrosis, a major dental complication of cancer radiotherapy in the head and neck. So we are investigating the radio-responsiveness of OFMSCs and their roles in the onset and pathogenesis of osteoradionecrosis. Adequate training is provided but some research lab experience and basic computer skills are desirable.

### **PATHOLOGY**

*Kelly Jordan-Sciutto*

#### **Project 1: Alternative splicing of the E2F1 transcription factor in Neurons**

To assess alternative splice variants of E2F1 that are specific to neurons. Many transcripts are alternatively spliced and delivered to discrete subcellular locations in neurons for local translation. Regulation of such RNAs is a subject of intense investigation. Using RNA isolate from primary rat neurons, we would like to determine the neuron specific splice variants of E2F1 and the conditions that lead to alternative splicing. Students will culture primary neurons, isolate RNA, perform reverse transcription PCR and real time PCR, and localize RNA in neurons by in situ hybridization.

#### **Project 2: Investigating RNA binding proteins in Neurons**

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Neurons transport RNAs to local sites for translation in response to neuronal stimulation. Regulation of the RNA localization, stability, splicing and translation is regulated by RNA binding proteins; however, only a few RNA binding species have been identified to date. We would like to use a novel technology called PIP-Seq to identify the RNA sequences bound in neurons and distinguish the roles of such RNA binding activity in neurons. Students will learn to culture primary neurons, isolate RNA, prepare isolated RNA for deep sequencing, and analyze obtained data sets.

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## **Design**

### **ARCHITECTURE**

*Yun Kyu Yi*

#### **Project 1: Smart Mobile Application for Residential Building Energy Usage Simulation**

Building energy simulation is proving to be one way of bridging the gap in knowledge between the building and its energy consumption. The power of building energy simulation lies in its use of physics to computationally model and predict how future changes to a building (e.g. upgrading windows, insulation, or equipment) would impact energy bills. Yet, current simulation software requires the expert use of powerful computer hardware to define parameters and produce accurate results, placing it beyond the reach of the homeowner. We propose utilizing data from smartphone sensors to bring the power of building energy simulation to the homeowner. This project embraces technologies to better educate residents about their single most important investment: their own homes. In an easy-to-use smartphone application, a building energy simulation tool would empower residents to learn about their homes, and make informed decisions as to which home improvements to implement. As a first step, we propose to develop a means of collecting and logging temperature and humidity data, creating simple building geometry, and executing energy simulation with an intuitive user interface. This research will be the ground work to develop application to be utilized for real time simulations. The research needs undergraduate support in following area: The research needs undergraduates to develop application to receive and collect environmental factors such as temperature, humidity, etc. During the main research, undergraduate will observe, learn and support energy modeling application. This research will allow undergraduates an opportunity to explore energy simulation modeling which is an outstanding skill for architectural and building engineering careers and great opportunity for computer science major to develop practical application.

#### **Project 2: Performance Based Parametric Design Tool Development**

The use of computers in architecture has extended beyond computer-aided design systems (CAD) to include dynamic modeling and animation software. The use of this technology moves beyond the rendering and refining of ideas to the generation of form. These programs are no longer mere tools, but have become collaborators in the creative process. However, using new software as a morphogenetic strategy does present potential problems. In a time-based process, an endless flow of geometric transformations gives rise to the problem of selection. Building simulation offers the potential to provide an alternative method for generating architectural forms. Simulation programs are utilized to assess and predict many aspects of building performance. This project develops module to plug-in with architectural CAD tool (NURB) that

able to integrate environmental performance analysis and the design process, with an emphasis on parametric methods. Performance analysis techniques can provide enormous amounts of information to support the design process, acting as feedback mechanisms for improved performance. Further parametric design tool will be combined with decision-making methods to achieve more complete integration. This research will be the ground work to develop application. The research needs undergraduate support in various stages. Undergraduate will participate to write CAD scripting that will further developed as a plug-in for CAD tool, this includes populating geometry information, connecting with simulation program and decision making tool. Undergraduates will have an opportunity to explore NURB tool and building simulation modeling which is an outstanding skill for architectural and building engineering careers.

## CITY AND REGIONAL PLANNING

*Amy Hillier*

### **Project 1: The Ward: Race and Class in Du Bois' Seventh Ward**

The Ward: Race and Class in Du Bois' Seventh Ward (formerly Mapping Du Bois) is now in its tenth year. Directed by Associate Professor of City & Regional Planning, Amy Hillier, the project aims to engage high school students and the broader public in a dialogue about race and racism using W.E.B. Du Bois's 1899 classic book, *The Philadelphia Negro*, as its springboard. Du Bois came to Philadelphia in 1896 to study the problems that Blacks living in Center City between Spruce and South Streets—the heart of the black community—faced. To date, our team has created an online interactive mapping system of the area Du Bois surveyed, 1911-1913, a 15-minute documentary, “A Legacy of Courage: W.E.B. Du Bois and The Philadelphia Negro,” draft curriculum, oral history collection and board game. For more about the project, visit [www.dubois-theward.org](http://www.dubois-theward.org). During the summer of 2013, our team will focus on finalizing our five-day high school curriculum, expanding our oral history collection, and integrating personal stories with digital maps showing neighborhood change. Interest in working with high school youth, interviewing experience, and experience with graphic design and/or video editing welcome but not required.

### **Project 2: Evaluating the Impact of a Non-profit Supermarket on Food Shopping and Diet**

After a decade with no supermarket, Chester welcomed a new nonprofit supermarket in September 2013. Run by Philabundance, the region's largest food bank, Fare & Square is a novel retail model that may be replicable in other low-income communities. Dr. Hillier and her colleagues are conducting an evaluation of the impact of the opening of the new supermarket on food shopping and diet among Chester residents. Research assistants will be involved in data collection (qualitative interviews, field-work in local food stores), data coding, and data analysis.

No previous research experience required, but students should be willing to conduct field research in Chester, PA (public transportation is available).

*David H. Hsu*

### **Project 1: Developing a Local Online Marketplace for Green Infrastructure**

The City of Philadelphia has become a national leader in green infrastructure, by enacting a market-based policy to reduce water pollution, and to increase the amount of green space in the city. As part of a research project with the US EPA, this opportunity is for a student to help design a web-based tool that connects city agencies with real estate owners, engineers, developers, and investors. The student would not do any direct programming, but would instead work with graduate students and the professor, David Hsu, to develop a document that describes how such a website or marketplace might work. This would require the student to become familiar with how various computational, statistical, and economic models work with existing data, and how these can be presented simply to users. This project would develop skills in project management and user interface design in the area of markets for real estate, urban property, and environmental services. The student would work directly with researchers and web developers, and assist in the development of a presentation at the end of the summer to officials from the City of Philadelphia, the USEPA, and other researchers and policymakers from around the Philadelphia region. This would provide excellent networking opportunities with both researchers and web developers, development of research skills, as well as a good look at how environmental policies are formulated and implemented in complex urban environments. Pre-requisites include strong technical writing, quantitative and analytical skills, familiarity with coding and how websites are constructed.

### **Project 2: Research into Elasticities of Environmental Consumption**

The City of Philadelphia has become a national leader in green infrastructure, by enacting a market-based policy to reduce water pollution, and to increase the amount of green space in the city. As part of a research project with the US EPA, this opportunity is for a student to research the existing literature in environmental economics, in order to understand how consumers respond to price changes in basic environmental resources, such as land, energy and water. The student would work with Professors John Landis and David Hsu in City and Regional Planning to survey the literature. This project involves: 1. Reading a great deal of academic literature in environmental economics 2. Discussing with graduate students and professors 3. Writing descriptions of the strengths and weaknesses of the existing literature. 4. Writing a review article for publication that would survey this literature for urban planners. These are all critical skills for research. A particularly advanced undergraduate could work on implementing and testing models using statistical programming and geospatial (GIS) modeling techniques. Pre-requisites include courses in microeconomics, environmental economics, or policy analysis. Finally, the

undergraduate at the end of the summer would present their research to academics, policymakers, and consultants who are all directly working on this problem in Philadelphia. This offers an excellent opportunity to explore future career interests in urban environmental policymaking, as well as to make contacts with a wide variety of people, agencies, and organizations.

## FINE ARTS

### *Orkan Telhan*

#### **Project 1: Microbial Fuel Cells as Designed Artifacts**

Microbial Fuel Cells (MFCs) are new kinds of batteries that use bacteria to convert biodegradable material into electricity. This technology has promising applications both in low cost renewable electricity production and designing new forms of sustainably powered household artifacts such as lighting elements, furniture, architectural materials and components. Students joining this research will design fuel cells in a variety of form factors such that both the aesthetic and functional affordances of the designs can be evaluated for different applications. The research for summer 2014 will focus on building alternative cell prototypes with different microbial ecologies and explore various serial and parallel cell arrangements that can power smart materials and objects with computational capabilities. Students are expected to have basic prototyping skills such as laser cutting, 3D printing, and model making etc. Biology or electronics background will be a plus but will not be required for the research.

#### **Project 2: Design Research for Electronically Augmented Paper Products and Electroluminescent Displays**

Paper is one of the most versatile media that is deeply rooted in the culture of design. It is a very expressive medium that allows the design of a wide variety of artifacts—from posters to packaging, clothing, furniture, and buildings. Today, it is also possible to ‘print’ electronic chips, display elements, batteries, solar cells, and sensors onto ‘paper’ to design low-cost, sustainable products with computational capabilities. ‘Augmented paper products’ can harvest their own energy, display static or animated graphics, and combine sound and interactivity with real-time information. These products not only find applications as display systems, smart labels, interactive posters, books, toys, games, but also open new possibilities for artistic expression. Students joining this research will focus on identifying new concepts, product ideas and applications that will demonstrate the practical and expressive potential of augmented paper products. The goal is to develop both product and application prototypes, and utilize them to attract further academic collaborations, corporate sponsorships, and commercialization opportunities. Students with basic visual design skills are preferred but not required.

## **Education**

### **CIVIC HOUSE**

*David Grossman*

#### **Project 1: History of Civic Engagement at the University of Pennsylvania**

Penn is seen as a national leader and model in civic engagement by students, faculty and with regard to the institution's overall commitments to local national and global initiatives. And over the past two years, both Civic House and the Netter Center for Community Partnerships celebrated significant anniversaries (15 and 20 years, respectively). While selected staff of these organizations and other long-standing faculty and administrators understand Penn's strong traditions in these areas, there is little, organized written record to help the University understand and learn from its past work. This project seeks to initiate a broader look at Penn's history of engagement to inform practice here, and more generally across higher education. Under the guidance of the faculty mentor, the student involved in this project would have the opportunity to learn and chronicle the broader literature in this field, participate in archival research, and conduct interviews with faculty, administrators, and community partners who have been important stakeholders in and observers of Penn's role over the years. In addition to gaining hands-on research skills in these areas, the student researcher would have the opportunity to learn about a rich aspect of Penn's and the city's histories, and also interact with a wide variety of people from within and outside of the University.

#### **Project 2: Course Design: Senior Seminar in Public Service** *Rising Juniors only*

Where the Penn Civic Scholars Program provides the opportunity for a number of Penn undergraduates to integrate their academic and civic engagement work over the course of their four years at Penn, there does not exist a course or program whereby students who are not Civic Scholars can do so in an interdisciplinary seminar, as a capstone to their undergraduate careers. A Senior Seminar in Public Service (working title) would offer students an opportunity to conduct research that is academically rigorous as well as informed by and useful to specific community organizations or public interest constituencies. Another planned emphasis of the course would involve students' exploration of their undergraduate engagement and academic experiences as they apply to their lives after college. Such a course would be available to students from a several areas of study so as to reflect the interdisciplinary of applied work and to enrich the intellectual experience for all involved. Under the guidance of the faculty mentor, the student researcher would explore relevant reading materials and consult with syllabi and capstone research projects across relevant disciplines at Penn and elsewhere. The student researcher would also assist the faculty mentor in synthesizing the findings toward a final report

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and the beginnings of a syllabus for the proposed course. Students will gain experience in basic library research, service-learning pedagogy (and general pedagogy), and in interviewing faculty and potential partner organizations.

### **Project 3: Mapping and Connecting Civic Engagement at the University of Pennsylvania**

Penn is in the final stages of its decennial reaccreditation; the University's self-study for the process was largely built around broader institutional objectives, one of which is local engagement. Among the final report's Major Recommendations was the directive that "Penn should strengthen the coordination of its local and national engagement initiatives for undergraduates." Under the guidance of the faculty mentor, the student researcher would continue the work of the Local Engagement Working Group in a variety of ways, including, but not limited to: organizing and chronicling findings that could not be included in the final report; seeking and reporting upon areas of effort that were not uncovered by the Working Group, and; identifying and reporting on the numerous connections and opportunities for integration among Penn's many civic engagement efforts. The final product of the student's research will greatly aid the faculty mentor and others dedicated to carrying forward the report's recommendations and Penn's related efforts. The student researcher will review primary and secondary materials, interview stakeholders, and hopefully utilize relevant software (such as GIS mapping or networking software) to help illustrate the above-mentioned connections and to assist the faculty mentor in developing recommendations for future practice and research.

## **HIGHER EDUCATION**

*Marybeth Gasman*

### **Project 1: Penn Center for Minority Serving Institutions**

The Penn Center for Minority Serving Institutions (MSIs) ([www.gse.upenn.edu/cmsi](http://www.gse.upenn.edu/cmsi)) is dedicated to supporting MSIs and those scholars that conduct research pertaining to them. MSIs include Historically Black Colleges and Universities, Tribal Colleges, Hispanic Serving Institutions, and Asian American Pacific Islander Serving Institutions. The students working with us would be working on research related to MSIs (including peer reviewed papers and policy reports) as well as working with our staff and research team to plan programs for MSIs, including think tanks and tool kits for scholars.

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## TEACHING, LEARNING, & LEADERSHIP

*Rand Quinn*

### **Project 1: From desegregation to diversity: The transformation of student assignment policy, 1954-present**

Demands to desegregate led communities to debate the role of parents, districts, and courts in the determination of which students attend which schools. As desegregation and affirmative action jurisprudence evolved, as local and societal attitudes shifted, and as student populations in urban districts changed, competing ideas of the purpose and parameters of student assignment were mobilized. Our goal is to understand the transformation over the last six decades of student assignment from a remedy for state discrimination to a mechanism for diversity, the corresponding rise of school choice, and the evolving sociolegal context that, when paired with local community mobilization, facilitated these changes. Primary duties include: (1) conducting a literature search on community mobilization, race, and the politics of school desegregation and school choice; (2) compiling and coding relevant archived organizational documents of the NAACP; (3) cataloging past and present school district student assignment policies and schemes; and, (4) compiling and coding newspaper articles, letters to the editor, and opinion pieces that pertain student assignment, the use of race and other factors in assigning students to schools, and school desegregation. Prerequisite: an interest in the political history of urban education.

### **Project 2: Understanding & documenting youth activism in Philadelphia schools**

Urban school districts throughout the nation are contending with declining enrollment, aging facilities in disrepair, severe fiscal constraints, persistently low achievement, and increased competition with charter schools. Philadelphia is a case in point. Just in the last 18 months, the School District of Philadelphia was forced to borrow \$304 million dollars to cover basic operating expenses, close 10 percent of its schools, and lay off thousands of employees. Essential student programs have been curtailed or eliminated, and the district faces the very real prospect of more cuts and closures in the 2014-15 school year. The crisis has led to the mobilization of local youth who are challenging existing educational arrangements and pushing for institutional change. Our goal is to understand—through a research study and accompanying documentary film—the processes by which Philadelphia youth mobilize to address local school issues. Primary duties include: (1) conducting (with a doctoral student or the sponsoring faculty member) semi-structured, open-ended interviews with students and student leaders; (2) observing and documenting student meetings, public protests, and school district town halls; (3) assisting on film shoots; (4) conducting a literature search on youth organizing and civic engagement; and, (5) compiling archival material on school reform and the School District of Philadelphia. Prerequisites: an interest in youth advocacy and activism, urban education reform, ethnography, and film.

## **TEACHING, LEARNING, & LEADERSHIP - CONSORTIUM FOR POLICY RESEARCH IN EDUCATION**

*Jonathan Supovitz*

### **Project 1: Education Policy Research and Writing**

The Consortium for Policy Research in Education is conducting the IES-funded evaluation of Reading Recovery, a first-grade literacy intervention. This high-profile study includes the largest randomized controlled trial ever conducted in the field of education. Our summer project offers an undergraduate researcher the opportunity to contribute meaningfully to this important project while building expertise in education policy. Working closely with CPRE researchers, the student will lead the development of an extensive literature review spanning several areas of research relevant to the Reading Recovery project and to education policy research in general. This project offers authorship opportunities on forthcoming papers and reports. There are no prerequisites for this position; however, it is a writing-intensive role. The ideal candidate will have excellent writing skills, will enjoy research, and will be interested in education policy.

## **Engineering and Applied Sciences**

### **BIOENGINEERING**

*Danielle Bassett*

#### **Project 1: A NeuroPhysics of Development.**

The human brain is a complex system composed of many interacting parts. Tools to deal with these types of systems have been developed in the context of social networks like Facebook and Twitter, but have statistical validity in many other contexts. This project will focus on applying these tools from network science to the human brain, to understand how the interactions between different parts of the brain are formed during development. The student will use existing data sets from healthy children and from children who have gone on to develop psychiatric symptoms. The goal of the project is to characterize changes in brain network structure that accompany both healthy and abnormal brain development. To meet this goal, the student will analyze the data in MATLAB using a combination of existing modules and newly developed analysis techniques. Familiarity with linear algebra and MATLAB programming is required. Prior course work in neuroscience, psychology, or cognitive science is not necessary. An interest in interdisciplinary research is advantageous.

#### **Project 2: A NeuroPhysics of Learning.**

How does your brain change when you learn a new motor skill like playing the piano or hitting a tennis ball or dancing a new jig? Which new connections are formed? Which unnecessary connections get rewired? In this project, we will use existing magnetic resonance imaging (MRI) data to answer these questions. We will use tools from network science, a field commonly associated with understanding social networks like Facebook and Twitter, to characterize the complex network of interconnections inside of healthy human brains. We will watch as these connections change as people learn a new motor skill, and quantify these changes statistically using network measures. The end result of this project will be a better understanding of how people learn, and will open up new avenues for research into methods to optimize learning environments. Familiarity with linear algebra and MATLAB programming is required. Prior course work in neuroscience, psychology, or cognitive science is not necessary. An interest in interdisciplinary research is advantageous.

#### **Project 3: Physics of Granular Materials**

Sets of particles, beads, stones, or sand are often referred to as granular media. These systems can display fascinating emergent phenomena including force chains, which consist of particles

that are held together by a network of mutual compressive forces. A critical open question is how the presence of these force chains changes the transmission of acoustic, mechanical, or electrical signals through the material. A fundamental understanding of this process would inform non-destructive testing approaches; for example, in probing seabeds or identifying oil reservoirs. In this project, the student would analyze existing data gathered from particulate systems, identify force chains using in-house MATLAB based software, characterize force-chain shape in both geometric and abstract topological spaces, and link changes in shape to external perturbations using acoustic or mechanical signals. Familiarity with linear algebra and MATLAB programming is required. Prior course work in materials science is not necessary. An interest in interdisciplinary research is advantageous.

*Jason Burdick*

**Project 1: Hydrogels as Engineered Cellular Microenvironments**

Hydrogels are water swollen polymeric networks that possess many similar properties such as mechanics and water content to tissues. More specifically, hydrogels can be engineered to control features including their ability to undergo proteolytic degradation, their 3 dimensional structure, and their mechanical properties to control cell behavior. My laboratory is particularly interested in controlling adult stem cell behavior towards fates such as chondrogenesis for applications in tissue engineering and regenerative medicine. The specific project will involve encapsulating and characterizing cells within these hydrogel environments and better understanding the relationships between material cues and cell behavior.

*Paul Ducheyne*

**Project 1: Inhibition of bacterial adhesion and biofilm formation on zwitterionic sol-gel film**

Sol-gel silica is a biocompatible and biodegradable material that can incorporate many therapeutic drugs. Previously, micron-thin sol-gel films have been applied on orthopaedic devices for the prevention of infection by releasing the potent antibiotic vancomycin at a constant rate for several weeks. The processing of nanoporous sol-gel silica is flexible, such that any structure and composition easily can be achieved. In this project we intend to rely on this processing flexibility in order to synthesize a non-fouling surface. In order to arrive at this goal, we will focus on achieving a unique surface chemistry capable of providing non-fouling behavior. Endowing surfaces with strong fouling resistance adds an extra benefit to the micron-thin films that can release antibiotics, since the surface remains active in staving off bacterial adhesion after the depletion of antibiotics. Recent studies suggest that the use of zwitterions can produce non-fouling surfaces, and thereby resist bacterial adhesion and biofilm formation. The

mechanism is that zwitterion attracts a large number of water molecules, producing a hydrated surface that leads to a large excluded volume and thus could prevent proteins from binding to the surface. This study will involve research to synthesis zwitterionic non-fouling sol-gel films. The first step of this study is to prepare the zwitterionic sol-gel by adding selected molecules to the sol-gel film. The study will continue to characterize the zwitterionic sol-gel film. The film properties such as contact angles and film stability will be measured. The antifouling properties of the sol-gel films will be assessed with a bacterial adhesion assay. This assay was routinely performed in our lab in the past. The student will actively participate in all stages of the research, including methods formulation, experimentation, and data interpretation and reporting. He/she will learn the synthesis and functionalization of sol-gel based biomaterials. The student will also gain hands on experience regarding the synthesis and characterization of sol-gel films. He/she will have the opportunity to address a critical biomaterials and biomedical goal through fundamental research.

### ***Christopher Fang-Yen***

#### **Project 1: Investigating worm sleep using a microfabricated multi-well array**

Our lab aims to understand the neural and genetic basis of behavior in the roundworm *C. elegans*. Using 3D printing technology we have developed a microfabricated device for imaging long-term behavior in hundreds of worms simultaneously. In this project, which will be done in collaboration with the Raizen Lab (Neurology), the student will use these devices to study the genes and neurons responsible for a sleep-like behavior in worms. Skills you will learn include worm handling, microscopy, image processing, and genetic analysis.

### ***Beth Winkelstein***

#### **Project 1: Defining Biomechanics of Pain**

Students will assist with measuring whole body, joint and tissue level biomechanical responses in a the context of tissue injury and painful loading scenarios. A basic interest in biomechanics is required, and experience with basic biomechanics is a plus. However, data analysis techniques including image analysis and stress/strain analysis will be taught. Additional studies can be crafted based on the student's interest. Outcomes will be integrated with ongoing studies of neuroscience and orthopaedics to related biomechanics to physiology. The student will be responsible for image analysis with digitization techniques, post-processing of tissue tests and integration with ongoing other studies in the lab.

#### **Project 2: Neuroscience of Pain**

This project involves participating in any number of studies investigating the CNS response to painful injury - including investigating neuronal activity in the spinal cord through electrophysiology and/or immunohistochemistry. An interest in working with tissue samples is a requisite but no prior experience is needed. If interested the student could learn how to analyze neuronal recording data and participate in that as well. Duties include but are not limited to: assisting with neuronal recordings, using Spike2 software to analyze the recording data, slicing tissue samples, performing immunohistochemistry and associated image analysis of various tissue markers.

## **CHEMICAL AND BIOMOLECULAR ENGINEERING**

*Matthew Lazzara*

### **Project 1: Engineering Systems for the Live Cell Imaging of Receptor-Ligand Interactions at Cell-Substrate Interfaces**

The aim of this project is to develop quantitative understanding of how receptors in the plasma membrane of a cell interact with cognate ligands that are sequestered in solid matrices with which cells interact. To do this, we are engineering a new experimental system comprised of: 1. cells expressing functional fluorescent fusions of receptor proteins, and 2. solid substrates on which ligands are printed at a sub-cellular length scale using micro-contact printing techniques. This system will be used to image the clustering and activation of receptors in the vicinity of the printed ligand features at the cell-substrate interface. The student will work closely with a graduate student to learn the cell and molecular biology and imaging techniques needed for this project.

### **Project 2: Engineering Proteins for Reabsorption in the Renal Proximal Tubule**

The aim of this project is to increase the bioavailability of protein-based therapeutics by engineering their intact reabsorption in the proximal tubule of the nephron. This project will include a protein engineering component and a cellular engineering component. The student will work closely with a graduate student to learn the required experimental techniques.

### **Project 3: Imaging Protein-Protein Interactions in Live Cells**

The spatiotemporal details of how certain proteins interact with one another in the cell interior is critical for the determination of a variety of cellular phenotypes. In this project, the student will help to develop and optimize a system for the live cell imaging of how two intracellular proteins of interest to our lab associate as a function of space and time in response to the activation of a receptor at the plasma membrane. The student will learn a variety of protein engineering, cellular engineering, and imaging techniques.

*Wen Shieh*

**Project 1: Biomatrix with Filamentous Backbones**

Background. Biologically-mediated reactions are highly effective in converting numerous anthropogenic organic compounds found in liquid waste streams into innocuous end-products. Two morphologically different bacterial groups are commonly grown in the same bioreactor to carry out the desired bio-reactions: floc-forming bacteria and filamentous bacteria. Floc-forming bacteria are clustered and embedded in dense aggregates (i.e., bio-flocs) and thereby, they can easily be separated from the liquid waste stream by gravity upon the completion of biodegradation. On the other hand, filamentous bacteria are bulky and their loosely-structured architectures produce poor settling properties. Kinetically speaking, floc-forming bacteria perform best when O<sub>2</sub> and nutrients (mainly N and P) are abundant, because their near-spherical shapes produce relatively small surface-to-volume ratios. As a result, in situ bubble oxygenation/mixing and nutrient addition are required to attain the desired aggregate mass in the bioreactor. Conversely, filamentous bacteria are highly competitive in the oxygen and nutrient deficient environments, because the filamentous morphology yields a large surface-to-volume ratio that facilitates the mass transfer at the liquid-cell interface. Most bioreactor systems currently employed for liquid waste treatment are designed to grow large quantities of floc-forming bacteria, however, the proliferation of filamentous bacteria is inevitable because of their competitive advantages. Therefore, in addition to high operating expenditures, these systems are highly susceptible to poor biomass-liquid separations that often lead to excessive biomass losses and deteriorated treatment performance. This project will attempt to grow a biomass structure that is morphologically different from the aggregates that are populated with floc-forming bacteria. In essence, a loosely-structured biomatrix that is dominated by the filamentous bacteria will be grown in the bioreactor as the primary agent to carry out the desired bio-reactions. It is hypothesized that the biomatrix is capable of capturing and retaining the cells with diversified physiological characteristics and degradation capabilities in close proximity. As a result, the biomatrix is able to offer the integrated functions of biodegradation, biomass retention, and biomass-liquid separation directly in the bioreactor. The bioreactor will be operated under the upflow and gas effervescence-free conditions to maintain the structural integrity of the biomatrix. External oxygenation, which can closely be controlled, will replace the in situ bubble oxygenation to satisfy the biochemical oxygen demands. A bioreactor system with these novel features could represent a much-needed breakthrough in the environmental biotechnology. Additional applications can also be identified which will benefit from this unconventional biotechnology. Study Approach. This project will primarily focus on the validation of the hypothesis regarding the biomatrix formed with filamentous backbones: “A stable but loosely-structured biomass matrix, in which the backbone structure provided by filamentous bacteria is utilized to capture and retain the cells with diversified physiological characteristics and degradation capabilities, is able to offer the integrated functions of biodegradation, biomass retention, and biomass-liquid separation in a variety of hydrodynamic and reaction

environments". A laboratory investigation will be performed to produce the experimental evidence that ascertains the validity of the hypothesis. Ethylene glycol (CH<sub>2</sub>OHCH<sub>2</sub>OH) and ammonium chloride (NH<sub>4</sub>Cl) will be used as the carbon and nitrogen sources, respectively, to grow the biomatrix. Ethylene glycol is chosen because it is commonly used as the deicing and antifreeze agents. It is toxic to wildlife and aquatic organisms. Two possible bio-reactions will occur separately or concurrently, depending on the degree of oxygenation adopted:  
 $2\text{CH}_2\text{OHCH}_2\text{OH} + 5\text{O}_2 \gg 4\text{CO}_2 + 6\text{H}_2\text{O}$   
 $2\text{CH}_2\text{OHCH}_2\text{OH} \gg 5\text{CH}_4 + 3\text{CO}_2 + 2\text{H}_2\text{O}$   
A C/N ratio > 50 will be used to prepare the feed stream to encourage the growth of filamentous bacteria. A glass bioreactor will be modified to accommodate for the flow scheme required to grow and maintain the biomatrix. The degree of oxygenation will be chosen as the sole experimental variable. The hydrodynamic conditions in the bioreactor which will affect the stability of the biomatrix are quantified through the definition of RMS (root-mean-square) shear gradient G. The biodegradation effectiveness of the biomatrix will be measured in terms of C and N removals. The stability of the biomatrix will be assessed in terms of biomatrix specific volume and biomass washout rate. A junior or rising sophomore will be appointed to carry out the experimental work and prepare the research report. The experiments will be performed in the Bio-Environmental Engineering Laboratory, Department of Chemical and Biomolecular Engineering. It is anticipated that a paper that is suitable for publication in a refer journal will be produced.

### **Project 2: Production of Commercial-Grade Micro-Algae using Waste Nutrient Inputs**

Introduction. It has recently been reported that a commercial-grade omega-3 fatty acid, eicosapentaenoic acid (EPA, C<sub>20</sub>H<sub>30</sub>O<sub>2</sub>), can be extracted from micro-algae. Moreover, the single cell protein (SCP) recovered from micro-algae is appealing because it is an excellent source to supplement animal/fish feed protein requirements. In spite of these promising applications, however, many technical challenges need to be addressed to ensure the success of the proposed enterprise. In particular, the production of commercial-grade micro-algae will be economically viable if (1) waste/nutrient inputs are used and (2) micro-algal biomass is mass-produced. Since the growth of micro-algae is biologically mediated, the rate at which solar energy is captured and recovered is intrinsically low. Therefore, the technical barriers mentioned above can be overcome if best available bioreactor technologies and cultivation practices are employed. It appears that a photo-bioreactor system will be a rational choice to meet the above-mentioned requirements. A photo-bioreactor can closely be controlled to circumvent the adverse ambient conditions. The light source is used when the nature light is either absent or weak. The wavelengths of the light source can be controlled within the desired ranges to increase the photosynthetic activities of micro-algae. Moreover, CO<sub>2</sub>-rich gas streams can be mixed with the air stream to yield the elevated CO<sub>2</sub> mass influx to the photo-bioreactor. Finally, the installation of photo-bioreactors is by and large location-independent and the resulting land requirements are small as compared to the open systems. To avoid the addition of nutrients (primarily N and P) the secondary effluent stream discharged from the municipal wastewater treatment facility will

be utilized as a candidate waste/nutrient input. In general, the secondary effluent stream will contain about 20-25 mg N/L, which is sufficient to grow significant quantities of micro-algae (i.e., about 0.1 g N is needed to produce 1 g micro-algal biomass). A cascade photo-bioreactor system is proposed for this endeavor. The key features of the system are described as follows. 1. Cascade Photo-Bioreactors. Micro-algae will be grown in a cascade of CFSTRs (continuous-flow, stirred-tank reactors). The cascade design enables a liquid flow through the system that resembles the plug-flow patterns observed in the race-way systems. When reaction rates are mass-dependent, improvements in the overall productivity will be noticeable when the plug-flow pattern is maintained. The feed stream will be sterilized (e.g., UV irradiation) prior to being fed to the 1st photo-bioreactor to remove pathogens and other harmful organisms. 2. Gravity Flow. The liquid will flow by gravity after it exits from 1st photo-bioreactor to reduce the energy expenditures. 3. Unique CFSTR Design. A micro-strainer will be installed at the outlet of each CFSTR to retain and concentrate its micro-algal biomass without disrupting the liquid flow through the system. This design feature permits micro-algae to be grown in and harvested from each CSFTR at the rates deemed necessary to increase the operational flexibility, protect the system stability, and optimize the overall biomass productivity. The absence of biomass circulation through the CFSTRs will curtail the frequent strain shifts that are a common occurrence in mixed microbial cultures cultivated in a single vessel. 4. Climate Control. A greenhouse or a translucent enclosure will be used in regions with low winter temperatures that will hinder the growth of micro-algae. In addition, evaporative water losses can also be reduced during the hot and dry season. Study Approach. A bench-scale photo-bioreactor system which consists of 4 cascade CFSTRs will be fabricated. A glass beaker with a discharge port fused at the 1-L mark will be used as the CFSTR. The discharge port will be covered with a porous filter pad to keep the micro-algae in the beaker. A porous air stone connected to an aquarium air pump will be placed inside the beaker to dissolve CO<sub>2</sub>, ventilate O<sub>2</sub>, and mix the micro-algae. A CO<sub>2</sub> canister can be connected to the air line, if necessary, to increase the mass % of CO<sub>2</sub> in the gas stream. A single peristaltic pump will be used to deliver the feed stream. The beakers will be housed inside an enclosure to keep the ambient light to the minimum. White LED strips (wavelength spectrum: 380 – 760 nm) attached to the inside walls of the enclosure will be used as the sole light source that can be adjusted at a prescribed photosynthetic active radiation (PAR) energy density (e.g., mW/cm<sup>2</sup>). Micro-algae harvested from the outlet weir of the Southwest Philadelphia Pollution Control Plant will be screened, washed, and equally distributed among 4 beakers and used as the seeding materials for the startup of the photo-bioreactors. It has been reported that the accumulation of micro-algal fatty acids contents is often coupled with the decrease in their biomass inventories. As result, the maintenance of a delicate balance between these two competing processes, which take place in the same system, will be the primary focus of this study. The criteria to be used to assess the process performance include: (1) biomass production (kg/d), (2) biomass concentration (kg/m<sup>3</sup>), (3) dilution rate (d<sup>-1</sup>), (4) fatty acids yield (kg/d), (5) cellular protein yield (kg/d), and (6) CO<sub>2</sub> consumption (kg/d). A junior or rising sophomore will be appointed to carry out the experimental work and prepare the research report.

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The experiments (including routine analyses on process parameters) will be performed in the Algaculture Laboratory. Special analyses on fatty acids and cellular proteins will be performed using the instruments available in the Biotechnology Laboratory. It is anticipated that a paper that is suitable for publication in a refer journal will be produced.

## COMPUTER & INFORMATION SCIENCE

*Norman Badler*

### **Project 1: Building a Character “Bible”**

Locate some samples of Character Bibles as written for plays, screenplays, movies, etc. They are apparently hard to find though they do exist. E.g., see <http://www.screenwritinggoldmine.com/forum/showthread.php?t=2029&highlight=bible> We want to see if we can use these documents to seed the computational agent models we build for narrative simulations. The idea is to use textual materials to establish a "backstory" for a character just as a real actor would study in preparation for a role, but our actors are virtual. We'd like to see what language is used in these documents: Ani Nenkova to examine the language used and Norm Badler to transform the content into the agent model. Such characters will become virtual actors in a digital narrative system. The core of the system is our ADAPT software (<http://cg.cis.upenn.edu/hms/research/ADAPT/>) which runs on top of the Unity game engine. Computer programming experience essential; storytelling and/or acting interest desirable.

### **Project 2: Sound synthesis and recognition system**    ***Rising Juniors only***

We have an existing virtual sound propagation and perception system (“SPREAD”), but there is no simple interface to generate sounds other than by selecting them from a list (e.g., environmental sounds or speech phonemes). The English language has many words to describe sounds. (We have a list.). Can these words be used to parameterize and/or index into sound generation procedures? Inversely, can sound features be used to index into attributes reflected in the dictionary of words? Then our virtual agents can hear sound attributes and describe the features (and thus maybe identify the sound) without having to match the sound form exactly. Acoustic signal processing and computer programming skills are essential.

### **Project 3: Rescue in a rubble pile (game/trainer)**    ***Rising Juniors only***

You are faced with a 3D pile of rubble from a collapsed building. People may be trapped somewhere underneath. Your task is to remove pieces from the rubble pile without causing “major” collapses or your own injury (falls, e.g.). This is a very general and more serious form of the children’s “Pick-up-sticks” game. The first task is to simulate the creation of the rubble pile.

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You can use standard building parts, model them (as polygons), allow breakage (pre-determined tessellations are simpler; though other generative breakage methods exist), and input them to a physical simulator (lots of options for this now). Once you have a visibly stable pile, you have to enter the area (with your size and body weight) and chose pieces to remove. This interaction can be via on-screen point and drag, or something more “VR-ish” such as reaching out for a part (via a Kinect?) and pulling in the direction you wish to use for extraction. Once extracted you can assume it “disappears” to get rid of it. As these extraction operations proceed, the physical simulation is always running, so the pile may start to shift or stay stable. You can continue or stop; then choose another piece to extract. You “win” if you uncover all the people (or ascertain none remain). Only then you can call in the bulldozers. A harder version of this situation is even more realistic. Since we can see only visible surfaces in the rubble pile, we actually can’t be sure what pieces are safe to remove (and having collapses are undesirable). So let’s try to build a plausible model of what we can’t see. What we know is that the pile is stable, but not why it is stable: the invisible parts of the objects must be stabilizing the pile due to unseen contacts, constraints and weight. So we’re going to use the physical simulation to hypothesize and test for the hidden, stabilizing parts. First, we start with the visible pieces (only) and, of course, the pile will collapse since we have nothing modeled underneath. Now iterate the model by extending candidate (visible) surfaces into the hidden area (some knowledge about standard materials and their sizes, weights and lengths, etc., might be useful here) and retest the pile’s dynamic stability at each model extension. Eventually we may create enough hypothesized object extensions to maintain static stability. At that point we can start interactive testing on surface stability under removal conditions (like the first part above). Computer programming experience essential. Good Physics/Mechanics/Math skills highly desirable.

## **ELECTRICAL AND SYSTEMS ENGINEERING**

*Lee Bassett*

### **Project 1: Quantum Engineering -- Imaging single electron spins in diamond**

Aside from their beauty and commercial value, diamonds possess remarkable properties as a platform for future quantum technologies. Tiny defects in the diamond crystal (e.g., missing carbon atoms and/or substitutional atoms of different species) can trap single electrons, whose quantum mechanical properties -- particularly, the electron's spin -- can be precisely controlled using optics and electronics, even at room temperature. Our lab seeks to use these systems to develop applications in quantum information processing and quantum sensing. The student will aid in the construction of a confocal microscope to image individual electronic spins in diamond. Tasks will include designing, building, and testing optical systems consisting of lasers, linear optical components, and single-photon detectors, and the development of associated automation

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and data-acquisition software. Previous lab experience and some knowledge of CAD software, LabView and/or MATLAB will be helpful but are not required.

### **Project 2: Diamond photonics -- Simulating the optical response of diamond nanostructures**

Atom-scale defects in diamond (e.g., missing carbon atoms and/or substitutional atoms of different species) act much like individual atoms or molecules in free space, except that they are trapped in a material that can be formed into nanoscale components of devices for future applications in photonics, quantum information science, and quantum sensing. The sub-wavelength dimensions of such devices dramatically alters their optical response, and simulations are needed to aid their design and for comparisons with experimental measurements. The student will use finite-difference time-domain methods to develop optical simulations of a variety of nanostructures, and will work with other members of our group to compare the results with experimental data. This project is well-suited to a student with a strong mathematical background and an interest in physics and engineering. Experience with computer programming -- particularly C-based languages, MATLAB, and Unix-like operating systems -- will be helpful, but are not required.

*Jan Van der Spiegel*

### **Project 1: Magic in geometry – design of reconfigurable flexible antennas**

Description of first project: Background description: Reconfigurable antennas changes its resonance frequency. This allows us to use it as a wireless sensor. The changes can be invoked through electrical, mechanical or other means. This project aims to explore the potential application on various pluripotent structures. Necessary Students' duties and responsibilities: 1) 2D/3D geometry modeling of different structures; 2) training on flexible PCB fabrication; 3) Sample fabrication and bench testing. Prerequisites: Fundamental understanding of circuit is required. Experience in 2D/3D modelling is helpful. Student with strong physics background is encouraged to take this project.

### **Project 2: Smart glove – Sensor Network Design for Tactile Perception Reconstruction**

Background description: Paralysis results from disruption of motor and sensory communication between the brain and body. Each year an estimated 550,000 Americans present with hand paralysis from stroke alone. This project seeks to reconstruct tactile perception by using various smart sensor networks. Necessary Students' duties and responsibilities: 1) explore different sensor capacities for potential system integration; 2) implementation of sensor networking; 3) microcontroller based signal processing. Prerequisites: Fundamental understanding of circuit design and embedded systems is required. Experience in microcontroller development is helpful.

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### **Project 3: Exploring the Brain – Wireless Neural Signal Recording and Digital Processing**

Background description: In neuroscience, researchers study the nervous system. One of the most important and fundamental studies is the study of the behavior of a neuron. A neuron is an electrically excitable cell that processes and transmits information by electrical and chemical signaling. In the last decade, scientists begin using a microelectrode system to measure and record the electro-physiological responses of a single neuron. This project cooperates with researchers from neuroscience to record, and to perform data mining on the signal captured from a wireless neural recording system. Necessary Students' duties and responsibilities: 1) neural signal recording using a customized wireless neural recording platform; 2) on-line data processing on the wirelessly recorded neural signals; 3) off-line data mining on the signal captured from a wireless neural recording system. Prerequisites: Fundamental understanding of circuit design and hardware coding is required. Experience in Matlab coding is helpful. Student with biology background is encouraged to take this project.

## **Law**

### **LAW**

*Paul Robinson*

#### **Project 1: Bringing Criminal Law Principles and Controversies to a Popular Audience**

Empirical research shows that laypersons have very sophisticated intuitions of justice. This project builds upon that innate expertise to bring laypersons into the debates about criminal law rules and their underlying principles. By using a series of carefully selected real-world provocative cases, a popular audience is introduced to the challenges facing criminal law drafters and drawn into the existing debates. This is a particularly important project because American criminal law, unlike any other body of law, is almost exclusively codified. That means that it is crafted by the popular democratic processes within legislatures, rather than by judicial decisionmaking in courts. Thus, the only effective path to the long-term improvement of criminal law is through the education of voters. The current project agenda calls for finding and developing cases for three planned books: (1) a book on vigilantism, its triggers, its moral complexities, and the societal problems it creates; (2) a book on excuse defenses and mitigations – instances in which an offender has done the wrong thing but is blameless for doing it, or at least significantly less blameworthy than the paradigm offender; (3) a book on justification defenses – instances of committing a criminal offense that arguably is the right thing to do under the circumstances. The undergraduate student's work will involve searching a variety of newspaper, magazine, legal, and other databases and writing up case narratives, guided by regular discussions with Professor Robinson. Particularly useful would be a creative and thoughtful mind and excellent writing skills.

## Medicine

### ANESTHESIOLOGY AND CRITICAL CARE

*Maurizio Cereda*

#### **Project 1: Strategies to for the spatial containment of acute respiratory distress syndrome**

Acute respiratory distress syndrome (ARDS) 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 limit early propagation of ARDS and to reduce its impact in patients. Our laboratory has perfected an animal model of early ARDS in which we measure injury propagation using multimodal high-resolution imaging. Our armamentarium includes micro-computerized tomography and hyperpolarized magnetic resonance imaging. Our recent findings indicate that early intervention to prevent loss of local lung volume can limit the propagation of injury; we are studying the functional and metabolic consequences of respiratory therapy. Students will assist in data collection, with particular involvement in 3D image reconstruction, segmentation, and analysis techniques. The involvement will depend on the student's experience, availability, and most importantly interests. For those interested, students can run the biological experiments associated with the project, namely running cell counts and protein assays of bronchoalveolar lavage fluid (BALF). There are no particular prerequisites for students.

*Roderic Eckenhoff*

#### **Project 1: Novel anesthetic drug development**

Overview: design and synthesis of functionalized small molecules with anesthetic activity with applications in in vitro and in vivo studies. Project: Student will learn basic elements of small molecule design and synthesis using standard methods of organic synthesis to create novel small molecules with unique activities for application in in vitro and in vivo studies. Opportunities for continued work during the school year, as well as independent studies, are available for highly motivated students. Prerequisite: Organic Chemistry I lab required.

#### **Project 2: Anesthetic Target Discovery**

Overview: despite giving anesthetics every day, functional binding targets in the brain and other tissues have not been identified. Project: Student will be involved in the study of in vivo binding of novel anesthetic photolabels and identification of binding targets using proteomic analyses.

Opportunities for continued work in our lab during the school year, as well as independent studies, are available for highly motivated students. No prerequisites required.

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

#### **Project 1: Optimizing operating room to intensive care unit handoffs**

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 handoff process predisposes to error and preventable harm. The proposed project will employ mixed methods to conduct a needs assessment, adapt published tools, and implement a standard postoperative handoff process. The project's deliverable will be a guideline to implementation of a standardized operating room to intensive care unit handoff process for a mixed surgical population. Students involved in this project will be responsible for collecting and analyzing data that will include video recordings and patient medical record abstraction. Interested students will be able to continue participation in the project after the summer.

#### **Project 2: Systematic review of transitions for survivors of critical illness**

Intensive care use is increasing over time, even as the number of critical care beds in the United States decreases. As a consequence, throughput has increased and patients are being discharged "sicker and quicker". The growing population of intensive care unit (ICU) survivors are subject to many short- and long-term complications, including clinical deterioration requiring ICU readmission, preventable adverse events, post-traumatic stress disorder, and functional impairment. Despite the importance of the transition between the ICU and the next site of care, evidence is lacking about how best to execute this process. The proposed project will conduct a systematic literature review that will inform future interventions to improve the quality of healthcare transitions for ICU survivors. Students involved in this project will learn how to conduct a systematic review, write a scientific manuscript, and manage references for a scholarly project. Interested students will be able to continue participation in the project that follows from this review.

## BIOCHEMISTRY AND BIOPHYSICS

*Mark Lemmon*

### **Project 1: Understanding Activation of the EGF Receptor in Cancer**

Approximately 10% of non-small cell lung cancer cases are caused by activating mutations in the cell surface epidermal growth factor (EGF) receptor. It is now almost standard practice to sequence the EGFR gene in patients presenting with this type of cancer, and those with EGF receptor mutations are treated with inhibitors of the receptor's intracellular tyrosine kinase domain. This is an effective treatment – although resistance does develop (and next generation drugs are addressing this problem). As more patients pass through this pipeline, the array of different mutations in the EGF receptor is growing steadily – and it is clear that not all can be genuine activating mutations. There is an urgent need to develop ‘smart’ computational approaches for predicting which mutations are genuinely activating, so that patients are not treated inappropriately. This project aims to achieve that, by analyzing a wide array of EGF receptor mutations using biochemical and cellular transformation studies, and interfacing with computational biologists whose algorithms will ‘learn’ from the biochemical data.

Simultaneously, the results obtained will also allow us to refine our models for how the EGF receptor works. Thus, this project has great basic mechanistic importance, but also has an immediate clinical relevance in the frontier field of personalized cancer therapy. Duties will include: i). Basic molecular biology manipulations (to make mutations) ii). Assessing effects of patient-derived mutations on oncogenicity of EGF receptor in mammalian cells. iii). Purifying mutated EGFR kinase domains for enzymological studies. iv). Interfacing with computational scientists. This project is ideal for undergraduates, since its individual components are nicely bite-sized, so can dovetail with a busy class schedule. All technical aspects can be taught readily within the lab, and cover a wide range of modern biochemistry.

### **Project 2: Signaling functions of pseudokinases**

The ‘pseudokinases’ are enzymes that resemble protein kinases in their sequence and structure, but lack one or more of the residues that are crucial for the phosphotransfer reaction catalyzed by ‘normal’ protein kinases. Of the ~530 protein kinases in the human proteome, approximately 10% appear to be pseudokinases. Among the human cell-surface growth factor receptors, which number 58, eight examples are pseudokinases. For these, the question arises as to how a receptor whose intracellular kinase domain is catalytically ‘dead’ can signal? Our hypothesis is that, like other kinases, these pseudokinases have two conformational ‘states’ – which resemble those seen when their actual kinase counterparts are switched ‘on’ and ‘off’ respectively. In the ‘on’ state, they may interact with downstream, signaling molecules and propagate a signal, whereas in the ‘off’ state they may be silent. This project focuses on leveraging structural biology studies to switch pseudokinase domains between the ‘on’ and ‘off’ states, in parallel with biochemical and

cellular studies to determine what are the interaction partners in these states. Success in this project will illuminate new signaling pathways for an important class of receptors. Duties include: i). Preparing constructs for expressing pseudokinase domains from growth factor receptors. ii). Preparing and purifying expressed proteins for biochemical and structural study. iii). Crystallization of pseudokinase domains for structural study. iv). Comparison of interactomes for pseudokinase domains locked in ‘on’ and ‘off’ states using mass spectrometry. This is an excellent multi-disciplinary opportunity that will teach a wide range of techniques and may have important clinical implications.

## CANCER BIOLOGY

*David Feldser*

### **Project 1: In vivo gene editing to assess tumor suppressor gene function**

The project is intended to use novel technologies developed in our laboratory to explore putative tumor suppressor activity for genes that are mutated in human lung cancer. We use a combination of molecular cloning, lentiviral transduction, and genetically engineered mouse models to destroy gene function in airway epithelial cells of the mouse that are destined to become lung cancer. The goal is to validate and functionally characterize the ever-growing list of genes found mutated in human lung cancer for putative tumor suppressor activities.

## CARDIOLOGY

*Yuli Kim*

### **Project 1: Tetralogy of Fallot: Outcomes of Adult Congenital Surgical Repair**

Almost one percent of children are born with some form of congenital heart disease. In patients with tetralogy of Fallot (TOF), a type of congenital heart defect, a long-term sequela of surgical repair in infancy and childhood is severe pulmonary valve regurgitation in the adult. Pulmonary valve replacement is one of the most common adult congenital heart disease (ACHD) surgeries performed in specialized programs such as ours, the Philadelphia Adult Congenital Heart Center, a joint program between Penn Medicine and the Children’s Hospital of Philadelphia (CHOP). It is still not known where these patients are best served- in children’s hospitals where there is expertise in the treatment and management of congenital heart disease but lack of familiarity with adult medical care, or adult hospitals where there is less familiarity with congenital heart disease but expertise in adult medicine and comorbidities. In collaboration with the Principle

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Investigator, the student will help design a study comparing the surgical outcomes of adult patients who undergo pulmonary valve replacement in TOF at either the Hospital of the University of Pennsylvania or CHOP. He/she would learn to conduct medical chart review and carry out the statistical analysis with the aim of writing an abstract and presenting (if accepted) at a local or national meeting. The student would gain invaluable experience in project design, data analysis, and medical writing. Furthermore, he/she would have a unique clinical opportunity to observe pulmonary valve replacement with our surgeons and to see these patients in the outpatient setting with ACHD cardiologists.

### **Project 2: Obesity in Adults with Congenital Heart Disease**

Dramatic improvements in the treatment of infants and children with congenital heart disease have resulted in a recent increase in the number of adults living with this condition. We know that these individuals are at higher risk of heart complications and even death. Many of these people also have an impaired ability to exercise that affects their quality of life and is related to their long-term outcome. Obesity is known to have adverse effects on the cardiovascular system but the impact of obesity on adults with congenital heart disease is not well understood. This project aims to determine whether or not obesity is related to impairment in the heart's response to exercise in adults with congenital heart disease. The student will have the opportunity to assist with data gathering by reviewing patient charts as well as to participate in analyzing and interpreting data from a preexisting database of exercise tests. In the process the student will also have the opportunity to participate in clinical activities and learn about the care of people with congenital heart disease. It is our hope that the student will establish a more long-term relationship with our research group and have the opportunity to be an author on a manuscript related to this project and/or present results at a local or national meeting.

### **Project 3: Communication Preferences of Adults with Congenital Heart Disease**

Adults with congenital heart disease face a variety of physical and psychosocial challenges that may influence their health and life plans. Some of these concerns include employment, health insurance, family planning, and advance care planning. It is recommended for health care providers to discuss these issues with their patients; however, the information needs of these individuals are not well understood. This study seeks to investigate the communication preferences of adults with congenital heart disease with the hope of improving provider-patient communication and better meeting the needs of these patients. This study involves administering questionnaires to patients followed in the Philadelphia Adult Congenital Heart Center outpatient clinics. The student will be trained in the study procedures and assist with patient recruitment, the informed consent process, and implementation of questionnaires. In addition to enrolling patients, the student will help with data entry and acquire skills in data management. In conjunction with the Principal Investigator, the student will learn to analyze and interpret data, including gaining proficiency in data analysis tools. Participation in this study offers the opportunity to interact with diverse constituents (e.g. clinicians, faculty, researchers), build

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competencies in clinical research, and collaborate on the preparation of manuscripts for publication.

*Emile Mohler*

**Project 1: Evaluation of Microvascular Disease in Patients with Peripheral Artery Disease**

Students will participate in patient recruitment, data entry, clinic visits, IRB correspondence, and other duties as interest, experience, and time permit.

**Project 2: PAD Registry: Evaluating Community Exercise Incentives**

Students will participate in patient recruitment, data entry, clinic visits, IRB correspondence, and other duties as interest, experience, and time permit.

**Project 3: Evaluation of Methotrexate to Reduce Heart Attack and Stroke: CIRT Study**

Students will participate in patient recruitment, data entry, clinic visits, IRB correspondence, and other duties as interest, experience, and time permit.

## CELL AND DEVELOPMENTAL BIOLOGY

*Shannon Fisher*

**Project 1: Genetic screen for zebrafish mutants affecting skull formation**

The student would join an ongoing screen for mutants affecting skull and suture formation in zebrafish. We aim to better understand the biology underlying normal skull development and skull malformations, developing the zebrafish as a powerful model system for these common human birth defects. The student would assist in several aspects of the screen, including staining skeletal preparations, screening them for abnormalities, breeding fish to recover carriers of identified mutations, and isolating DNA samples for mutation identification.

**Project 2: Enhancer mutation of the bone transcription factor Runx2**

We have isolated several enhancer regions that regulate transcription of the Runx2 gene, which is required for bone formation during development. In order to determine the contribution of individual enhancers to the overall regulation of the gene, we aim to mutate one or more of the enhancers in their native genomic context in the zebrafish. The student would use recently developed efficient reagents (CRISPRs) for targeted genome manipulations to introduce such mutations directly in vivo. The student would inject the targeting RNAs into zebrafish embryos,

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screen by PCR for induction of the appropriate mutations, and then breed correctly targeted fish to recover the desired mutations in the next generation.

### **Project 3: Visualization of skull development in normal and mutant zebrafish**

Defects in development of the skull bones and sutures represent common human birth defects, affecting nearly one in 2000 live births. Traditional model organisms (mouse and chicken) used to understand the processes of skull development are inaccessible during critical periods. In contrast, zebrafish are accessible, especially for imaging, at all stages of development and growth. We have established several transgenic lines that express fluorescent proteins in tissues and cells of the skull. As a first step in documenting skull formation in zebrafish, we will be using a new confocal microscopy system to image fish at the earliest stages of skull bone formation, and with those images create 3-D reconstructions that will eventually be available in an online atlas. The student would use the existing transgenic fish to establish optimal imaging conditions, first on fixed samples, comparing different stages of development and several newly developed methods for clearing large tissue samples. Time permitting, the student would use the optimal conditions to compare normal skull development to that in several mutants currently being studied in the lab.

## ***Amin Ghabrial***

### **Project 1: A screen for suppressors of ichor**

We will be carrying out a genetic screen to identify suppressors of "ichor" overexpression. The gene "ichor" encodes a transcription factor with an essential role in the formation of tubes in the *Drosophila* respiratory system. The student will work closely with a graduate student to identify candidate genes regulated by ichor. These will be identified by screening for suppressors of "ichor" overexpression. Student will be involved in all aspects of the screen and in the subsequent characterization of the suppressor mutations.

### **Project 2: Structure-function analysis of disjointed**

We have cloned a gene, disjointed, that encodes a protein of unknown function that is highly conserved in all eukaryotes. Animals with mutations in this gene have tube defects in their respiratory system. We will generate transgenic animals in which a wild type cDNA will be expressed to rescue the mutant animals. To identify functional domains of the protein, a series of mutant constructs will be generated and tested for their ability to rescue the mutant. Student will gain molecular biology experience by making DNA constructs and molecular genetic experience by planning crosses, generating transgenic animals, etc.

## CENTER FOR CLINICAL EPIDEMIOLOGY AND BIostatISTICS

*Karen Glanz*

### **Project 1: Prostate Cancer Prevention Research**

We are looking for a student to work on projects as part of the prostate cancer community engagement, evaluation, and dissemination core (Pro-CEED Core). This core is part of a larger NIH Center of Excellence to study prostate cancer disparities. Main responsibilities include conducting exploratory research (focus groups, surveys), developing communication and dissemination materials, and assisting the project coordinator with community outreach activities. Specific duties for the exploratory research project include: study participant recruitment and eligibility screening, administering informed consent, conducting focus groups, and administering surveys. This student must have proficiency in Microsoft Office and should be interested in the measurement of health behavior, the theoretical basis of understanding health behavior, community health, and/or cancer prevention.

## EPIDEMIOLOGY

*Michael Levy*

### **Project 1: The Epidemiology and Ecology of Bed Bugs**

We are studying the spread of bed bugs through Philadelphia using a combination of field work, GIS mapping and mathematical modeling. The ultimate goal is to understand how the insects spread so as to better control them. Students will be involved in all aspects of the research--including going door to door to collect bed bugs, interviewing residents about their bed bug infestations, mapping and analyzing data, developing statistical and mathematical models and writing up scientific papers. There are no prerequisites other than enjoying working with bugs, and more importantly, people. Field work can involve long hours in the Philly heat; but can also be very enjoyable. We always go to the field in a group.

## **FAMILY MEDICINE AND COMMUNITY HEALTH**

*Frances Barg*

### **Project 1: GHI summer intern**

Community Health Outreach Support, Hospitalito Atitlán The PURM CH Outreach support intern will work with Guatemala Health Initiative (GHI) faculty and the development office staff of the Hospitalito Atitlán to develop baseline community health characteristics of the rural outreach communities in Santiago Atitlán. The Hospitalito Atitlán runs outreach programs to two remote communities associated with the municipality of Santiago Atitlán. The PURM student will work with faculty to conduct research on facilitators and barriers to the development of a train-the-trainer program centered around teaching local Mayan women of childbearing age about factors affecting healthy brain development. Written Spanish and English skills are important. Travel to Santiago Atitlan with the GHI is required.

*Ian Bennett*

### **Project 1: Production of brief video presentations of depression treatment options in pregnancy**

As part of the development of the TIPS (technology to improve prenatal services) patient decision aid we will be producing a series of brief videos. These videos will be of an actress describing a series of treatments that are appropriate for use in pregnancy. The TIPS tool is designed for use particularly by low income and race/ethnic minority populations with limited literacy. Students will be involved with every part of the video production from writing and revising scripts to helping with the recording and then reviewing the results with an advisory board of patients and prenatal providers. Students will be expected to be intimately involved with working on these videos and preparing them for use within the TIPS electronic system. Experience with working on health projects with vulnerable populations and with video production is helpful but not necessary.

### **Project 2: Development of a patient decision aid app for depression treatments in pregnancy**

This is another project connected with the previous described project but includes a much broader set of responsibilities including: review of evidence for treatments, risk communication for treatments, electronic design of an app for use by low income depressed women in pregnancy. The student will be part of a multidisciplinary team working on this project and will have a range of responsibilities in helping move this project forward.

*Kent Bream*

**Project 1: Integration of Technology in Health Care in the Developing World**

The PURM student will work primarily in Santiago Atitlan, Guatemala and other partner locations in San Juan Sacatepequez and Chimaltenango. The research fellow will gather qualitative and quantitative data on the use of technology and perspectives on technology implementation of community members, health professionals, and policy leaders in remote and urban environments. While IT experience is not required, the student should have a solid understanding of multiple technology platforms (web services, internet function and network infrastructure, mobile devices) in order to understand the range of information gathered. Research will be carried out in Spanish so a strong conversational understanding of Spanish is required. Living conditions are developed but basic so the student should be comfortable in simple living conditions.

**Project 2: The development of ethical review of research in Low and Middle Income Countries**

Following the ethical challenges highlighted in the historical experiments in Guatemala described in the presidential report "Ethically Impossible", Guatemala is implementing research review and IRB systems at all levels of government. The principles of bioethics, however, may not generalize to other cultures as seamlessly as expected based on the experiences of US based IRBs. The PURM student will work in Guatemala to gather perspectives and experiences in developing ethical review of research at the University, national, and municipal levels. Both observational and interview data will be collected. The student must have a conversational level of Spanish, be able to interact in formal or official Latino professional environments, and be prepared to travel to multiple sites. The living conditions are basic and the student should be comfortable in such an environment.

**Project 3: Sayre Health Center Patient Centered Medical Home Implementation process**

The Bennett L. Johnson Sayre Health Center is applying for Patient Centered Medical Home recognition. The PURM student will both participate in this process as well as develop an analysis of barriers and facilitators to implementation of PCMH recognition in a community health center. The student will be responsible for a literature search on this topic, a summary of findings, collecting interview and observational data, and data management. Skills in working in a diverse intercultural environment are required. The student should have studied anthropology or another social science in their first or second year at Penn.

*Jun Mao*

**Project 1: Wellness after Breast Cancer**

The “Wellness after Breast Cancer” study is an NIH-funded clinical research study to evaluate how genetic factors in estrogen synthesis and metabolism affect the development of side effects from aromatase inhibitors among early stage breast cancer survivors. Aromatase inhibitors are the most common hormonal drugs to treat breast cancer. Despite the efficacy of these drugs, many patients develop severe joint pain and have to stop taking the drugs. Our research will inform the understanding of the genetic determinants of this drug toxicity that will lead to personalized diagnosis and treatment. This knowledge will ultimately improve the quality of life and clinical outcomes for women with breast cancer. We are seeking a highly motivated, hard-working, and enthusiastic undergraduate student to participate in research with our Integrative Oncology Research Team at the Hospital of the University of Pennsylvania during the summer of 2014 and beyond. The student will help us with patient recruitment, literature searches, and data management. The student will learn skills in patient communication, clinical research design and conduct, and research hypothesis generation and testing. Substantive contributions will lead to a published abstract and manuscript. This is an excellent opportunity for a student who is interested in medicine or other health care-related fields. No prerequisites are required.

**Project 2: Patient-centered primary care for cancer survivors**

Over 13 million Americans have a personal history of cancer and are considered to be cancer survivors; the majority of them receive care from primary care physicians. Cancer survivors often experience high symptom burden, cardiac or pulmonary late effects related to prior cancer treatment, and are at risk for recurrence of primary tumor or development of secondary malignancy. Many primary care physicians do not feel prepared to care for this growing population, yet the majority of long-term cancer survivors see primary care physicians exclusively. We propose to evaluate the feasibility of using the patient-centered medical home as a model to address the unmet clinical needs of cancer survivors in the primary care setting with several specific aims: 1) To define the gap in health service delivery among cancer survivors seen in the primary care setting; and 2) To pilot a process of the population management approach to improve the quality of care for cancer survivors in the primary care setting. We are seeking a highly motivated, hard-working, and enthusiastic undergraduate student to participate in research with our Integrative Oncology Research Team at the Hospital of the University of Pennsylvania during the summer of 2014 and beyond. The student will help us with patient recruitment, literature searches, and data management. The student will learn skills in patient communication, clinical research design and conduct, and research hypothesis generation and testing. Substantive contributions will lead to a published abstract and manuscript. This is an excellent opportunity for a student who is interested in medicine or other health care-related fields. No prerequisites are required.

## GENETICS

*Zhaolan (Joe) Zhou*

### **Project 1: Understanding the role of MeCP2 in gene regulation in the brain**

Mutations in MECP2 are the primary cause of the neurodevelopmental disorder, Rett Syndrome, that is characterized by normal development in the first 6-18 months of life followed by a loss of acquired language and motor skills. MeCP2 is a methyl-DNA binding protein and has been demonstrated to affect gene expression in the brain. However, the molecular mechanisms by which MeCP2 modulates gene expression remain poorly understood. This project is to take advantage of the MeCP2 mouse models we have recently developed in the laboratory and examine newly raised hypothesis. Student's responsibilities include genotyping mice, tissue collection, performing chromatin immunoprecipitation (ChIP) and quantitative PCR. Prior experience working with mice is preferred.

## HEMATOLOGY/ONCOLOGY, ABRAMSON CANCER CENTER

*Susan Domchek*

### **Project 1: METEOR, Multiplex Testing for Evaluation of Breast Cancer Risk**

A new form of genetic testing called multiplex testing has become available in the hereditary cancer world in the last year. In the past patients were often tested for one or two genetic mutations using a single blood sample. However, multiplex testing allows for multiple genetic mutations, and therefore multiple syndromes, to be tested for with a single blood specimen. This new strategy of genetic testing has both potential advantages and disadvantages, all of which are unknown at this time. In this study we are examining attitudes and knowledge in individuals considering this testing. This student working on this study will have several different responsibilities. S/he will split time between subject recruitment, data collection, data entry, and basic data analysis. No previous experience working in research is necessary. The student who will excel in this position is one who is mature, open-minded, able to multi-task and work autonomously as needed. Our team is diverse in background and experience, but unites under a desire to better the life of those affected by cancer. If you think these attributes describe you then please consider applying.

### **Project 2: Biobanking and Research Registry**

Cancer is the second leading cause of death in the United States. Even established cancer screening methods often lack specificity and fail to detect all cases at an early stage. The lack of

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sensitive and specific forms of cancer screening is especially problematic for individuals with hereditary cancer syndromes whose risk of developing certain cancers is greatly elevated. Two known breast cancer susceptibility genes together, BRCA1 and BRCA2, are thought to account for 20-30% of all inherited breast cancer. When mutated, BRCA1 and BRCA2 are associated with a very high risk of breast and ovarian cancer as well as several other cancers. As part of our research we have created a biobank of samples from BRCA1 and BRCA2 mutation carriers. This specimen repository may aide in the identification of novel cancer biomarkers which would lead to the development of enhanced cancer surveillance. We are looking for a student who is interested in “bench-to-bedside” research to work with us on this project. As part of this project the student would help collect samples from eligible patients, perform follow-up calls, do data entry, and process samples in our laboratory. This position is also ideal for those who want patient exposure and interested in learning more about clinical research.

## **MEDICAL ETHICS AND HEALTH POLICY**

*Jonathan Moreno*

### **Project 1: Brain Apps**

For a probable book on neuroengineering, this project would involve research on some lab-based technology, e.g., brain-brain or brain-machine interface, transcranial direct current stimulation, EEG, etc.

## **MEDICINE**

*Morris Birnbaum*

### **Project 1: The Regulation fo Pyruvate Dehydrogenase by Insulin**

One of the most important biological targets of the hormone insulin is he control of de novo lipogenesis, that is, the synthesis of fatty acids from sugar or three carbon substrates. A critical metabolic step in this process is the conversion of of pyruvate to acetyl-CoA, which then forms the lipogenic substrate citrate. Early in the study of insulin action, it was discovered that insulin activates the enzyme that catalyzes the oxidative decarboxylation of pyruvate (PDH), thus increasing lipid synthesis and accumulation adipose tissue. However, the molecular mechanism mediating this pathway has never been elucidated. This project entails performing experiments aimed at dissecting the biochemical steps that insulin uses to activate PDH using cultured adipocytes as a model system

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### **Project 2: The Regulation of Glucose Production by the Liver**

Metabolism during recurrent cycles of fasting is controlled by a combination of hormones, the nervous system, and metabolites acting as both substrates and signaling molecules. Perhaps the most important hormonal influence is the relative concentrations of the two major pancreatic hormones, insulin and glucagon. During fasting, glucagon provides a critical signal for hepatic glucose output, initially mediated by glycogen breakdown and later by the synthesis of new glucose. In recent years, the transcriptional control of hepatic metabolic gene expression has been worked out in some detail. However, glucagon also exerts a rapid, post-translational activation of gluconeogenesis. This project consists of basic, lab research aimed at understanding the metabolic pathways that are controlled by glucagon and that provide newly synthesized glucose during fasting.

### **Project 3: Compartmentalized Signaling in Fat Cells**

This project utilizes modern optical microscopical techniques to assess the activity of signaling pathways localized to different sub-cellular compartments of cultured adipocytes.

## **MICROBIOLOGY**

*Jun Zhu*

### **Project 1: Genome-wide screen of small regulatory protein in bacterial pathogenesis**

The student will be independently performing genome-wide screens using classic genetics and cutting-edge Next-generation sequencing (NGS) to look for small, transmembrane proteins that have impact on virulence gene expression in *Vibrio cholerae*, a bacterial pathogen that causes epidemic disease cholera, which is still endemic in many parts of developing country. The experimental duties involve in bacterial culturing, transformation and conjugation of plasmids, DNA manipulation, measuring gene expression, PCR, and deep-sequencing sample preparation.

## **NEUROLOGY**

*David Raizen*

### **Project 1: Tooth function in the aging nematode**

The project aims to understand the decay of tooth function with aging using the laboratory model *C. elegans*. *C. elegans*, a microscopic nematode that lives a mere 2-3 weeks, uses its teeth to

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grind its bacterial diet. The student will use microscopy to assess the ability of the teeth to break open bacteria as a function of age. In addition, the student will analyze teeth and aging mutants. The project could evolve into an elegant thesis project describing for the first time a model system to understand the molecular basis of age-related tooth decay. The undergraduate student will work directly with Dr. Raizen on this project.

### **Project 2: Metabolic oscillations in energy stores during *C. elegans* larval development**

The nematode *C. elegans* displays prominent changes in behavior during its larval development. It sleeps during larval transitions and is active during the mid larval stages. In addition, we and others have found large fluctuations in gene expression during larval development. This project aims to extend this analysis to metabolic stores. The student will measure fat and glycogen during larval development in order to test the hypothesis that these metabolic stores oscillate. Our preliminary data supports this hypothesis.

### **Project 3: Identifying genes controlling sleep**

The student will use a discovery approach to identify genes required for sleep. The student will use the nematode *C. elegans* for this purpose. The student will learn classical genetic methods, behavioral analysis, and machine vision approaches. This project will entail a collaboration with the laboratory of Dr. Christopher Fang-Yen (engineering).

## **NEUROSCIENCE**

*Xiangzhong Zheng*

### **Project 1: Molecular mechanisms underlying age-dependent deterioration of sleep:wake cycle**

Student will learn *Drosophila* genetics and current knowledge of sleep regulation in flies. Duties include fly culture maintenance, collection of data for behavioral analysis, and dissection of brains to determine changes of neural substrates during aging. Basic knowledge of biology and Mendelian inheritance is required.

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## ORTHOPAEDIC SURGERY

*Xiaowei Liu*

### **Project 1: Effects of Lactation and Weaning on Maternal Bone**

During lactation, increased calcium demand caused by milk production results in dramatic maternal bone loss. In fact, during the lactation period, bone is lost at an even faster rate than in osteoporosis. However, in contrast to osteoporosis, the rapid bone loss caused by lactation is quickly reversed, and bone mass is recovered following weaning. Our lab is interested in better understanding the mechanism that causes this dramatic recovery of bone mass. Using a rat model, we are working to assess the effects of lactation and post-weaning recovery on bone structure and mechanical function. This project will involve analysis of CT scans and histology slides of bone made at various time points during lactation and after weaning. Students will use image processing techniques to make precise measurements of bone structure, remodeling, and mechanical properties, in order to determine the effect of lactation and recovery on bone quality. Additionally, students will monitor the rats as they go through the process of mating, pregnancy, lactation and weaning, allowing students to gain valuable experience in animal research. This project would be ideal for an engineering student with interests in biomechanics, physiology, and imaging. Students will gain experience in image processing, experimental techniques, and data analysis. An interest in working with animals and a basic understanding of computer programming are helpful for this position.

### **Project 2: Assessment of tooth fracture in dog**

Dog tooth fractures are a common in veterinary practices. These fractures usually occur on canine and carnassial teeth, used for tearing and shearing, typically on hard bones and other chew toys. These fractures consequently cause oral discomfort and decreased appetite. Our lab is interested in studying how and why these fractures occur, and how we can better design bones and toys to prevent them in the future. By using micro computed tomography ( $\mu$ CT), or three-dimensional x-ray, we can build a computer model of the tooth and simulate the forces caused by chewing using finite element modeling. Furthermore, we will obtain dog tooth samples and perform mechanical testing to confirm the complex fracture conditions seen clinically. Students will use a series of  $\mu$ CT images of canine and carnassial teeth of dogs. They will be responsible for building computer simulation models and performing complex computational analysis from both finite element modeling and mechanical testing. Students will have the opportunity to utilize complex simulation software such as Abaqus for finite element analysis and state of the art mechanical testing equipment such as Instron testing machines. This project would be ideal for one or two mechanical engineering students with interests in biomechanics, imaging, and simulation. Students will gain experience in  $\mu$ CT imaging analysis, finite element modeling, and

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data analysis. A basic understanding of finite element modeling and analysis is a plus but not required.

### **Project 3: The structure-function relationship in bone due to osteoporosis treatments**

As bone changes due to aging and hormones, the normal robust pattern of trabecular bone is degraded by the loss and breakage of existing trabecular elements. This degraded bone often results in osteoporosis and serious fractures in the elderly. Drug treatments must be developed to optimize the restoration of bone while minimizing excessive bone gain. This project will aim to better understand the structure-function relationship of human trabecular bone on an individual trabecular level. Students will use a series of three-dimensional images from high resolution quantitative computed tomography (HRpQCT) scans of patients with osteoporosis. By aligning the trabecular patterns in these scans before and after treatment using computer optimization, they will identify precise changes to the structure over time, and quantify each change's contribution to the bone's mechanical function. Mechanical function will be assessed using finite element analysis. The student will have the opportunity to work with clinical bone images and cutting edge computational methods. This project would be ideal for bioengineering students or those in computer science with an interest in biomedical sciences. This student must be very comfortable working with computers, as they will be expected to eventually do computer optimizations and simulations independently. No experience is required, but skills in computer programming would be helpful.

## **ORTHOPAEDIC SURGERY AND BIOENGINEERING**

*Louis Soslowsky*

### **Project 1: Orthopaedic Biomechanics: Tendon and Ligament Structure-Function Relationships**

Responsibilities include assisting with various aspects of orthopaedic research project interested in tendon and ligament structure-function relationships including mechanical testing and other multidisciplinary assays. Engineering background and/or pre-med preferred.

### **Project 2: Orthopaedic Biomechanics: Tendon and Ligament Injury, Repair, and Regeneration**

Responsibilities include assisting with various aspects of orthopaedic research project interested in tendon and ligament injury, repair, and regeneration including mechanical testing and other multidisciplinary assays. Engineering background and/or pre-med preferred.

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## PATHOLOGY AND LABORATORY MEDICINE

*Nina Luning Prak*

### **Project 1: Clonal Expansion and Selection in Lupus**

Lupus is an autoimmune disease that is characterized by the production of antibodies that recognize self. The B cells that produce these antibodies undergo activation and clonal expansion, but how self tolerance is broken is not clear. In this project, we wish to understand how the antibody repertoire is selected (and at what developmental stage antibody selection goes awry) in lupus. We hypothesize that autoantibody producing B cells form expanded clones that reside in particular B cell subsets and that the frequency of these clones and their subset localization correlate with disease activity. To begin to test this hypothesis, the student will analyze different B cell subsets in the peripheral blood by high throughput sequencing of antibody genes in patients with active SLE and healthy control subjects. The student who undertakes this project will participate in flow cytometry of peripheral blood B cell subsets, DNA extraction, amplification (PCR) and preparation of antibody libraries, high throughput sequencing and analysis of the antibody sequencing data. Students of all levels are welcome.

### **Project 2: Identification and Characterization of Malignant B cell Clones**

B cell neoplasms are characterized by the expansion of malignant cells that arose from a common progenitor cells (expanded clones). The detection and tracking of expanded clones is useful for monitoring disease activity and response to therapy. To that end, in this project, the student will be involved in developing a high throughput sequencing assay to measure clonal expansion in patients with B cell neoplasms. The student will perform flow cytometry or B cell enrichment, followed by high throughput sequencing of blood and other specimens from subjects with B cell neoplasms at multiple time points to identify and track malignant B cell clones. Students of all levels are welcome.

*Kar Muthumani*

### **Project 1: Creating soluble antibody like molecules as synthetic DNA to treat pathogens & tumor and to explore immunobiology**

A recent focus has been on the generation in vivo of DNA plasmid-encoded neutralizing antibodies (NAbs) in order to generate passive immunity against select pathogens. Using highly optimized DNA construct designs and delivery methods, we are studying the ability of our plasmids to actively drive immune responses or passively provide protection against HIV-1, Dengue virus, Chikungunya virus, and other pathogens of interest and enhanced CTL-mediated anti-tumor immunity.

### **Project 2: Directing immune responses against emerging infectious disease agents**

We specialize in the development of novel DNA vaccines and therapeutics against emerging infectious diseases using enhanced DNA technology and comparing their ability to drive immune responses with previously developed immunogens for HIV, Dengue, Chikungunya virus and Middle Eastern Respiratory Syndrome (MERS) virus.

### **Project 3: Immunopathogenesis of viral disease and molecular studies of host-pathogen interactions**

The molecular functions of viral proteins are arguably the most important pathogenic factors during viral infection. Using modern tools of virology and immunology, we explore the molecular basis of protein function, the interaction between viral factors and host cell signaling proteins, and general T cell and APC functions. By studying viral proteins and their interacting cellular partners, our research is aimed at understanding the mechanisms of these interactions and developing new compounds that block them.

### ***Vivianna Van Deerlin***

### **Project 1: Next generation sequence analysis of genetic variability in amyotrophic lateral sclerosis** ***Rising Juniors only***

My research is focusing on the Genetics of neurodegenerative diseases (ND) including Alzheimer's diseases (AD), Parkinson's diseases (PD), Frontotemporal degeneration (FTD), and Amyotrophic lateral Sclerosis (ALS). Our laboratory at the Center for Neurodegenerative Disease Research (CNDR) has been collecting thousands of DNA samples from living individuals and postmortem brains along with pedigree information, clinical, and pathological diagnoses. We evaluate the genetic characteristics of individual cases by a number of conventional and novel genotyping approaches including SNP genotyping and Sanger and next generation sequencing (NGS). ALS is an adult-onset motor neuron disease characterized by rapidly progressive paralysis leading to death with a mean survival of ~3 years of symptom onset. ALS has a prevalence of 30,000 in U.S. with ~5,600 new cases diagnosed each year. ~30% of ALS cases in our cohort are classified as familial, as the pedigree has history of same or other neurodegenerative diseases. ~50% of ALS patients present cognitive impairment such as FTD, which emphasizes the importance of genetic etiology of ALS and dementia. One of my research goals is to determine spectrum of genetic variants in the ALS cohort using a targeted panel of previously identified 45 genes for ALS, FTD, AD, and PD to screen for known pathogenic mutations, novel/rare variants in the coding regions, splice site variants, within the selected ND-associated genes. Approach: ALS cases with medium to high risk for familial disease based on pedigree information are selected and carefully evaluated for clinical and pathological subtypes. DNA libraries will be enriched for MiND-Seq panel with Haloplex

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custom kit (Agilent) and sequenced on MiSeq platform. Sequence reads will be aligned and variant calls will be generated by both SureCall (Agilent) and Draw (DNA Resequencing Analysis Workflow; Lin et al). Genotype evaluation and the association testing will be performed by SVS software (Golden Helix) for allele frequency of novel, rare, and common variants in disease subgroup and for genotype association. Students' duties, responsibilities, and/or prerequisites. While an undergraduate student will assist in preparation of MiND-Seq libraries and setting up the runs on the instrument, major responsibilities are analyzing the NGS data with a number of Bioinformatic tools and studying association between spectrum of genetic variants and clinical variables. Interest in genetics or neuroscience required. Minimal experience and knowledge on data analysis and biostatistics and high level of computer literacy are preferred.

## **PEDIATRICS**

*Chris Bonafide*

### **Project 1: Video study of alarm fatigue**

Hospitalized patients are often connected to heart and lung monitors. These monitors alarm hundreds of times per day, and the alarms are usually, but not always, false. This causes alarm fatigue. This research project will take place at The Children's Hospital of Philadelphia. We will use a system of GoPro video cameras mounted inside the rooms of critically ill ICU patients to measure alarm fatigue. The student will recruit patients and staff, set up video equipment, edit video using Final Cut Pro X on a Mac, review video, and enter data into a REDCap database. Interested students should be outgoing, interested in medicine as a career, technologically-savvy, and must have experience editing video using Final Cut Pro X.

*John Maris*

### **Project 1: SU2C-St. Baldrick's Pediatric Cancer Dream Team: Immunogenomics to Create New Therapies for High-Risk Childhood Cancers**

Please see URL. Students will be part of the team focused on discovery and development of immunotherapeutic targets in the pediatric cancer neuroblastoma.

### **Project 2: Drug development for childhood cancers**

The student will work on studies of new anti-cancer drugs from industry that have a rational basis for effectiveness in neuroblastoma. These studies will be at the interface of academia and industry, and are designed to get new drugs to children with cancer as quickly as possible.

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*Jennifer Walter*

**Project 1: Continuity of Providers in the Pediatric Intensive Care Unit: Does it improve communication and outcomes?**

Students will be responsible for identifying eligible subjects to recruit into the study and will enroll appropriate parents and patients by getting their informed consent. Students will also administer several online surveys to parents throughout the summer. Students should have excellent communication skills, be organized, comfortable in a medical environment and responsible working independently. Students will also be exposed to data collection, literature reviews in preparation for publication and basic data management.

## **PEDIATRICS, ADOLESCENT MEDICINE**

*Rebecka Peebles*

**Project 1: Quality Improvement Drivers of Health Outcomes in Adolescents with Eating Disorders**

This is a quality improvement (QI) collection, and students will help with tracking patients progress in our Eating Disorder Program from their first encounter, as well as 3 month, 6 month, and 1 year time points. Students will collect data from medical records, participate in lab meetings and educational conferences, cross check data, enter data, and begin some basic analyses. They need to be interested in eating disorders, team players, detail-oriented, and responsible. There are no prerequisites.

**Project 2: Rate of Weight Gain as a Predictor of Remission in Adolescents with Eating Disorders**

Students will be involved in both the collection of ongoing data, as well as preliminary work toward a large grant submission to the National Institutes of Health (NIH). Students will take part in data collection from medical records, participate in lab meetings and educational conferences, cross check data, data entry, and begin some basic data analyses. They need to be interested in eating disorders, team players, detail-oriented, and responsible. There are no prerequisites.

## PEDIATRICS/ONCOLOGY

*Lamia P. Barakat*

### **Project 1: Clinical Trial Decision-making among Adolescents and Young Adults with Cancer** *Rising Juniors only*

Approximately 21,400 adolescents and young adults (AYA) ages 15 to 29 years were diagnosed with cancer in 2000, which is nearly 3 times that of patients diagnosed in the first 15 years of life. Contrary to younger and older age groups, 5-year survival and mortality reduction rates for AYA with cancer have remained stagnant, particularly for ethnic minority AYA. One explanation for this disparity is reduced participation in therapeutic or Phase III clinical trials as AYA with cancer are significantly less likely to enroll than children under 15 years of age. Lack of participation in clinical trials may reduce direct medical benefits and hinder advances in AYA cancer treatment. Because few empirical studies have addressed AYA participation in Phase III clinical trials, we conducted qualitative interviews with families of AYA with cancer and health care providers and discovered a more basic problem than low enrollment. That is, our results suggest that AYA are not involved in decision-making about clinical trial enrollment. AYA describe the presentation of treatment information as ineffective in promoting their understanding of treatment options, and providers feel challenged to maintain the engagement of AYA in treatment planning at diagnosis. Thus, research on how to increase involvement of AYA in clinical trial decision-making may be critical to addressing disparities in AYA cancer outcomes. Using mixed methods and a randomized trial, the proposed study aims to develop and test preliminary efficacy of a web-based decision support intervention (DECIDES = AYA Deciding about Enrolling on a Clinical Intervention Trial: Decision Aid for Education and Support) to increase AYA involvement in clinical trial decision-making and improve decision-making processes for AYA and primary caregivers. DECIDES will be informed by: (1) Health Beliefs Model<sup>6</sup> and Theory of Reasoned Behavior; (2) our qualitative study of AYA decision-making; (3) stakeholder input; and (4) established decision aid development guidelines. DECIDES will be developmentally appropriate, consider demand literacy, and contain components that increase knowledge about cancer and clinical trials, address attitudes to Phase III clinical trials, and weigh clinical trial benefits and barriers relative to values for AYA and their primary caregivers. In an iterative process, DECIDES will be revised based on feedback from our AYA Patient Steering Committee, their primary caregivers, and a Scientific Advisory Committee. Using mixed methods, acceptability and feasibility of DECIDES will be evaluated. Efficacy will be estimated for involvement and decision-making processes by comparing AYA (ages 15 to 24), who are newly diagnosed with leukemia, non-Hodgkin's lymphoma or a sarcoma and offered treatment via a Phase III clinical trial, and their primary caregiver randomized to receive DECIDES (n = 24) or to usual care (n = 24). This research is central to the goals established by the Children's Oncology Group and National Cancer Institute to address the

unique and unmet needs of AYA with cancer through increased research on availability of and enrollment on clinical trials. Data from this study will inform a larger multi-site randomized trial to establish the efficacy of DECIDES.

## **Project 2: CARES**

A large body of research confirms the psychological distress and the resiliencies of families as they initiate and complete treatment. While most families adapt and are able to cope with the stressors associated with treatment, there are currently many “missed opportunities” for identifying problems for which we have effective early or preventative behavioral treatments. If untreated, psychosocial stress has the potential to escalate and impact cancer care and outcomes more generally. For example, psychological factors are important, across cancers, in adherence to treatment and ongoing medical monitoring and health promoting behaviors. Although evidence based assessment and intervention approaches relevant across the course of treatment have been developed, they have yet to be translated into clinical care on a systematic basis. Indeed, the integration of patient report (family report) measures which can be used in clinical trials and for clinical decision-making is an important emerging research priority. This grant provides infrastructure support for the Section of Behavioral Oncology to conduct translational research directly relevant to clinical care. More specifically, it will support the development of a standardized psychosocial protocol and the means to generate important research data, that can be integrated into other clinical databases, by conducting assessment of all families in the Division of Oncology at diagnosis, during the course of treatment, and at the conclusion of treatment. Evidence based assessment is the first step in delivering evidence-based interventions. In the first aim we will assemble a developmentally-sensitive standardized psychosocial assessment protocol to assess psychosocial risks and resiliencies and pilot test its implementation at key points across the treatment trajectory. Aim 1 will demonstrate the feasibility of implementing an evidence-based research assessment protocol across cancer treatment that attends to the needs of children and families. We will use a multi-informant methodology, including data from parents (mothers-fathers), patients and siblings (age 8+). The second aim is to utilize technology (e.g. web-based, tablet-based) to facilitate screening of patients and families and provide data which can be readily integrated into clinical care, other CCCR programs and data systems. In order to advance the integration of behavioral research data into clinical oncology research more broadly, psychosocial data must be collected in an expedient manner that will facilitate linkages with other relevant clinical and research databases. Completion of Aim 2 will establish the feasibility of using web and tablet-based technology for completing the assessment protocol. These steps will be invaluable in preparing subsequent grants, both in advancing the psychometric properties of the measures and in demonstrating our ability to aggregate and utilize datasets to answer clinically meaningful questions.

## PSYCHIATRY

*Rinad Beidas*

### **Project 1: Philadelphia Alliance for Child Trauma Services (PACTS)**

Background: The Philadelphia Department of Behavioral Health and Intellectual Disability Services (DBHIDS) in collaboration with the Penn Center for Youth and Family Trauma Response and Recovery (CYFTRR) at Pennsylvania Hospital's Hall-Mercer Community Mental Health Center was awarded a Substance Abuse and Mental Health Services (SAMHSA), Community Treatment and services (CTS) grant to develop a trauma-informed and trauma-focused system for young people and their families in Philadelphia. The Center, named the Philadelphia Alliance for Child Trauma Services (PACTS), will function as a consortium of child and adolescent behavioral health providers, pediatric and other child serving agencies that see young people who may be traumatized. PACTS will be responsible for the implementation of trauma-focused evidence-based practices (EBP) and for increasing screening and assessment of children in a variety of physical and behavioral health care settings. The impact of PACTS will be evaluated in collaboration with an evaluation team at the University of Pennsylvania's Center for Mental Health Policy and Services Research (CMHPSR) to collect and provide data and outcomes to providers expeditiously as required by SAMHSA. Methods/Design: This mixed-methods study uses a pre-post design. We will investigate the effectiveness of providing trauma-focused cognitive-behavioral therapy (TF-CBT) and the child and family traumatic stress intervention (CFTSI) to traumatized youth. The study will include community therapists who provide mental health treatment services to uninsured and Medicaid-eligible children and families as well as children and families receiving those services in the city of Philadelphia. In the first year of the grant, we will enroll child mental health agencies in the Philadelphia area who have previously participated in DBHIDS Trauma Initiative and have agreed to join the PACTS center (N = 10). Over the course of four years of the grant, we will reach out to all child-serving mental health agencies in the Philadelphia area (around 35 agencies) and offer them the opportunity to join the PACTS center. Of those agencies; we will randomly sample approximately 75% for the purpose of the evaluation (N = 26). Within the agencies, we will gather data from all participating therapists (N = 100), and a random sample of youth and families (N = 200). Data will be collected prior to treatment, at discharge, and 6-months after baseline. Quantitative data will include measures of general child functioning and symptoms. We will also gather information about clinician attitudes towards evidence-based practices. Qualitative data will include semi-structured interviews with a subset of the sample around the implementation experience. Discussion: Findings from the proposed research will inform national roll-outs of trauma-informed care and provide information on whether the implementation of these evidence-based practices improves youth outcomes. Student responsibilities: Students will interview youth and families about their experiences in treatment

and trauma symptoms; enter data; attend weekly evaluation meetings; and have the opportunity to participate in scholarly activities such as presentations and publications.

## **Project 2: Policy to Implementation (P2i)**

Background: Evidence-based treatments (EBTs), treatments that have been evaluated scientifically and show evidence of efficacy, are not widely available in community settings. It takes up to 17 years after proof of efficacy for these treatments to make their way into community settings. In response to the call for implementation of EBTs, states and counties have mandated behavioral health reform. Evaluations of the impact of these policies and other initiatives on implementation are rare. A new center to support the implementation of EBTs, the Evidence Based Practices Innovation Center (EPIC), has been created in Philadelphia as part of the Department of Behavioral Health. We have operationalized the activities of EPIC as a policy mandate. EPIC will encourage and incentivize clinics to implement EBTs for youth by providing an infrastructure to support these services (e.g., training, consultation). The formation of EPIC offers a rare and important opportunity to prospectively study implementation in response to a policy mandate. Methods/Design: This mixed-methods study is prospective, longitudinal, and observational. We will investigate the response of 30 community mental health clinics to EPIC and the resulting policy from the Department of Behavioral Health encouraging and incentivizing clinics to implement EBTs for youth. Study participants will be 210 therapists, 30 clinical directors, and 30 executive directors. Data will be collected prior to the policy, and then 2 and 4 years following the implementation of the policy. Quantitative data will include clinician-level measures of intervention implementation and potential moderators of implementation (organizational and leader-level variables). Clinician-level measures include self-reported therapist fidelity to EBT techniques as measured by the Therapist Procedures Checklist-Revised, observed therapist fidelity as measured by the Therapist Process Observational Coding System- Strategies Scale, organization variables as measured by the Organizational Social Context Measurement System and the Implementation Climate Assessment, leader variables as measured by the Multifactor Leadership Questionnaire, attitudes towards EBTs as measured by the Evidence-Based Practice Attitude Scale, and knowledge of EBTs as measured by the Knowledge of Evidence- Based Services Questionnaire. Qualitative data will include semi-structured interviews with a subset of the sample. Discussion: Findings from the proposed research will inform both future policy mandates around implementation and the support required for the success of these policies, increase the number of youth in the public sector who can access quality psychosocial treatment, and reduce the research-practice gap. Student responsibilities: Students will assist in creating feedback reports for agencies based on their baseline data; assist the principal investigator in attending meetings at agencies; and have the opportunity to participate in scholarly activities such as presentations and publications.

*Olivier Berton*

**Project 1: Neurobiology of social aversion**

Learning to avoid dangerous conspecifics (i.e. learned social aversion) is a behavioral response key for survival in many species that involves specialized brain circuits, partly conserved across evolution. Aberrant activity in these neural systems contributes to symptoms of psychiatric disorders such as social phobia and depression. With the long term goal of discovering novel treatments, our lab investigates the cellular organization of these circuits and seeks to identify molecular mechanisms whereby social experiences (negative or positive) induce their plastic remodeling. In this project students will use optogenetics (a technique allowing targeted control of neural activity at millisecond-timescale in the living brain using light) and genetic tracing methods to dissect the circuits implicated in a form of learned social aversion in the mouse. Working in collaboration with a postdoc or a senior graduate student the trainee will become familiar with key methods applied to measure neuronal morphology, neuronal activity and animal behavior. Previous PURM trainees in our lab have gained lead authorship on papers reporting their results and received awards for presenting their research at local and international symposiums.

*Trevor Hadley*

**Project 1: Medical Care for Children with Mental Illness**

Integrated health care for children becomes an important area of study with the implementation of Affordable Care Act. Our study examines the extent and quality of healthcare services received by Medicaid-eligible children in Philadelphia. We compare health care utilization and quality for targeted healthcare conditions such as asthma for individuals receiving mental health treatment through the Philadelphia Department of Behavioral Health with those in Health Choices who have no mental health treatment. To complement this study, we are conducting a study to understand primary care physicians' and mental health professionals' perception of quality of care for children with mental illness in both primary care and mental health specialty care settings. In this project, the student will help the investigators submit IRB application, recruit study subjects, design study questionnaire, conduct interviews, and organize interview data. To understand the study area, the student will also review literature that would help conducting qualitative study in the quality of health care for children. The student will have an opportunity to write a paper with the investigators and publish in a peer-reviewed journal. Strong organization skills and excellent communication and writing skills are necessary. Experience of working on a research project is helpful.

*Selam Negash*

**Project 1: Implicit Learning Paradigms as Potential Markers of Preclinical AD**

As research on Alzheimer's disease (AD) moves toward early detection and prevention, the need for tools that are sensitive to subtle changes, very early in the disease course, has become increasingly important. Nonetheless, one of the challenges in the detection of preclinical AD has been the lack of instruments that are specific to subtle cognitive changes in very early AD versus normal aging. While standard psychometric tools have received significant attention over the years, a parallel approach using well-developed, experimental paradigms has been less aggressively pursued with little change in testing batteries. Implicit learning, with its multiple forms, is a less studied, yet potentially important system that can offer insights into the dissociation of preclinical AD from normal aging. Specifically, if some forms of implicit learning are impaired in preclinical AD compared to normal aging while others are not, this pattern could help in early and accurate detection of AD. Equally important, an intact implicit system might be used to help design programs that can increase the period during which patients can be relatively independent. To this end, the current project investigates the utility of two novel, well-developed, implicit paradigms (contextual cueing and sequence learning), which, based on cognitive neuroscience literature and our own work, appear to differentially dissociate between age-related and AD-related changes. The proposal also leverages on high-dimensional imaging pattern classification method, SPARE-AD index (Spatial Pattern of Abnormality for Recognition of Early Alzheimer's disease) in classification of preclinical AD and normal aging groups. It is hypothesized that the implicit learning paradigms will detect subtle cognitive deficits in preclinical AD versus normal aging, and that this will occur to a greater extent than in standard neuropsychological instruments. As such, it is expected that this project will provide an important foundation for development of inexpensive screening measures in preclinical disease and potential outcome measures in trials directed at this population. Student duties: Recruit and enroll participants into the study; administer computerized cognitive testing; data entry and analysis

*Steven Siegel*

**Project 1: Animal models of psychiatric disorders**

Students will work with faculty, fellows and students to perform behavioral and electrophysiological assessments in mice that have been modified to display behaviors that mimic human disease. Activities will include learning small animal surgery for electrode placement, and behavioral assessments, as well as the relevant scientific literature and clinical issues.

## **PULMONARY, ALLERGY, AND CRITICAL CARE**

*Nuala Meyer*

### **Project 1: Molecular Epidemiology of Severe Sepsis in the ICU (MESSI) cohort study**

This is a prospective, observational cohort study of patients with severe sepsis (= an infection and new organ injury or organ failure attributable to the infection), to identify genetic and molecular risk factors associated with respiratory failure, kidney failure, and death. Eligible subjects are inpatients in the medical intensive care unit at HUP. Students' duties include: 1) Abstracting clinical data from patients' ICU stay to a standardized electronic case report form 2) Participating in weekly lab meetings to discuss enrollment, data inspection and cleaning, and analysis 3) Data inspection and cleaning 4) If desired and with adequate training, student may also participate in laboratory procedures including: a) processing of blood specimens to obtain plasma b) plasma analysis by ELISA c) DNA extraction and genotyping Prerequisites: Rising sophomores or juniors interested in clinical and/or translational research HIPAA training, CITI training, and universal precautions for contact with bodily fluids will be required before any patient contact or contact with protected health information.

*Michael Shashaty*

### **Project 1: Adipose inflammation as a cause of kidney failure in critically ill 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 witness various aspects of care for trauma patients including acute resuscitation, operations, and ICU care. This translational human cohort study aims to determine the molecular mechanisms underlying the association of obesity with acute renal failure (also known as acute kidney injury, or AKI) in trauma patients requiring intensive care. Obese patients are at significantly higher risk of AKI after major trauma, and we hypothesize that a profound inflammatory response in adipose tissue, with subsequent inflammatory insult to the kidneys, may be responsible. In order to test this hypothesis, we are obtaining blood, urine, and subcutaneous fat samples from trauma patients shortly after emergency department arrival. Expression of key inflammatory genes in fat and blood will be tested and compared with healthy controls to determine the extent of adipose inflammation in response to trauma, and if this correlates with the development of AKI. Students will have the opportunity to: evaluate patients in the emergency department trauma bay and in the trauma ICU for potential study enrollment, assist with obtaining patient or family consent, assist with acquisition and processing of fat, blood, and urine specimens in the operating room and the ICU, and collect patient information from the electronic medical record into a computerized database.

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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.

### **Project 2: Understanding organ failure in critically ill trauma patients**

This project is, similar to Project 1, 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 a longitudinal human cohort study, and have the chance to witness various aspects of care for trauma patients including acute resuscitation, operations, and ICU care. This human cohort study is an ongoing project designed to determine clinical and molecular/genetic risk factors for the development of organ dysfunction, such as acute kidney injury (AKI) and the acute respiratory distress syndrome (ARDS), after major trauma. The cohort has been the source of numerous prior publications in the critical care literature including studies identifying obesity and race as risk factors for AKI, blood type as a risk factor for ARDS, and certain genetic variations as conferring risk for organ dysfunction. Ongoing projects include studies of the association of intraabdominal pressure and muscle damage with AKI after trauma as well as molecular studies investigating why type A blood confers increased risk of ARDS after trauma. The opportunity to work on this project may be extendable into the school year. Students will have the opportunity to: collect patient information from the electronic medical record into a computerized database, gain experience reading medical charts, collect and process blood specimens from the clinical lab, participate in weekly meetings to learn about the conduct of a clinical research study. Through the connections made in this study, opportunities may be available for shadowing 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.

## **RADIATION ONCOLOGY**

*Alejandro Carabe-Fernandez*

### **Project 1: Testing and calibration of a dose calculation program designed for proton radiotherapy**

Abstract: Radiation therapy is a complex type of treatment that requires of special software in order to plan the radiation fields used to treat the patients. Also, proton radiotherapy benefits from the extra amount of biological effectiveness that these particles have compared to more conventional modalities of radiation such x-rays and electrons. This enhanced effectiveness is related to an increased capability of protons to deposit energy along their tracks, thus causing

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more damage to the DNA of the cells they traverse. The linear energy transfer (LET) is the physical quantity used to characterize the amount of energy deposited by a particle per unit of track length and it is a variable of interest in a radiotherapy clinical as it could help to determine the increase of radiation effectiveness protons have versus other particles of reduced LET (ie, reduced amount of energy deposited per unit of track length). We have developed a software that is capable of calculating LET based on an analytical formulation. This formulation needs to be implemented in our main treatment planning system (Eclipse, Varian) in order to be able to calculate LET fast and routinely.....Job Description: The role of the student would be to construct, carry out and evaluate a comprehensive test plan for our forward dose calculation tool. Depending on the student's interests, this could include using commercial TPS software, analyzing real patient data, performing Monte Carlo simulations and collecting experimental data. The student will be responsible of the initial implementation of the existing code (in MATLAB) in ECLIPSE using an API provided for such purpose. The work of the student will of course be acknowledged in any publications resulting from this project. The student will have the opportunity of understanding how treatment planning systems work to create radiotherapy plans..... Requirements: The student needs to be computer language (C++) proficient, and hopefully with a physics background in order to understand the required formulation.

## **RADIOLOGY**

*Bryan Pukenas*

### **Project 1: 3D printing for development of novel bone biopsy needles**

State of the art bone biopsy needles often yeild indeterminte or non-diagnostic results because of paucity of tissue. The prospective student will be involved in designing a novel bone biopsy needle, 3D printing of a plastic prototype, and if time allows, 3D printing of a metal prototype.

## **SURGERY**

*Daniel Holena*

### **Project 1: Family costs of surgical critical care: the role of interhospital transfer**

The cost of care in the Intensive Care Unit (ICU) is substantial and well known. Less well described, however, are the direct and opportunity costs incurred by family members of ICU patients. The Hospital of the University of Pennsylvania is a quaternary academic medical center which serves as at a referral center for southeastern Pennsylvania and adjacent states. As part of

a larger project examining interhospital transfer for patients with acute surgical conditions, we seek to characterize the cost of critical care from the perspective of family members of patients in the ICU with specific interest in the differential costs between local and transferred patients. This research project will involve the development a survey instrument and a semi-structured interview tool. Students will then assist in screening and administration of interviews. These interviews will be recorded, transcribed, and coded using Nvivo software. Analysis of data using a grounded theory approach will occur concurrently with collection to allow for inclusion of important emic domains in the semi-structured interview. Students will gain familiarity with qualitative research methods in this project and will be invited to present their findings at the research conference of the Division of Surgical Critical Care. Additionally, this project is expected to result in an authorship credit for published results in a peer-reviewed journal. For students considering a career in medicine, this project will provide excellent exposure to the clinical practice of medicine, particularly as it relates to the ICU.

**Project 2: The Use of TeleSurgical Consultation to Expand Access to Acute Surgical Care: A pilot trial of feasibility and utility**

Access to on-call specialists has become a major concern in the treatment of ED patients with acute surgical issues. Approximately one-half of ED physicians across rural and urban settings currently report little or no access to on-call surgical consultation, and projected physician shortages combined with increased patient load will place further strains on the system. Telemedicine has been demonstrated to improve access to some sub-specialty providers, but use of telemedicine for acute general surgical disease states is not well studied. In this pilot study, we plan to trial the feasibility and reliability of a telesurgical consultation platform at an academic medical center. In the first aim of the study, we will examine the inter-rater reliability between remote telesurgical evaluation and physical presence surgical evaluation in the domains of physical examination and disposition planning. In the second aim of the study, we will perform a quasi-random allocation trial of the utility of telesurgical consultation vs. standard physical attending surgeon presence coverage during nighttime hours. We will also use survey methodology to assess patient and provider satisfaction with the two models of coverage. Students participating in this project will be expected to coordinate with consulting surgical residents to facilitate telemedical communications, assist in data collection and entry. Students can expect to gain familiarity with clinical research, trial design, and telemedicine. Additionally, for students considering a career in medicine, this project will provide excellent exposure to the clinical practice of medicine.

## TRANSPLANT SURGERY

*Paige Porrett*

### **Project 1: Generation of T cell memory during pregnancy**

We are interested in studying T cell memory development during the unique encounter between T cells of the maternal immune system with fetal antigen. These experiments are performed in a mouse model of pregnancy where maternal T cells specific for the fetus can be tracked. The student would be responsible for setting up timed matings, experimental design, data analysis and interpretation and potentially project publication.

### **Project 2: Mechanisms of immunoregulation in early pregnancy**

We study mechanisms of fetomaternal tolerance and are interested in how the hormonal environment of early pregnancy influences maternal anti-fetal T cell behavior during encounter with fetal antigen later in pregnancy. We explore this biology in a mouse model of pregnancy where maternal T cell responses to fetal antigen can be tracked. Students will participate in experimental design, maintenance of the mouse colony, data acquisition and analysis and publication of results.

## **Nursing**

### **BIOBEHAVIORAL HEALTH SCIENCES**

*Charlene Compher*

#### **Project 1: Copper Nutrition in Men with Bariatric Surgery**

This study involves: 1. consenting and scheduling study visits for patients eligible to participate in the study, 2. meeting with them during their study visit to obtain information on short surveys, 3. measure body composition using Bodpod and BIA devices, 4. entering data from the visit into Excel sheets.

*Bart De Jonghe*

#### **Project 1: Chemotherapy, Neuroinflammation and Illness Behavior**

To treat cancer, it is critical that patients adhere to treatments without interruption or discontinuation. Cisplatin chemotherapy is among the most potent and widely studied antineoplastic drugs, and is accompanied by severe side effects [chemotherapy-induced nausea and vomiting (CINV), anorexia, gastric stasis, and weight loss] that devastate quality of life and require constant symptom management. Anti-emetic drugs have greatly reduced the severity of CINV; however, the majority of patients still exhibit treatment-induced nausea/emesis that obviate treatment adherence. Preliminary Studies show that cisplatin induces robust release of inflammatory cytokines (tumor necrosis factor alpha [TNF] and Interleukin 1 beta [IL1]) that are linked to anorexia, increased pain, and emetic events. Surprisingly, it is relatively unexplored how TNF and IL1 impact anorexia, nausea, “malaise” (generalized feelings of unwellness), and gastric stasis following cisplatin treatment. While both IL1 and TNF suppress food intake when administered alone, these cytokines synergistically suppress feeding when given together, a situation more similar to an actual pathological state. However, there have been no comprehensive studies of cisplatin-induced elevation of these cytokines on the elicitation of visceral malaise. Our overarching hypothesis is that cisplatin induces IL1 and TNF signaling within the caudal brainstem, which uses synergistic transduction mechanisms to elicit anorexia, nausea and gastric stasis. The student's duties include various in vivo and in vitro techniques related to the observation of rat feeding behavior and processing of brain tissue for molecular analysis. No training or lab experience is required, however both would be preferred and helpful.

*Julie Fairman*

**Project 1: Filipino Nurse Oral History Project**

This project will use oral history to explore the history of Filipino nurses in the United States post-World War II. In particular, the study will examine the education and practice trajectory of these nurses and the contextual factors that shaped their nursing careers. Most studies of the history of nursing in this period with this method examine white nurses. There are no studies of nurses from the Philippines except for pre-world War II analyses (e.g. Choi, Brush). Students working with this project will work with me to develop the IRB proposal, an interview guide, secondary literature review and identify, conduct and help analyze interviews with Filipino nurses. I envision a manuscript to be developed from this work with the student as co-author. Students will experience oral history research first hand, as well as data analysis and learn about the ethical conduct of research.

*Sarah Kagan*

**Project 1: Understanding Frailty and Cancer in Older Adults**

Physiological frailty is widely thought a determining factor in treatment tolerance and disease control among older adults diagnosed with cancer. Nevertheless, the absence of well-established measures of frailty contributes to absent evidence to confirm or refute the working hypothesis that frailer individuals require more support to tolerate cancer treatment or elucidate what interventions are influential. The Living Well Geriatric Oncology Program at Pennsylvania Hospital is launching a project to explore the measurement of frailty and the intersection of social support in cancer experience. The project is suitable for students seeking exposure to clinical teams and patient care who are able to think creatively about designing and implementing an exploratory study measuring frailty and social support in older adults living with cancer. Some familiarity with clinical research processes and descriptive statistics are desirable but not mandatory. Patient oriented research training certification must be current or completed by the initiation of the PURM grant. The student will collect data from patients and their families as well as actively participating in data analysis and interpretation.

**Project 2: Describing Older Adults Preferences about Electronic Resources for Cancer Treatment Support**

Relatively little is known about how older adults think about, use, and evaluate electronic resources for specific health education and self-care concerns. While there are many cancer resources available through the internet, few studies establish how, when, and for which older adults they should be used. The Living Well Geriatric Oncology Program at Pennsylvania Hospital aims to design and test an interactive, personalized web resource for older adults that

identifies tools selected based on individual characteristics including demographic and geographic variables. This project is well suited to rising sophomore or junior students who are majoring in computational biology or other majors that may lead to careers in healthcare and who have established skills in software and web design as well as fundamental research skills including basic descriptive biostatistics. The project entails direct contact with patients and family members and the clinical team to complete a needs assessment for the actual resource application and with the clinical team and others to identify elements important in the research design. Patient oriented research training certification must be current or completed by the initiation of the PURM grant.

### **Project 3: Understanding and Addressing the Needs of Adolescent Sarcoma Survivors**

The needs of people who survive sarcoma diagnosed as children and teens fall within the national mandate from the Commission on Cancer to supply all cancer survivors with a treatment summary and survivorship care plan. The Joan Karnell Cancer Center, part of the Abramson Cancer Center, at Pennsylvania Hospital houses one of the largest sarcoma treatment programs for adolescents and adults in the country. Understanding the unique needs of adolescent patients and meeting those needs with evidence based intervention is a strategic program priority. This project entails a student working with the clinical team treating teens diagnosed with sarcoma and with the teens themselves to identify dimensions of survivorship experience to be measured and described in initial research. The results of this initial research will help define the Sarcoma Survivorship Care Program, its implementation, and evaluation and thus offers opportunity for continued volunteer activity during the academic year for the successful student. Some familiarity with clinical research processes and descriptive statistics are desirable but not mandatory. Patient oriented research training certification must be current or completed by the initiation of the PURM grant. The student will collect data from teen patients, their parents, and clinicians as well as actively participating in data analysis and interpretation.

*Lea Ann Matura*

### **Project 1: Impact of Fatigue in Pulmonary Arterial Hypertension**

Pulmonary arterial hypertension (PAH) is a chronic, debilitating, life-limiting disease affecting primarily young to middle age women. It is characterized by increased pulmonary artery pressure (typically without a known cause) and results in right-sided heart failure. Fatigue is reported by > 90% of patients. Fatigue interferes with patients' lives and negatively affects health-related quality of life (HRQOL). While fatigue is commonly measured by self-report we do have an objective measure to capture the impact of fatigue in PAH. A novel way to gauge the impact of fatigue is by determining the relationship between fatigue and physical activity using accelerometry. The accelerometer is worn on the waist of the dominant side to provide objective data regarding physical activity levels throughout the day. The purpose of this study is to

evaluate the reliability of accelerometry to measure physical activity in patients with PAH and to examine its relationship with self-reported fatigue and HRQOL. Our overall hypothesis is patients with more self-reported fatigue will have lower physical activity (accelerometry) and HRQOL and the accelerometry will demonstrate good reliability overtime in PAH. Data from this study will have important implications in terms of future studies of strategies to reduce fatigue. Students will assist with subject recruitment, analyzing and interpreting data and acquire basic scientific writing skills. Students will need to know basic library research skills and knowledge of working with Microsoft office.

### **Project 2: Feasibility of slow-paced respiration therapy for treatment of a symptom cluster in Pulmonary Arterial Hypertension**

Pulmonary arterial hypertension (PAH) is a chronic illness characterized by increased pulmonary pressures resulting in right heart failure and premature death. Common symptoms that impair quality of life and functioning are dyspnea, fatigue and sleep disturbance. This trio of symptoms is highly prevalent and forms a symptom cluster (2 or more symptoms that co-occur) in PAH. From a biological, proinflammatory cytokines are implicated in dyspnea, fatigue and sleep disturbance; there is activation of the sympathetic nervous system (SNS) and an inherent inflammatory process in PAH that contributes to the pathophysiology, but the link to this symptom cluster has not been investigated. One novel, treatment for symptom clusters is slow-paced respiration therapy using the FDA-approved device, RESPeRATE. The device contains headphones and a sensor that attaches to the chest to detect inhalation and exhalation. Musical tones synchronize with the respiratory cycle to slowly guide the user to decrease respirations. RESPeRATE moderates effects of the SNS; lowers blood pressure; improves functional capacity and ejection fraction; and significantly decreases pulmonary pressures in left heart failure. Participants will use the RESPeRATE device to perform slow-paced respiration for 15 minutes per day for 8 weeks to determine the feasibility and effects on the SNS and inflammatory activity and the symptom cluster. Our overall hypothesis is that, as compared to baseline, after eight weeks of therapy participants who receive slow-based respiration therapy will have lower SNS activity and inflammatory levels, and improved dyspnea, fatigue and sleep disturbance. Students will need to know basic library research skills and knowledge of working with Microsoft office.

*Therese Richmond*

### **Project 1: Psychological Consequences of Injury in Urban Black Men**

This is an NIH funded project that examines the emotional responses of traumatic injury in urban black men and seeks to more accurately predict those at highest risk for injury. We enroll and interview patients after injury while still hospitalized and then conduct follow-up interviews 3 months after hospital discharge. Students would join an interdisciplinary research team and work with a stellar staff. Job responsibilities would include accompanying staff for f/u interviews,

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transcription of qualitative interview audiotapes, data entry in REDcap, possibly geocoding, and conducting some library research. We are looking for an inquisitive student with excellent people skills and abilities to interaction with a diverse population with high levels of respect, and existing computer skills. Knowledge of ArcGIS is a plus.

## FAMILY AND COMMUNITY HEALTH

*Martha Curley*

### **Project 1: RESTORE-cognition** ***Rising Juniors only***

We are starting a new NIH-funded study where we need help over the summer in contacting parents of previously sick children who survived the Pediatric ICU. We need a sleuth to locate these parents, talk with them over the phone and invite them participate in our study. After completing the informed consent process, the student will then coordinate the cognitive evaluation appointment with participating sites over the USA. The candidate should be a mature intuitively compassionate individual who can communicate well with individuals around a potentially stressful topic.

### **Project 2: Braden Q+D onstrument validation study**

We are currently collecting data from 6 pediatric hospitals across the country and could use some help in evaluating the data received and, working within REDcap, evaluate its completeness. If incomplete the student will send data requests to participating sites. The student will also be responsible for compiling quality monitoring reports for the study. Through these processes, the student will acquire skills in data management and presentation.

*Lisa Lewis*

### **Project 1: A Longitudinal Examination of Medication Adherence Factors in Hypertensive Black Men**

Black men in the United States are dying at two times the rate of their white counterparts (31% vs. 14%) as a result of uncontrolled hypertension related to their poor adherence to antihypertensive medications. The purpose of this National Institutes of Health Funded longitudinal study is to identify determinants of medication adherence in hypertensive black men. We are recruiting 200 hypertensive black men age 18 years and older from Philadelphia and its surrounding areas and who are taking at least one antihypertensive medication. We will assess the following determinants every 3 months for 12 months: (a) self-efficacy, (b) social networks, (c) depression, (d) physician trust and (e) perceived masculinity. We will also assess

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medication adherence every 3 months. We hypothesize that perceived masculinity and depression will be negatively associated with medication adherence and we hypothesize that self-efficacy, social networks and physician trust will be positively associated with medication adherence at 12 months. Data collection includes measurement of medication adherence using an electronic monitoring system known as the GlowCap system, measurement of blood pressure using an automated device (BPTru device), and study questionnaires. Training will be provided for all data collection techniques. As such, the student will not need health assessment skills but must be comfortable working with diverse populations and be willing to travel throughout Philadelphia, if necessary. The student will gain skills mostly in health measurement. There will also be some opportunity for the student to gain skills in data analysis using the SPSS software and manuscript preparation.

### ***Jianghong Liu***

#### **Project 1: Early health risk factors and child psychophysiology**

The purpose of this project is to investigate how early health risk factor affect psychophysiology in children/adolescents and its subsequent effect on childhood behavior. The research assistant will work with a large dataset and conduct psychophysiology data cleaning and scoring, for which training will be provided. The student is expected to attend weekly lab meetings and work with an interdisciplinary research team. The student needs need to be responsible, self-directed, and organized.

#### **Project 2: Early nutrition and neurocognition**

The purpose of this project is to investigate how nutrition, food frequency, exercise, affect neurocognition and behavior in children/adolescents. The student will conduct both data related and literature search. Data component research will involve working with data collected from the China Jintan Cohort and assessing associations between health risk factors and childhood behavior and cognition measures. The student will also need to conduct extensive literature searches to gather background for the topic. The student wil have experience in literature search, data coding and analysis; the student should have good organizational skills and be comfortable working independently and in a group setting. Training will be provided

#### **Project 3: Prenatal factors in sleep and neurocognition**

The purpose of this project is to investigate how prenatal events (e.g. maternal smoke exposure, birth complication, or depression) affect childhood sleep patterns and their subsequent effect on neurocognition and behavior in children/adolescents. The student will conduct both data related and literature search. Student will read and analyze published literature to establish a solid background on the topic. Data component research will involve working with data collected from the China Jintan Cohort and assessing associations between prenatal health factors and childhood

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sleep, behavior, and cognition measures. The student will have experience in literature search, data coding and analysis; the student should have good organizational skills and be comfortable working independently and in a group setting. Training will be provided

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## **Social Policy and Practice**

### **SOCIAL POLICY AND PRACTICE**

*Femida Handy*

#### **Project 1: Practice and Promise of Philanthropy**

I am writing a book on Philanthropy on India and I need a research assistant who can help me during the summer. Duties include: Research Editing Preparation of book manuscript. You will benefit by participating in this project as I will guide and mentor you all along. I expect you will sharpen your research and writing skills. Also learn about the topic and hopefully have a fun summer doing it!

#### **Project 2: Nonprofit and Voluntary Sector Quarterly**

I am the editor of the Nonprofit and Voluntary Sector Quarterly- the top ranked journal in its field. I require assistance in running this journal. You will experience all facets of managing a journal (on-line) including receiving manuscripts, assigning it to editors and shepherding it through the review process. Duties will include all the above. It is a unique opportunity to learn how academic journals work and how articles are chosen for publication or rejected.

#### **Project 3: For-profit, nonprofit or public sector? Influencing factors for employment sector choice**

What factors influence sector choice among students looking for employment. To what extent do these factors differ between the public, for-profit, and nonprofit sector? Student duties will include research analysis editing. You will benefit by participating in this project.....I will guide and mentor you all along. I expect you will sharpen your research and writing skills. Also learn about the topic and hopefully have a fun summer doing it!

## **Veterinary Medicine**

### **CLINICAL STUDIES-PHILADELPHIA**

*Mark Oyama*

#### **Project 1: Measuring the Effect of Companion Dog and Cat Ownership on Pet Owner Quality of Life**

The aim of this project is to develop a survey instrument (questionnaire) to determine the effects of dog or cat ownership on pet owner quality of life (QoL). There are 70 million dogs and 74 million cats in the US, and approximately one-third of all US households own a dog and/or cat. Within these homes, 91% of these pets are considered as members of the family. Pet ownership impacts human physical and psychological health in a number of potentially positive ways including improved physical activity, lower blood pressure, and less depression. The relationship between the health and QoL of pets and their owners is increasingly interconnected and we believe that pet ownership provides individual and societal benefit. The study involves a series of focus groups that will help progressively design and test a questionnaire instrument within the Veterinary Hospital of the University of Pennsylvania, followed by testing in the field at local pet shelters and adoption centers. The objective of the study is to both design and validate a questionnaire as well as to test its responsiveness in people before and after owning a pet. We hope that such a questionnaire will become a standard measurement tool in studies exploring the effect of pet ownership on human health. The student will gain exposure to a variety of research methods, clinical operations in the Veterinary Teaching Hospital of the University of Pennsylvania, and actively participate by assisting research staff in the following: 1. Development and field testing of questionnaires 2. Recruitment of and data collection from prospective adopters of pets at local pet shelters and humane societies and from clients of the Veterinary Hospital of the University of Pennsylvania. 3. Running of pet owner focus groups 4. Data entry and basic data analysis Prospective students should have some experience with either dogs or cats, have strong social and interpersonal skills, have experience in using Excel, and be motivated and willing to become part of an active research team.

## **Wharton**

### **BUSINESS ECONOMICS AND PUBLIC POLICY**

*Judd Kessler*

#### **Project 1: Organ Donation by State**

Over 120,000 people are currently on a waiting list for a life saving organ transplant, and every year over 10,000 die while waiting. The organ donation rate — i.e. the percentage of individuals 18 years of age or older who have registered as organ donors at their state DMV — varies dramatically across states, from above 80% in states like Alaska and Utah to below 20% in New York and Texas. This research project aims to better understanding the variation between states by systematically investigating how individuals are asked to register as donors in their state DMV and analyzing those strategies. The student would be researching policies at each state and gathering visual materials (e.g. PDFs of DMV forms that ask about organ donation), primarily by internet research but also by correspondence with DMV or organ donation contacts.

#### **Project 2: Behavioral Economics to Promote Medication Adherence and Habit Formation**

We aim to investigate behavioral economics interventions that can help overcome cognitive and motivational barriers to medication adherence through consumer engagement. While previous work has investigated interventions such as reminders and incentives in isolation, our goal is to study how these interventions interact. Are incentives more or less effective for subjects receiving reminders? How is habit formation affected by the interaction of these two? Does this vary by patient type? Answering these questions allows medication adherence interventions to be designed optimally. Understanding how to optimally design adherence interventions has the potential to improve patient health, thus lowering cost of care, while minimizing the cost of the intervention through effective targeting to certain patient types. We plan to track daily adherence of 500 patients to a prescribed drug using a technology that electronically monitors when a pill bottle has been opened. Our innovative study design aims to accomplish three goals: (1) promote medication adherence; (2) promote long-term habits that persist even when the interventions are removed; and (3) understand how various patient characteristics (including their beliefs about their ability to comply with their prescription) predict adherence and treatment receptivity. Depending on the timing of the study, the student's duties will involve supporting the research coordinator in running a very large randomized control trial, potentially communicating with subjects and conducting administrative tasks.

*Shing-Yi Wang*

**Project 1: Land, Migration and Agricultural Productivity in China**

The student would assist on two related projects related in decisions in agricultural production and migration in rural China. One project examines the contracts signed by rural households in leasing in and out land. Another project examines the consequences of rural migration on agricultural production in rural areas. Both projects would involve working with large household data sets to help think about these questions. The research assistant will assist in data entry, finding additional data, cleaning and analyzing data and with background research such as literature searches. Experience with Stata (or another statistical package) or a willingness to learn to use Stata would be a plus. Chinese language ability would also be a plus but is not necessary.

## HEALTH CARE MANAGEMENT

*Guy David*

**Project 1: Organizational Innovations in Primary Care**

Description: This research will examine innovations in the organization of primary care in the U.S. health care market from an economics perspective. In particular, our research focuses on the development of “concierge” or “retainer-based medicine”, which involves patients paying an annual membership fee to primary care physicians in return for longer office visits and same day appointments (similar to the television show *Royal Pains* but with less drama). The student will help in collecting information from websites and through phone surveys, assist in writing case studies, and developing presentations. Strong oral and written communication skills are important and an interest in economics, business, or health care is a plus.

## MANAGEMENT

*Iwan Barankay*

**Project 1: A randomized control trial of daily incentives for daily tooth brushing to reduce gingivitis and plaque**

Students will help implementing an innovative research study run in collaboration between the Wharton School, Penn Nursing, and Penn Dental. The objective of this study is to use monitoring and feedback rooted in behavioral economics to improve oral health practices and outcome.

Students will get hands on practice in the broad range of logistics, design, and procedures of conducting a randomized control trial combining ideas from behavioral economics and health.

*Emilie Feldman*

**Project 1: Corporate Divestiture Capability**

This project focuses on the corporate development process of divestiture, and explores key factors that impact firm divestiture capability and performance. Student responsibilities involve collecting and coding data on companies' characteristics and divestiture experience from various sources, as well as generating summary statistics from these data. Familiarity with corporate reports (such as 10-Ks) will be helpful, and an eye for detail is a must. Economics majors or Wharton undergraduates with a basic background in statistics preferred.

**Project 2: Corporate-Level Learning from Business Unit Divestiture Experience**

This research explores whether and what firms may learn from the business units they acquire. Specifically, this project investigates if firms may learn to improve their divestiture performance when they acquire business units that have previously experienced divestiture. Student responsibilities involve collecting and coding data on the histories, experiences and characteristics of firms and their business units from a variety of sources (e.g. 10-Ks, Compustat); generating summary statistics from these data; and manipulating data sets. Economics majors or Wharton undergraduates preferred.

*David Hsu*

**Project 1: Entrepreneurial Team Composition & Innovation**

How should entrepreneurial managers in high technology industries structure their teams of scientists and engineers? Does intellectual diversity contribute to innovation? In this study of the universe of venture capital-backed startup biotechnology firms, we analyze how various team structures can influence the innovative productivity of firms as they grow. In this project, you will learn about innovation management, organization theory, entrepreneurial strategy, and venture capital. You will also assist with other projects in the fields of finance, management, and economics. You will receive training in contemporary research techniques and tools. All undergraduates are encouraged to apply, with preference to students in Wharton, Engineering and the social sciences (economics, sociology, etc.). No prior experience or knowledge is necessary; freshmen are especially encouraged to apply. This opportunity will be beneficial for a future career in finance, management consulting, or academic research.

**Project 2: Two-Sided Matching in the Market for Venture Capital**

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How do venture capital investors and entrepreneurial firms match? Venture capital investors make a decision to invest in entrepreneurial firms, and the firms choose to accept that investment, for reasons including technological fit, geographic proximity, and financial needs. However, many characteristics, such as personal compatibility and technological feasibility, remain unknown to outside observers. This market between venture capitalists and entrepreneurs can be thought of as a two-sided matching game with unobserved characteristics. We investigate the identification of the distribution of these unobserved characteristics using data on who matches with whom. In this project, you will learn about venture capital, entrepreneurial strategy, and game theory. You will also assist with other projects in the fields of finance, management, and economics. You will receive training in contemporary research techniques and tools. All undergraduates are encouraged to apply, with preference to students in Wharton, Engineering and the social sciences (economics, sociology, etc.). No prior experience or knowledge is necessary; freshmen are especially encouraged to apply. This opportunity will be beneficial for a future career in finance, management consulting, or academic research.

*Laura Huang*

### **Project 1: Entrepreneurship in the New Space Industry**

This project looks at the emergence of the New Space Industry (including firms such as Virgin Galactic, SpaceX, XCor, etc.) to show the circumstances in which entrepreneurs are more likely to engage cooperatively, rather than competitively with regulatory bodies and other ventures. In this project, we will explore how entrepreneurs in the industry contend with high uncertainty and substantial opposition in the entrepreneurship process. The goal is to examine how despite the numerous policy-relevant implications and the need to contend with the governments ruling over them, the role of regulatory bodies and their mutual interaction with entrepreneurs in the entrepreneurship dynamic affect success. Students participating in this project will help examine primary and secondary sources of data, analyze findings, read background literature, and design and run field experiments as needed.

*Natalya Vinokurova*

### **Project 1: Best Practices in Heart Surgery Outcome Reporting**

This project looks at the evolution of cardiac surgery outcome data collection in New York State between 1950s and 1990s. The goal is to understand what institutional arrangements enabled New York to achieve a 40 percent drop in open heart surgery mortality. The student will be asked to read, look for patterns in, and summarize large volumes of archival data. The project may involve digitizing and organizing archival materials. I am looking for a critical thinker with

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good writing skills. The major is unimportant although some experience with mathematics or statistics and/or facility with MS Excel or Atlas.ti is a plus.

### **Project 2: Property Rights in the 2008 Mortgage Crisis**

This project seeks to develop a history of Mortgage Electronic Registration System (MERS), an entity that played an important role in the 2008 mortgage crisis. The goal is to understand the extent to which the ideas of transaction-cost economics influenced the creation of this entity and the entity's role in the aftermath of the crisis. The student will be asked to consult primary and secondary sources and to write detailed memos. I am looking for a critical thinker with good writing skills. The major is unimportant, but being detail-oriented, experience with documenting sources, and/or facility with MS Excel or Atlas.ti would be great.

### **Project 3: Culture of Unsafty at British Petroleum**

This project looks at the safety record of BP plants before they were owned by BP, during BP ownership period, and after BP sold them. The goal is to understand the effect of BP culture on its safety record. The student will work with government records, corporate ownership records, industry press and legal filings to construct a database of BP facilities. Research skills, experience with documenting sources, and facility with MS Excel are critical. Some knowledge of statistics or econometrics would be a plus.

## **MARKETING**

*Peter Fader*

### **Project 1: Development/Applications of Probability Models**

I encourage students who have taken my elective course, MKTG/STAT 476, to extend their knowledge of the models and methods we covered. I want students who seek to engage in original research by extending these models and/or applying them to interesting new datasets.

*Jerry Wind*

### **Project 1: Creativity**

This project supports the research and publishing of Jerry (Yoram) Wind by developing and expanding the lessons of his popular MBA Creativity course to individuals and organizations who want to create a creative culture in today's fast-paced, innovative business environment. Student responsibilities will include extensive literature review and searching for real-world examples of creativity in all domains (business, art, architecture, science, dance, theater, etc).

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The results of student research will augment the MBA course and contribute to the development of a book, *Being Creative: A Guide for Individuals and Organizations*. These include not only business organizations, but also non-profits, associations, NGOs, and government organizations. Organizations in the early stages of growth will find it essential in guiding them to retain and develop the initial creativity that got them started in the first place. Established organizations in turbulent markets will learn how to transform themselves into innovative powerhouses. Mature organizations with innovative pasts will learn how to ensure that they don't succumb to the innovator's dilemma and fail to maintain the creative momentum they will need to continue to prosper. Because of the book's focus on the rewards of creativity, it is expected that there will be two additional kinds of readers: those who want to improve their individual creativity, and those civic leaders – such as mayors, council people, school boards, legislatures, and the like – who want to create a “creative society.” This project presents an exciting opportunity for a student to engage with a topic relevant to growth in all fields. In addition to outstanding research skills, qualities that a successful student can contribute include enthusiasm, strong writing ability, and an analytical mind that is able to synthesize a variety of information from diverse sources.

### **Project 2: Market Segmentation**

This project supports the research and publishing of two professors in the Marketing Department, Jerry Wind and David Bell, who have a book on market segmentation strategy forthcoming from Now publishers. Student responsibilities will include extensive literature review and the analysis of real-world examples of segmentation in all fields – business, elections, social policy, academia, etc. This project presents an exciting opportunity for a student to engage with two senior members of the Marketing department on a relevant business topic. In addition to outstanding research skills, qualities that a successful student can contribute include enthusiasm, strong writing ability, and an analytical mind that is able to synthesize a variety of information from diverse sources.