Penn Undergraduate Research Mentoring Program
Project Descriptions

Summer 2016

Application and instructions at http://www.upenn.edu/curf/research/grants/penn-undergraduate-research-mentoring-program

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

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

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Arts and Sciences

AFRICANA STUDIES

Herman Beavers

Project 1: Turbulent Blackness: African American Literature and the Poetics of Chaos ***Rising Juniors only***

This project involves the use of chaos theory as a critical and analytical tool aimed at the interpretation and periodization of texts by post-WWII African American writers, ranging from approximately 1940-2005. I am currently in the midst of developing a preliminary bibliography for the project in which students would be responsible for pulling sources from scientific, literary, and historical materials. Students with a background in African American literature are preferred, though students with an interest in the intersection of science and expressive culture are also welcome to apply.

Project 2: African American Poetics

This project involves creating a bibliography that consists of book reviews, critical essays, and occasional pieces dealing with contemporary African American poetry and poetics. Given the explosion of small literary presses and the increased visibility of African American poets across the U.S., this project seeks to establish a critical vocabulary that will prove useful in the reading and interpretation of African American poetry published over the course of the last 20 years. I am especially interested in finding out how the emergence of the digital humanities has impacted the publication and dissemination of poetry by African American writers. Students will be required to read and summarize scholarly sources as well as identify primary sources for review. Students who have a background in English (and in particular, African American poetry) are preferred.

Project 3: African American Literature and Racial Conduct ***Rising Sophomores only***

Students working on this project will be tasked with doing archival searches in the African American press, starting in 1925 and running to 1970. This is a continuing project that seeks to examine the relationship between jazz music in the U.S. and the politics of racial conduct. How did political and social elites use the press to communicate either their displeasure with or support of jazz musicians over a 45 year period? Did the objections to jazz raised by clergy, politicians, and organizations devoted to racial uplift reflect views held by the masses in black communities in large cities in the Northern, Midwestern, and Southwestern U.S.? Does the response to jazz music in the 20s, 30s, and 40s anticipate the negative assessment of HipHop music by black elites in the 1980s and 90s? What do these responses tell us about the politics of

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respectability and the policing of racial conduct. By creating an archive of materials, I hope to be able to historicize this discussion. Students with a background in Musical history are welcome to apply, though this project's greatest need is for a student who is excited about archival research.

AFRICANA STUDIES & SOCIOLOGY

Dorothy Roberts

Project 1: The Ethics of Biosocial Research

In November 2016, I will deliver the Tanner Lectures on Human Values at Harvard University, on "The Ethics of Biosocial Science." Mainstream science now disavows past biosocial paradigms such as eugenics, evolutionary explanations for gender inequality, and biological definitions of race as unethical misinterpretations of the relationship between biology and society. An emerging biosocial science investigates instead the impact of social environments on human bodies—how societal factors become embodied. Rather than explain social inequality as biologically predestined, these scientists show how social inequality produces disparate biological outcomes. During summer 2016 I will explore the question, does the new biosocial science replicate or contest the ethical flaws of the old biosocial science? The PURM student will help me to collect cutting edge biosocial theories and studies across a range of disciplines—genetics, neuroscience, criminology, anthropology, and sociology—and to analyze critically their social and ethical implications. This position would be especially helpful to students interested in careers in these fields, as well as bioethics; science and technology studies; and history and sociology of science. It requires excellent research skills and critical and creative thinking.

ANTHROPOLOGY

Megan Kassabaum

Project 1: Smith Creek Archaeological Project

This project centers around the archaeological excavation of a prehistoric Native American mound site in Mississippi. Through their participation, students will be exposed to the various stages of original, anthropological fieldwork and to the prehistory of the American South. SCAP will provide the training necessary for students to continue on in the field of archaeology. Through daily, hands-on experience in the field, students will learn the skills involved in

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archaeological survey, excavation, and site mapping, as well as lab skills including artifact processing and basic ceramic analysis. Moreover, the project will provide the opportunity to engage broadly with anthropological questions about prehistoric technology, monument construction, food production and consumption, and American Indian history. While the research questions addressed in my own research center on why prehistoric mounds were built, how they were used, and what they meant to their creators, there will be many opportunities for students to influence the questions being asked and the methods being used to answer those questions.

Theodore Schurr

Project 1: Exploring the Genetic History of the Dominican Republic

In this project, we will investigate the genetic diversity of contemporary populations from the Dominican Republic. Although archeological evidence suggests that Caribbean islands were populated in a series of northward and eastern migratory waves, many questions remain regarding the relationship of these Caribbean migrants to other indigenous people of South and Central America. There have also been profound changes to the demography of indigenous communities following European contact, with the influx of African and European individuals into the region since the early 16th century transforming the genetic make-up of Caribbean populations. Thus, the gene pool of the Dominican Republic reflects both pre-contact and historical processes of colonization. To explore these issues, we will conduct a high-resolution analysis of mitochondrial DNA (mtDNA) and Y-chromosome sequence variation in ~1000 individuals from various regions of the Dominican Republic. While working on this project, the student will learn various methods of genetic analysis, including PCR amplification, gel electrophoresis, DNA sequencing, and SNP genotyping, among others. In addition, the student will be trained in basic statistical and phylogenetic methods of DNA sequence analysis so that he/she can conduct a comparative analysis of Dominican and Caribbean genetic variation. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for the Dominican population.

Project 2: Mitogenome Variation in Ethnic Populations of Northeast Pakistan

In this project, we are conducting a detailed genetic study of populations living in the Buner and Swabi area of Khyber Pakhtunkhwa Province in Pakistan. This research will help us to elucidate their origins in the region, define their affinities with the populations from the Indian subcontinent, West Asia and Central Asia, and delineate the relationship between genetic and identity formation in contemporary villages from this province. Approximately 700 unrelated individuals of five major ethnic groups (Yousafzai, Gujars, Syeds, Jadoon and Tanoli) from the Swabi and Buner area are being analyzed for mtDNA and Y-chromosome diversity. We need to further characterize whole mitogenome sequences in these populations to obtain the highest resolution view of maternal genetic variation in them. Thus, the student involved in this project

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will learn how to conduct mitogenome sequencing and employ statistical and phylogenetic tools to interpret patterns of genetic variation in the Pakistani populations. The resulting will allow us to reconstruct the movements of human groups into and out of this region for the past 60,000-70,000 years, and also begin elucidating the histories of the ethnic groups themselves. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for the Pakistani populations.

Project 3: Mitochondrial DNA Variation in Indigenous Populations of San Luis Potosi

The study will involve the high-resolution analysis of mitochondrial DNA (mtDNA) sequence variation in the Teenek, Pame and Nahua populations from this state of Mexico. Interestingly, Huastecan is a Mayan language related to those spoken further south and east in Mexico and Central America, raising intriguing questions about their genetic relationship to them. By contrast, the Pame speak a language belonging to the Oto-Pamean group of the Oto-Manguean family, while to Nahua speak language belonging to the widespread Uto-Aztecan language family. Given these ethnolinguistic differences, this analysis will reveal important new details about the population structure, phylogeography, admixture and population dynamics of these indigenous groups. The data from this study will also contribute to our understanding of Mexico's role in the peopling of the Americas, the relationship between linguistic and genetic diversification in Mexico, and the impact of the Aztec civilization on patterns of genetic diversity in Mexico. While working on this project, the student will learn various methods of genetic analysis, including PCR amplification, gel electrophoresis, DNA sequencing and SNP genotyping, among others. In addition, the student will be trained in basic statistical and phylogenetic methods of DNA sequence analysis so that he/she can conduct a comparative analysis of Native Mexican mtDNA variation. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for this population.

BIOLOGY

Ted Abel

Project 1: Mechanisms of sex-specific behavioral and structural deficits in a mouse model of autism

Autism spectrum disorder (ASD) affects five times as many males as females, but the molecular basis of this male predominance is not well understood. Impairments in synapse development and changes in volume and white matter connectivity in brain structures have been identified as likely sources of dysfunction in ASD. One gene linked to both synapse development and ASD is protocadherin 10 (Pcdh10), which is expressed in brain areas associated with cognition and social behavior, including the amygdala. Using a mouse model of ASD in which mice are

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missing one of two copies of Pcdh10, we found reduced social approach behavior in juvenile males, but not juvenile females or adult mice. We were able to rescue the behavior with administration of an NMDA receptor agonist. Interestingly, males have increased dendritic spine density and decreased NMDA receptor expression in the amygdala as well. Future studies will investigate the roles of hormones and social experience in the age- and sex-dependent behavioral deficits as well as altered morphology and connectivity in the amygdala and the mechanism of behavioral rescue. A student working on this project will work directly with mice and be exposed to a number of interesting techniques, including multiple behavioral assays, surgical techniques, microscopy and imaging of brain tissue and neural activity.

Project 2: Non-Neuronal Underpinnings of Sleep Homeostasis

Insufficient sleep is associated with neurological disorders and numerous health problems. Additionally, cognitive impairment resulting from sleep deprivation accounts for incalculable costs in work accidents and lost productivity. In a modern society where sleep is often sacrificed and working around the clock is rewarded, inadequate sleep is a growing problem. Despite this, very little is known about the cellular and molecular mechanisms underlying sleep homeostasis. The prevailing view is that these mechanisms are neuronal; however, many characteristics of astrocytes make them an attractive cellular mechanism possibly contributing to sleep homeostasis. Long thought to be “passive” cells in the brain due to the fact that they are not electrically excitable, astrocytes are now known to alter neuronal activity and synaptic transmission through release of chemical transmitters, called “gliotransmitters”. Recent work from our lab showed that whole brain conditional attenuation of vesicular-dependent exocytosis from astrocytes protects against the intense sleep drive and memory impairments typically observed following sleep deprivation. The molecular mechanisms, neurotransmitter systems, and brain regions underlying these phenotypes remain unknown. We hypothesize that gliotransmitter release resulting in adenosine buildup in the basal forebrain contributes to sleep drive, while astrocyte-derived adenosine in the hippocampus contributes to the cognitive deficits resulting from sleep deprivation. A student working on this project would work directly with transgenic mice and viral vectors to locally attenuate and activate gliotransmitter release from astrocytes in vivo. The student would learn and perform rodent behavioral tasks, viral transfection, and biochemical techniques such as western blotting and immunostaining.

Project 3: Noninvasive-optogenetic enhancement and characterization of memory circuits with IlaC, a novel optogenetic tool

Cyclic AMP (cAMP) is an important signaling molecule across species involved in the regulation of memory and behavior, and implicated in many psychiatric disorders. Despite important breakthroughs defining the role of cAMP in memory and psychiatric disorders, there has yet to be a tool developed that can noninvasively control cAMP levels with temporal and spatial precision in an awake, freely moving animal. Traditional cAMP-optogenetic tools contain the spatial and temporal resolution needed, but they rely upon light centered mainly in the visible

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blue-light spectrum which is unable to penetrate the skull. This requires surgical implantation of a fiber optic cannula that results in brain damage and gliosis. In addition, visible light can reflect through the brains of mice saturating photoreceptors that can result in behavioral confounds. Interestingly, infrared light is able to penetrate mammalian tissue, and is not visible to mice. Infrared light activated adenylyl cyclase (IlaC) is a recently developed tool that has shown promise in controlling cAMP levels; however, the potential for IlaC to be used in vivo is largely unexplored. The goal of this proposal is to develop and optimize IlaC for in vivo use, and then use IlaC to dissect the cellular circuitry and temporal phases of cAMP in the various phases of memory. A student working on this project would work directly with mice performing viral-brain infusions and behavioral studies. The student would also learn biochemical techniques such as western blotting and immunostaining. Students should have completed introductory biology and chemistry.

Nick Betley

Project 1: Deconstructing the behavioral function of hunger circuits ***Rising Sophomores only***

How does the brain influence behavior? To begin to unravel this mystery we study basic survival behaviors in the rodent model. One goal is to better understand how information coding hunger is integrated in the brain and how the motivated state of energy deficit modulates behavioral responses aimed at obtaining food. Starvation sensitive neurons (AGRP neurons) that are active during hunger provide a convenient entry point into the neural circuitry of feeding behavior. The goal of this project is to understand how activity in anatomically defined subsets of hunger coding neurons influence the level of effort the animal performs to obtain food. The project will involve running daily behavioral experiments including operant training and conditioned flavor preference. These behaviors will be performed in animals subject to optogenetic neuron activation - where the activity of specific neurons in the brain is turned on by pulses of light. Since these experiments require animal handling, either previous experience or a willingness to work with rodents is required. Students will need to demonstrate proficiency to the University animal staff before beginning research. Students will learn how to design, perform and analyze behavioral experiments and gain an understanding of statistics used in such experiments.

Project 2: Monitoring activity changes in neurons that drive hunger ***Rising Sophomores only***

How does the activity of neurons that signal hunger increase with energy deprivation? To answer these questions, we use various methods to image fluorescent indicators of neuron activity in awake and behaving animals. Students involved in this project will be responsible for establishing neuron activity recording paradigms, performing experiments and analyzing data. Since the establishment of these techniques requires a strong engineering and computational

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component, it is preferred that students applying to work on this project have a background in either engineering or computer coding. A desire to apply these skills to work with live animals is also desirable, but not essential.

Fevzi Daldal

Project 1: How do cells acquire copper, which is a micronutrient essential but also toxic?

If cells do not manage properly copper acquisition, traffic and delivery to the user proteins, they develop disease states, including exercise intolerance, lactic acidosis, neuromuscular diseases as well as Menkes and Wilson, Alzeimer or Parkinson diseases.

We are interested in molecular characterization of regulation and biogenesis of cytochromes, which are heme proteins involved in energy production (photosynthesis and respiration). We use microbes (facultative photosynthetic bacteria) and human mitochondria (diseased patients derived cybrid cell cultures) as experimental models to understand the molecular mechanisms of related diseases.

We use molecular genetics, biochemistry, cell culture and "omics" (genomic-RNAseq / proteomic-mass spectrometry) approaches.

If you like to work independently or in collaboration, under the supervision of an advanced postdoctoral fellow then consider this project. Chosen student will participate in all aspects of the projects, from bench-work to conception and design of novel immediate steps of the work. She/he will be involved in hands-on execution, data analyses and interpretation, and design of future extensions of the projects.

This summer activity provides an excellent training opportunity for professional studies beyond the undergraduate level, including medical, veterinary, dental and graduate schools. It is possible to extend the project to the academic year as an independent research study. Basic 100 levels biology, and chemistry background, a keen interest to learn, and a desire to accomplish something are the only requirements.

Project 2: How do cells make cytochromes with covalently attached heme?

Cytochrome production is essential for life because cells that do not make cytochromes properly induce disease states, extending from microphtylmia, porphyremia, sideroblastic anemia and mitochondrial multisystem disorders. Cells use an exquisite machinery to carry out this process, and we dissect the components of this machine and their specific functions.

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Project 3: How do cells form and regulate respiratory and photosynthetic enzyme supercomplexes in bacteria and human mitochondria?

Enzyme supercomplexes are multi-subunit, higher order protein organizations that yield large macromolecular entities. They are are essential for natural energy transduction, from cellular ATP generation to biofuel production. The components involved in forming supercomplexes (SCFs) and their regulation are not yet known, but the process is tightly associated with human mitochondrial myopathies, neuropathies, reactive oxygen production and aging. Elucidation of the underlying regulatory mechanisms will undoubtedly lead to novel therapies for these diseases for which no efficient cure is available.

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Mark Goulian

Project 1: Aerobic c-type cytochrome biogenesis in E. coli

E. coli, like many bacteria, synthesize a class of proteins called c-type cytochromes that enable cells to respire using compounds other than oxygen. Since oxygen is the energetically preferred substrate for respiration, it has generally been assumed that alternative respiratory pathways function only under anaerobic conditions. This view is further supported by the fact that the known machinery for synthesizing c-type cytochromes only function under anaerobic conditions. However, it has recently been discovered that aerobically growing E. coli are able to utilize an alternative respiratory system that requires a c-type cytochrome. This raises the question of how c-type cytochromes are synthesized when oxygen is present.

The goal of this project is to identify the genes responsible for this aerobic c-type cytochrome biosynthesis pathway. The research will involve a genetic screen for mutants that are unable to synthesize c-type cytochromes when growing aerobically, as well as characterizing the activity of candidate proteins that may play a role in this pathway. The ease with which E. coli can be manipulated and the availability of simple colorimetric and fluorescence-based tools for following c-type cytochrome activity make this an ideal summer project. The student will acquire the fundamental skills of culturing and manipulating bacteria, performing genetic screens, characterizing mutants, and following gene expression by fluorescence microscopy.

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Chris Jang

Project 1: Structural characterization of human α-synuclein

Proteins that are natively unstructured, such as prions, have historically been difficult to study through traditional means, such as NMR and x-ray crystallography. Our research revolves around the structural characterization of human α-synuclein, a prion-like protein that forms amyloid plaques implicated in the development of neurodegenerative disease.

We are interested in utilizing site-specific incorporation of artificial amino acids into α-synuclein by using a modified protein expression system, and an in vitro click chemistry-based structural assay to obtain structural information for this protein. The student will be responsible for engineering novel α-synuclein proteins, developing the structural assay, and obtaining/interpreting structural data. In the long-term, we hope to use these assays to develop a new inquiry-based undergraduate biology lab, and the student will have the opportunity to co-author scientific and educational research, as well as be involved in curriculum development at the University of Pennsylvania.

Mia Levine

Project 1: Telomere integrity on a treadmill: causes and consequences of telomere protein evolution

Specialized proteins package genomic DNA into chromatin. This DNA packaging regulates gene expression, chromosomal inheritance, genome defense, and many other essential, strictly conserved biological processes. Nevertheless, many essential chromatin proteins evolve very rapidly over time. Even closely related species encode essential genes with wildly different DNA sequence. The biological significance of this paradox—conserved cellular functions supported by unconserved molecular machinery—is poorly understood. The Levine Lab aims to address this paradox by studying the causes and consequences of evolution at chromatin proteins that package the very ends of chromosomes—the telomeres. Genes that encode telomeric proteins are absolutely essential for ensuring that two chromosomes don't fuse together end-to-end. Such chromosome fusions cause both DNA breakage during cell division and mistakes in chromosome inheritance. These aberrations are hallmarks of cancer cells. Using the model fruit fly, Drosophila melanogaster, we aim to test the hypothesis that rapid telomeric protein evolution is driven by selfish DNA elements embedded in the ends of chromosomes. We will engineer fruit flies that encode the ancestral versions of the rapidly evolving proteins. To construct these genotypes, we replace the target gene with a version from a sister species. We will assay this "Frankenstein fly" for various phenotypes related to telomere function. This project offers the opportunity to learn classical Drosophila genetics, evolutionary genetics, cell biology (including

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confocal microscopy), and molecular biology including cloning and quantitative PCR. Students with a keen interest cell biology or evolution are encouraged to apply.

Mechthild Pohlschroder

Project 1: Swimming faster: using hyper-motile mutants to investigate regulation of archaeal flagella

Archaea were once thought to be found only in extreme environments, but are now known to be an important part of the human microbiome – playing a role in both health and disease. Archaeal cell biology radically departs from that of bacteria. For example, while both bacteria and archaea have flagella that enable cells to swim, the composition of these surface filaments in the two domains is distinct. This type of cell motility is directly related to the formation and dissolution of complex microbial communities, known as biofilms, which can form on tissues in the mouth, skin, and gut, as well as abiotic surfaces. Little is known about how archaeal cells regulate their flagella during biofilm formation, when cells must turn off swimming motility in order to attach to a substrate, and during dispersal from a biofilm, when cells must turn swimming motility back on.

The goal of this summer project is to use a transposon mutagenesis screen to identify motility mutants in the model archaeon Haloferax volcanii. These mutants will allow for the identification of novel components that control archaeal motility. A previous undergraduate student utilized a similar scheme to identify several non-motile mutants; however, identification of hyper-motile mutants has not been rigorously investigated. Time permitting, biochemical and molecular biological characterization of these components will be used to identify their role(s) in regulating the flagellum and its role in swimming motility and biofilm formation.

Investigating the archaeal flagella and its regulation will greatly expand our understanding of the cell biology of archaea, which have not been extensively studied, and will likely reveal novel aspects of prokaryote biology.

Philip Rea

Project 1: Managing Discovery in the Life Sciences

"Managing Discovery in the Life Sciences" is a commissioned book, intended for a broad audience, that Dr. Rea and his colleagues Drs. Lawton R. Burns and Mark V. Pauly are working on. The objective of this project is to investigate the discovery process in the life sciences. Emphasis is placed on the interface between life sciences research and its realization through

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case studies that highlight the difficult transition from discovery in the laboratory to implementation. The case studies not only incorporate the "established" (peer-reviewed) scientific literature but also the successes, failures and near-misses in the discovery process through interviews, reference to other science and/or industry commentaries, and, when practicable, primary (sometimes unpublished) sources. Four chapters that Dr. Rea and colleagues (in three cases with undergraduate students) have now taken to near-completion are: "Gleevec: from broken chromosomes to precision cancer therapy"; "The statins: cholesterol's 'penicillins'"; "Metformin: out of the backwaters into the mainstream"; "Ivermectin: an end to blindly following the next generation." The PURM project will require the preparation of publication-ready explanatory figures, as well as some final editing, proofreading and fact checking. This project will be ideal for any students with a solid grounding in the life sciences that are interested in the history of drug and medical device discovery and development and have a flair for scientific diagrammatic representation, which will be the most time-intensive component of our efforts over the summer months.

Paul Sniegowski

Project 1: Experimental evolution of mutation rates

Evolution has traditionally been studied only in retrospect. My research group's work is part of a newer approach in which evolution is studied in real time. By propagating populations of microbes under controlled conditions for hundreds or even thousands of generations, we investigate the roles of natural selection, mutation, and recombination in evolution directly. Because microbial populations can be frozen and revived, we are able to generate a "fossil record" of the stages of evolution in our work; this enables us to go back into the past of our experiments and examine evolutionary processes with great experimental rigor and in great detail.

Our major current interest is the evolution of mutation rates. We are looking for an undergraduate to participate in an ongoing project that examines the role of genetic recombination in mutation rate evolution. Work will involve performing experiments using standard techniques of microbiology and molecular genetics and may also involve whole-genome sequencing methodology and analysis. My lab group is small, consisting 3 graduate students, 2 current undergraduates, and myself. Interactions are informal and there would be daily contact with me personally on the project. The lab has included about 20 undergraduates in past years, many of whom have co-authored peer-reviewed scientific papers on their work. Undergraduates work as full intellectual partners in our group and contribute actively to discussions about the direction of future work. A burning interest in studying evolution is an absolute prerequisite for this project; introductory biology is recommended but not required.

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CHEMISTRY

David Chenoweth

Project 1: Covalent modification of Carbon Black Materials for Coatings Applications

Carbon black is one of the world's oldest manufactured products being primarily used as a pigment for ink, plastics and coatings. It is produced mainly by two methods, consisting of the incomplete combustion or oxygen-free thermal decomposition of hydrocarbons. Its small particle size and dark black color has sparked the interest of industrial coating companies to investigate its use in black coatings, specifically to improve a coating's jetness, a measure of how black the color is perceived to be. The compound is characteristic of multiple fused aromatic rings and a high degree of hydrophobicity, facilitating aggregation and agglomeration of the base particle. When spread across a surface, aggregated or agglomerated particles result in a surface with fewer particles per square inch as the particles favorably attract to each other, thereby reducing the jetness of the paint. In an effort to increase the particles per square inch of the coating, we propose to covalently modify the particles with various functionalities to reduce aggregation and agglomeration by introducing water soluble or polar groups on to the surface through covalent modification. Students will gain experience in fundamental organic chemistry and will learn to work with carbon materials and be exposed to various methods of characterization including thermogravimetric analysis, Boehm titrations, and dispersion assays.

Project 2: Biomimetic Collagen Materials

Design, synthesis, and computational analysis of collagen based materials for biomedical applications. Our laboratory has recently discovered simple modifications to collagen mimetic peptides that lead to enhanced stability and self-assembly properties. We are interested in taking advantage of this synthetic modification to create new collagen mimetic biomaterials with enhanced properties and applications. This project involves literature research, experimental design, organic synthesis, solid-phase synthesis, biophysical measurements, computational modeling, mathematical analysis, and materials characterization. The student may be involved in one of any combination of these techniques but a strong mathematical and computational background is preferred although not strictly required.

Elizabeth Rhoades

Project 1: Structural features of tau bound to tubulin

Tau is a microtubule associated protein whose aggregation is linked to a number of devastating neurodegenerative diseases. Tau belongs to the class of proteins known as intrinsically disordered proteins in that it lacks stable secondary and tertiary structure. Thus, it is challenging

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to study using the traditional tools of structural biology. In this project, a student will use an environmentally sensitive fluorophore to probe the conformational features of tau upon binding to tubulin or microtubules. The skills acquired over the course of this research project include: site-directed mutagenesis; protein expression, purification, and fluorescent labeling; ensemble fluorescence spectroscopy.

Project 2: Determining a functional role for alpha-synuclein

Alpha-synuclein is an abundant neuronal protein whose aggregation is linked to the pathology of Parkinson's disease. It belongs to the class of proteins known as intrinsically disordered proteins in that it lacks stable secondary and tertiary structure in solution. The function of alpha-synuclein is poorly understood; it is thought to associate with synaptic membranes, where it becomes partially alpha-helical, and to modulate vesicle fusion, although the mechanism is unclear. In this project, a student will determine how modifications to alpha-synuclein impact its binding to membranes in order to understand how mutations linked to disease may impact function. The skills acquired over the course of this research project include: site-directed mutagenesis; protein expression, purification, and fluorescent labeling; ensemble and single molecule fluorescence spectroscopy.

Marisa Kozlowski

Project 1: Organic chemistry synthetic methods

We are engaged in the development of new organic chemistry synthetic methods. Methods for the generation of enantiomerically pure compounds are a particular interest. We use these methods for the synthesis of novel natural products with a focus on those of biomedical relevance. There is significant interest in these methods due to their use in the the pharmaceutical industry both for the synthesis of medicinal chemistry leads and in process development.

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Project 2: Calculations to Predict and Explain Chemical Reactivity

Electronic structure and quantitative structure activity relationship calculations are undertaken on organic and organometallic reaction methods. The results establish mechanistic pathways and the determinants for selectivity. This information in turn is used to predict the outcomes of modified systems with the aim of improving yield, selectivity, or scope.

E. James Petersson

Project 1: Studies of the Aggregation of the Parkinson's Disease Protein alpha-Synuclein

Amyloid diseases comprise a significant subset of neurodegenerative diseases, including Alzheimer's and Parkinson's Disease (PD). Protein misfolding is at the heart of amyloid formation, where individual functional proteins adopt non-functional conformations. These misfolded proteins then self-template and form oligomeric assemblies, ultimately forming extended fiber-like aggregates termed fibrils. These highly-stable fibrils are the major component of plaques that form in the brain of patients suffering from these diseases, and have long served as a post-mortem hallmark of pathology. Furthermore, studies have demonstrated that administration of pre-formed fibrils to cultured neurons or mouse models of neurodgeneration results in propagation of the misfolding and aggregation event along with symptomatic development. Although generation of fibrillar structure from monomers has been recapitulated in vitro, isolation of intermediate oligomeric species has remained elusive. Moreover, the insoluble nature of fibrils suggests that soluble oligomers may be the species responsible for toxicity due to increased mobility. Overall, the dynamic and transient nature of these intermediate assemblies has hindered development of a detailed structural description of the amyloid formation process.

In Parkinson's disease, α-synuclein (αS) is the primary amyloidogenic protein associated with disease pathogenesis. The Petersson laboratory has focused on using chemical biology techniques to fluorescently label αS and obtain measurements in fibrils to study misfolding. This project will focus on applying fluorescence as well as other methods to studying the oligomeric intermediates. While working with a graduate student mentor, the student will gain experience in molecular biology and perform biophysical techniques aimed at characterizing intermediate species during in vitro aggregation of αS. Additionally, the student will gain exposure to several advanced techniques including atomic force microscopy and electron microscopy. Lastly, the student will explore the effects of altering the aggregation procedure on the on-pathway aggregate population. Identification and characterization of these on-pathway aggregates will provide a better understanding of the aggregation process and impact our understanding of Parkinson’s disease pathology.

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Eric Schelter

Project 1: Coordination Chemistry for the Recycling of Critical Rare Earth Metals

Rare earth metals are essential components of materials used in smartphones, displays, wind turbines and electric vehicles. Because of their unique chemical characteristics, rare earth metals always occur naturally as mixtures of elements in their ores. The mining and separations chemistry of rare earths required to obtain pure materials is extremely environmentally harmful. Globally, more than 90% of rare earth element mining and separations is performed in China. However, the industry has caused major environmental problems, particularly in northern China. In this project, the student will work with senior grad students and postdocs on basic coordination chemistry of the rare earth elements. The goal of the project is to develop a new chemical method for purifying rare earths from their mixtures. In particular we are interested in developing new chemistry to obtain pure rare earths from recycled consumer materials such as permanent magnets and phosphors. Targeted chemistry for recycling is expected to diversify the supply chain of the elements and reduce the environmental damage from obtaining rare earths from their primary ores. The student will be involved in hands on synthetic inorganic chemistry to prepare new compounds that test hypotheses in aerobic and anaerobic conditions. The student will also work with their mentors to characterize the compounds and the effectiveness of the compounds in accomplishing separations. A desire for hands on synthetic chemistry experience and a real passion for progress and achieving goals are the primary requirements for the project. Chemistry or Chemical Engineering majors in particular are encouraged to apply.

CLASSICAL STUDIES

Cynthia Damon

Project 1: Variorum commentary on Tacitus' Agricola

Digital edition of a teaching commentary on Tacitus' biography of a contemporary Roman general, Cn. Julius Agricola. This project is about halfway finished at present; the first phase was completed in fall 2015 by the 21 students in LATN 309. It has been accepted for digital publication in the Dickinson College Commentaries series. Over the summer I need two students to work on digital enhancements to the roughly 300 pages of explanatory notes that have been assembled so far. The work will involve finding relevant material on the web and creating links to it, creating internal links within our text, editing for consistency of format, and so on. It is likely to involve collaboration with students working on similar projects at Haverford and Dickinson Colleges, the home institutions of the Commentary series' editors.

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Project 2: Manuscript transcription, collation, and encoding for a digital edition

Transcription, collation, and encoding of medieval manuscripts and Renaissance editions from page images using digital tools, as well as training an OCR-reader to process early printed editions accurately. This is the fourth stage in the preparation of an eventual digital edition of a classical text from the Caesarian corpus, the Alexandrian War; previous stages were done by an undergraduate with PURM support (summer 2014), Post-baccalaureate students (fall 2014), and graduate students (spring 2015). The work will be continued by another set of Post-bac and graduate students in 2016/17. Prerequisites are (1) knowledge of Latin, (2) a good eye, (3) enthusiasm for contributing to an entirely new editorial process. The edition has been accepted for digital publication as a pilot project of the new Digital Latin Library.

C. Brian Rose

Project 1: Gordion (Turkey) excavations ***Rising Juniors only***

The archaeological site of Gordion is frequently remembered as the location of an intricate knot ultimately cut by Alexander, but in antiquity it served as the center of the Phrygian kingdom that ruled much of Asia Minor during the early first millennium BCE. The site lies approximately 70 km. southeast of Ankara in central Turkey, and the University of Pennsylvania has been excavating there since 1950, revealing a wide range of discoveries that span nearly four millennia. Each year the excavation season lasts for 75 days in June, July, and August. The staff is typically composed of professional archaeologists and graduate students, but since there is a new Mediterranean Archaeology concentration in the Classical Studies department, I would like to increase the number of undergraduates involved in the project.

The selected student will be a full-time member of the Gordion excavation team for the two month duration of the season (June 10-August 10, 2016). S/he will learn a variety of skills, including organizing and inventorying pottery and bones in the site depot, surveying, site mapping, drone photography and photogrammetry, and trench supervision. Since the student will be working with a large team in the heat of summer in central Turkey, s/he must be versatile, flexible, and collegial, with strong organizational skills. This project is ideal for students looking to major in Classics, Art History, Anthropology, Near Eastern Languages and Civilizations, or History.

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CRIMINOLOGY

Charles Loeffler

Project 1: Criminal Justice Experience Survey

Each year U.S. criminal courts produce over 1 million felony convictions and substantially more misdemeanor convictions. While the adversarial legal system in the U.S. provides many legal protections to the accused in order to minimize the likelihood that an innocent person will be found guilty, it is virtually impossible to know how often a wrongful conviction occurs. DNA and non-DNA exonerations in recent years provide some basis for estimating this number, but exonerations normally happen in unusual or very serious cases, making it difficult to generalize onto the vast majority of criminal cases that result from guilty pleas lacking post-adjudication proceedings. In order to estimate how often someone is wrongfully convicted, this project will focus on using social surveys to estimate how often and under what circumstances wrongful convictions are likely to occur in less serious but more common criminal cases. The selected student project member will be responsible for collecting and entering survey responses generated by a sample of convicted persons. He or she will also have opportunities for exploratory data analysis and memo writing. Familiarity with survey administration and/or service-sector experience is helpful. Prior course work in criminology, psychology, or law is desirable but not required.

EARTH AND ENVIRONMENTAL SCIENCE

Irina Marinov

Project 1: Southern Ocean dynamics and its role in the global climate

Despite its critical importance for the global heat and carbon cycles, the Southern Ocean is the least understood region of the world ocean, particularly because of the sparcity of observations and our incomplete understanding of high latitude processes such as sea ice dynamics. Here we propose to analyze a large dataset of 35 different state-of-the-art climate models ran as part of the last IPCC (Intergovernmental Panel for Climate Change) model intercomparison, to analyze the role of the Southern Ocean in the global climate. We plan to verify a set of hypotheses. (H1) Expected changes in sea ice, sea surface temperatures and salinities south of 60S over the next century will trigger changes in the so-called Ferrell and Hadley atmospheric circulation cells, atmospheric energy budget and cross-equatorial heat exchange, ultimately influencing the position of the Intertropical Convergence Zone (the band of maximum rain on the planet) and rain patterns in the tropics and subtropics (e.g., Saharan desert). (H2) The circulation of the Southern Ocean will change in fundamental ways over the 21st century; this signal will

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propagate to the tropics and the North Atlantic via oceanic pathways, changing the ocean circulation at these other locations. (H3) Ocean circulation changes will affect in major ways by year 2100 the storage of carbon and heat in the oceans.

The student will read ocean and climate literature, learn how to read and visualize gridded data fields in either MATLAB, Python or the oceanographic software Ferret and to independently write codes, which will involve statistical techniques (such as linear regression, correlation analyses and hypothesis testing) and mapping of results. Excellent computational background and skills, basic statistical skills are necessary. Some natural science background ideal.

Project 2: Ocean biology and chemistry in a warming climate

Ocean Phytoplankton are responsible for 50% of photosynthesis on the planet and are the base of the ocean 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). Spatial and temporal distributions of PFTs are expected to change with climate, with potentially significant impacts on ocean nutrient and carbon cycling. In this project, the student will work with NASA satellite remote sensing products to understand biodiversity of ocean phytoplankton and the response of the ocean biology to climate change project. We will analyze the natural variability and climate-driven, decadal trends in nutrients, phytoplankton biomass and productivity, and we will attempt to link changes in ocean biology to changes in oceanic physical properties (light, surface to deep mixing, sea surface temperature) that are known to influence phytoplankton growth. We will also work on a novel, evolutionary-based ecological model of phytoplankton growth, with the goal of incorporating it in a large climate model we run in our group for future climate predictions.

The student is expected to read some primary literature, learn how to read and visualize satellite imagery and other gridded data fields in MATLAB or python 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 are necessary. More advanced statistical knowledge and some natural science background ideal.

Alain Plante

Project 1: Organic matter stabilization in tropical, Puerto Rican soils

Soils are a critical component of the global carbon cycle, yet our understanding of how soils store carbon (particularly at depth and in the tropics) is incomplete. The mineral composition of

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soils is known to contribute substantially to a soil's mineral surface area, which in turn contributes to its ability to store carbon through mineral association. One of the goals of the NSF-funded Luquillo Critical Zone Observatory project is to understand how organic matter and carbon interact with minerals in these Puerto Rican soils. Additional work will seek to compare and contrast these tropical soils with sub-tropical and temperate soils from two other CZO sites (Calhoun in South Carolina, and Christina River Basin in Delaware). Tropical soils are more highly weathered, but they contain an abundance of iron oxides available for organic carbon stabilization. We are seeking a motivated undergraduate researcher to learn and perform a set of laboratory experiments to characterize the organic matter and minerals from a set of CZO soils. Candidates should have a vested interest in the environmental, ecological or geosciences. Some laboratory experience is preferred, but not required. Travel to, and field work at collaborating sites may be required to collect soil samples.

Project 2: Characterization of organic matter in Anthropogenic Dark Earths

Most soils in tropical areas are highly weathered, causing them to be nutrient-poor. Anthropogenic Dark Earth (ADE) soils (like the terra preta found in the Amazon) are a notable exception. Formed by amendment with char, bones and other by-products of human and agricultural life for hundreds of years, these soils are extraordinarily fertile and rich in stable organic matter. So what is special about ADE that makes it so precious and fertile? We are seeking a motivated undergraduate researcher to perform a set of laboratory experiments to characterize the organic matter in a set of ADE and non-ADE soils from Ghana, Liberia and Australia. Experiments will include various physical and chemical methods to fractionate and extract organic matter, characterization of its chemical composition, and analysis of basic soil fertility properties. The goal of this work is to understand how these soils are capable of both storing organic matter over the long-term, while at the same time turning over carbon and nutrients to make them available for plant uptake.

Project 3: Microbial CO2 respiration of soil organic matter

Microbial CO2 respiration of soil organic matter is a major component of the global carbon cycle, and has important implications for climate change. Laboratory incubations (basically putting soil in a jar and measuring microbial CO2 respiration) is a commonly used tool to assess the biodegradability of soil organic matter. A large number of studies have been published over the past few decades using this technique, but comparisons are difficult due to wide range of experimental design parameters used. For instance, incubation durations range from 6 days to 600 days. The outcomes of these incubations are also expressed using different forms and metrics. The objectives of this project are to perform an extensive literature review of laboratory incubation experiments. We seek to: 1) summarize the various experimental parameters, 2) synthesize the outcomes into a common form, and 3) provide prescriptive advice about optimal designs for assessing the biodegradability/vulnerability of soil organic matter stocks. These end

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products would represent an important contribution to the soil science, biogeochemistry, and climate science communities, and be of very high value.

ECONOMICS

Aislinn Bohren

Project 1: Reputation-Building on Online Platforms

What is the value of a good reputation? The rise of online platforms such as Yelp, Quora and MathStackExchange has led to the expansion and decentralization of information collection about participants on the platform. Users are rated for the quality of their product or post, and these ratings are usually generated anonymously by other users. A user's reputation score rises when others vote up her post and declines when others vote it down.

This project will study reputation formation on an online forum. We will run a randomized control trial to study the dynamics of reputation, and measure whether consumers with higher reputations receive more favorable feedback. Student research assistants will be involved with all aspects of this project, including assisting with developing the study protocol, generating the posts and collecting the online responses, to analyzing the results. A student with a strong mathematical background can also assist with theoretical modeling. Students will learn how to design and conduct a field experiment, analyze data, and write a research paper.

Background Course Requirement: Real Analysis

ENGLISH

Michael Gamer and Scott Enderle

Project 1: Eighteenth-Century and Romantic Dramatic Networks

What can playbills and playtexts -- which customarily listed actors, characters, and secondary acts playing at a given theater on a given night -- tell us beyond their obvious advertising function? Among other things, they can help us to track the movements of actors, theatrical companies, and even the plays themselves. Where do plays go after their premier in London? How long before they hit the other parts of the kingdom? With what patterns? In this project, students will learn about the history of London and provincial theater as well as about new digital approaches to literary study. In other words, we will combine traditional close reading

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with computational and quantitative analyses. If the student wishes, s/he may also learn more advanced computer skills, including programming in the Python language and the fundamentals of database creation and management. No prior experience with these technologies is necessary -- and we mean that. We're interested in training a student on the job in the history of this period's wonderful, insane theater (which saw the invention of the musical, the star system of acting, and other modern innovations). We also want to provide students with the kinds of computer skills that will enhance their research, not to mention be attractive to future employers.

GENDER, SEXUALITY AND WOMEN'S STUDIES

Nancy Hirschmann

Project 1: The Market versus Merit: Is the Market Gender-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 2: Gender Bias in Online Course Evaluations

A number of studies have shown a substantial bias in course evaluations; online courses taught by men and women receive higher scores when students believe the professor is male than when

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they believe the professor is female, regardless of what gender the professor actually is. More recently, a study in France and the United States that gender bias in evaluations far outweighed professorial competence when gauged by objective measures such as student performance. My study ask a further question: is some of this bias exacerbated by the online format? In an age of online nastiness and cruelty fueled by the anonymity that the internet offers, are students' greater bias against female faculty exaggerated or enhanced? Are students bringing their "facebook mentality" to the evaluation of their academic professors, and is this enhancing gender bias? Student should have skill sets in quantitative analysis as well as knowledge of gender and sexuality theory. 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.

GERMAN

Simon Richter

Project 1: Global Sustainabilities

Sustainability and sustainable development are recognized worldwide as aspirational mandates for addressing climate change. Representatives from 196 nations gathered in Paris in December 2015 to hammer out a consensus known as The Paris Agreement: Next Steps. Sustainability and sustainable development remain among the most important watchwords. But what does sustainability actually mean? The subtitle of a 2014 book on Sustainability registers the authors' exasperation with the ambiguity of the term: "If it's everything, is it nothing?"

My project on global sustainabilities approaches the problem of meaning from the opposite perspective. Proceeding on the assumption that sustainability is always actualized in a cultural and linguistic context, the project aims to gather cultural information about the linguistic and cultural translation (i.e., cultural implementation) of sustainability in the nations, regions, and languages of the world. In this respect, the idea of sustainability offers a unique opportunity for new research.

Sustainability and sustainable development were called onto the world scene with the publication of the UN-sponsored Brundtland Report on "Our Common Future" in 1987. In every nation and language party to the efforts of the World Commission on Environment and Development it was necessary to translate the terms. Since for most languages there is no literal antecedent to the term, the idea of sustainability is typically conveyed in a neologism. Reconstructing the path to the neologism (etymology, connotations, tone, etc) as well as the course of its adoption in the target language is instructive for assessing how individual nations are responding culturally to the UN mandate.

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It will not be surprising to discover that the term conceals a considerable diversity of meaning, connotation, degrees of acceptance and/or resistance. Gathering detailed data on the ways in which sustainability and sustainable development are being translated into world languages and cultures will allow us to take the temperature, so to speak, of the world's culturally varied commitment to sustainability. Discovering recurring patterns of cultural and linguistic response might allow us to group nations for comparative purposes and may reveal effective strategies for encouraging acceptance within specific response patterns.

The goal of this project is to establish an online database for the study of global sustainabilities. I am looking for students interested in cultural aspects of sustainability. Duties include analysis of the Intended Nationally Determined Contributions (INDCs) that formed the basis of discussion for the Paris Agreement and analysis of UN documents relating to sustainable development; compiling a bibliography of scholarly literature on the practice of sustainability around the world; and assisting me in assembling a large international team of scholars who will contribute qualitative reports and data about the practice of sustainability in the regions and languages of their expertise. This is an interdisciplinary project which could be of interest to students of anthropology, culture, education, environmental studies, linguistics, political science, and religion. Knowledge of another language or languages would be helpful.

HISTORY & SOCIOLOGY OF SCIENCE

David Barnes

Project 1: Philadelphia's Lazaretto, Forgotten Monument to a Hidden History

The oldest surviving quarantine facility in the Western Hemisphere lies dormant and forgotten on the banks of the Delaware River just downstream from the Philadelphia International Airport. In the nineteenth century, the Lazaretto acted as Philadelphia's first line of defense against invasion from yellow fever, cholera, and other epidemic diseases. Uncovering its history, mostly ignored by scholars, reveals a lost world of acute fears and hidden dangers, bitter conflict and tragic suffering, punctuated by thankless caregiving and even heroism.

Students' research for this project will contribute to the history of everyday life, medical care, and death in nineteenth-century America. It will also shed new light on the nation's long and conflicted history of immigration and public health, and contribute to scholarly debates in the history of epidemics, contagionism, quarantine policy, and public health. Moreover, unlike most historical research, this work will contribute to the documentation and preservation of the historic site, and will pave the way for its restoration and interpretation as a historic resource and visitor attraction.

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Students will work in various archives and specialized libraries in Philadelphia and vicinity, as well as with online resources. A book manuscript is nearing completion, and the final stage of research is crucial. Where were Philadelphia's paper mills located in 1885? Which physicians believed yellow fever was contagious in 1804? Can we identify present-day descendants of immigrants who arrived on the ship "North Star" in 1847? Answering questions like these quickly and thoroughly will require a nimble, flexible, and curious mind. Experience with historical research is desirable but not required.

Project 2: Ganges Nation: Generations of an American Family Like No Other

Sometime in the spring or early summer of 1800, slave traders captured between a hundred and two hundred men, women, and children near the Guinea coast of West Africa. The enslaved Africans were then shackled and chained aboard two American schooners, the Phoebe and the Prudent, bound for Cuba. Outside of Havana harbor, the U.S. naval ship Ganges intercepted the two schooners, which were in flagrant violation of a 1794 law prohibiting American vessels from engaging in the slave trade. The Ganges brought the vessels to Philadelphia, where their human cargo was deposited at the Lazaretto quarantine station. (One widely circulated story at the time reported that a pregnant woman and her partner were separated when captured, only to be reunited at the Lazaretto. The shock of the unexpected reunion caused the woman to give birth prematurely, although both mother and child reportedly survived.)

A federal judge declared the 126 surviving Africans free, gave them all the surname Ganges, and put them in the care of the Pennsylvania Abolition Society, which indentured them to local families for periods of servitude ranging from four to twelve years. At the time of indenture, they were given first names that included conventional English names like David, Peter, and Mary as well as the Spanish Sambo (indicating at the time a mostly black mixed-race person) and a variety of names such as Gango, Kellafe, and Abana that suggest a possible African origin. When their indentures expired, the Ganges survivors went on to live, work, marry, have children, and die—mostly in obscurity, some in or close to Philadelphia, and others far away.

Today there are Ganges descendants scattered all over the country. They share family reunions and family lore like other families, but their legacy is different, and reflects a somewhat different light on the last two centuries and more of African-American life. This project proposes to reconstruct as much of the Ganges family tree as possible, from before capture in West Africa to the present. Sources and stories from the lives of representative descendants in each generation will be collected and brought to life to highlight the triumphs, tragedies, and everyday hopes and fears that have marked the African-American experience.

Students will do extensive work in local archives as well as with online genealogical and other databases, tracking down descendants and the fragmentary details of their lives that have left

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traces in the historical record. Some knowledge of American history is desirable, but no genealogical experience is required.

Project 3: The "Spoke" Project: Speaking Trumpets and Information Technology in the Age of Sail

Before the internet, before the telephone, and before the telegraph, information traveled around the world through letters and newspapers carried by sailing ships. But there was another crucial information technology, largely ignored by historians, which spread out and sped up the exchange of news along the high seas. When ships' paths crossed at sea, captains hailed one another by shouting through "speaking trumpets," which amplified their voices and allowed key bits of information to be exchanged from vessel to vessel. Names, port of origin, date of departure, and destination were always shared, but often these open-water conversations included reports on pirate attacks, accidents, and shipwrecks encountered, as well as military and political news from faraway places. Typically, when each vessel arrived at its destination, local newspapers would publish not only its own information but also that which it had gathered from other vessels. The newspaper accounts always introduced this latter kind of news with the word "Spoke," as in "[This vessel's captain] spoke [with the captain of the] brig Antonia," along with the date, latitude and longitude of the encounter.

This project will use digital humanities tools to document and map hundreds (and eventually thousands) of these everyday exchanges, and to show exactly how specific news items traveled, week by week, between and across continents. Our studies will contribute a new dimension to the history of information technology, and will enhance our understanding of maritime culture and what could be considered an early version of the internet. Experience with digital humanities would be helpful but is not required.

Bekir Harun Küçük

Project 1: Scientific Journeys to the Early Modern Ottoman Empire, 1500-1800

Travelers' accounts are some of the most important sources for understanding the circulation of scientific knowledge in the early modern period. However, scholars usually study individual sources in isolation. This project seeks to lay the groundwork for an online database that gathers the accounts of travelers in the Ottoman Empire in a systematic and accessible format. Students will work on a bibliography provided by the advisor. They will work with early modern printed books to gather information pertinent to the history of science. These include:

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1. Observed natural phenomena (including descriptions of flora and fauna and accounts of wondrous or unusual events)

2. Encounters with scholars and naturalists (including perceptions and verbatim accounts of conversations)

3. (Mis)translations and (mis)transliterations of scientific terminology

Depending on their skills, students will read, transliterate -- translate if necessary - accounts in English, Italian, Latin, French or German.

Prerequisites

Working knowledge of French, Italian, German or Latin preferred, but not required.

Some experience with Omeka preferred, but not required

Duties and responsibilities

Work on a list of books provided by the advisor.

Acquire copies of books through the Kislak Center, American Philosophical Society, Google Books, the British Library, AG Sammlung Deutscher Drucke, Hathitrust, BNF Gallica, EEBO and other online databases.

Find, index, cross-reference and transliterate the pertinent parts of the works

Work with advisor to analyze these accounts

Note: For this project, I am asking for two undergraduate assistants.

Beth Linker

Project 1: America's Forgotten Epidemic: Poor Posture and the Twentieth-Century Promise of Health and Beauty

In the 1990s, American critics and academics became scandalized by the revelation that just decades earlier, many of the nation's elite schools took nude posture photographs of all incoming freshman. Some claimed that the photos were a thinly guised form of pornography, while others argued that it was a vast eugenic experiment run by pseudo-scientists with a hidden master-race agenda. In actuality, for much of the twentieth century many Americans believed that they were living through a posture epidemic, with an estimated 80 % of U.S. citizens exhibiting faulty form. Fitness manuals, "posture-perfect" clothing and shoes, as well as ergonomic furniture abounded in this period. This project will reopen the so-called Nude Posture Photo debate with the intent to offer a deeper historical consideration of the practice, seeking to understand

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twentieth century posture experts on their own terms. The research assistant for this project will work with me to uncover this history by looking at early twentieth century popular women's and health magazines, university newspapers, digital archives, and advertisements for posture devices and furniture. The best candidate for this position will have good library skills, careful note-taking ability, and a background and interest in gender and health, as well as the history of twentieth century science, body, and popular culture. HSOC, STSC, and history majors preferred. Experience with digital technology a plus but not required.

LINGUISTICS

Gene Buckley

Project 1: Kashaya Dictionary

I am working on the completion of a comprehensive dictionary of Kashaya, an endangered Native American language of northern California. I seek a research assistant this summer to help with various aspects of the editing of the database on which the dictionary is based, as well as the design of dictionary itself in its various forms: a printed scholarly dictionary; an extensive practical wordlist; a web page version of the printed dictionary; and an Android app for accessing the entries. The focus of work will depend on the student's background and interests, and technical skills.

No previous knowledge of Kashaya is expected, but some knowledge of linguistics from at least one course is preferred. The student should understand basic aspects of phonetic transcription and morphological structure. Tasks could include checking the English definitions for clarity 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.

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

Gareth Roberts

Project 1: Sociolinguistics in an alien language

The purpose of this project is to test sociolinguistic hypotheses using an innovative experimental method, whereby participants learn a miniature artificial "alien language" and play a computer

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game with other participants, which involves communicating in that language. Different social pressures are put on the participants during the experiment (for example, whether or not they are competing or cooperating with other players in the game is manipulated) and the consequences for the alien language measured. Students will be responsible for recruiting participants, running trials, and recording and analyzing data, for which training will be provided. Depending on interest and ability, students may also get involved in other aspects of research, such as experimental design and programming tasks.

Project 2: Visual vowelspaces

This project is designed to investigate how the organization of vowels in human language comes about. Vowels are speech sounds produced with a relatively open vocal tract (compared with consonants) and are differentiated in articulatory terms by different tongue positions, and in acoustic terms by the relationship between different frequency components ("formants") in the sound wave. If all the vowels in a language are plotted according to tongue position or formants, they are likely to be spaced apart relatively evenly in the available space. If a vowel changes in this vowelspace, this often causes other vowels to change in a similar direction. In this project, the dynamics of vowelspaces are investigated in an innovative way. Participants play a computer game in which they must communicate by touching their fingers to trackpads, producing colors on screen (analogous to moving the tongue in the mouth to produce different acoustic effects). This allows us to investigate some of the physical and cognitive pressures acting on vowelspaces, while abstracting away from the acoustic nature of speech. Students will be responsible for recruiting participants, running trials, and recording and analyzing data, for which training will be provided. Depending on interest and ability, students may also get involved in other aspects of research, such as experimental design and programming tasks.

Meredith Tamminga

Project 1: Cognitive characteristics of the leaders of language change

Languages change constantly, and one approach to understanding why is to ask who plays a key role in such change. In seeking an answer to this question, sociolinguists have characterized the leaders of phonetic change in demographic and social network terms, while laboratory phonologists have related individual differences in general processing mechanisms to linguistic behavior in the lab. My current project connects these two lines of research by correlating phonetic change in individuals' conversational speech with those same speakers' performance on a number of laboratory tasks, including phonetic experiments such as perceptual compensation, tasks tapping domain-general constructs like working memory, and several standardized personality assessments.

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Because the project has many components, an RA joining the project for the summer will have a chance to gain a number of different skills: making acoustic measurements in Praat, coding phonological variability in conversational speech, using programs for experimental presentation and forced alignment, scoring psychometric surveys, and more. Besides contributing to data collection in these ways, the RA will have the opportunity to identify a sub-area of interest within the project and delve deeper and more independently into data analysis. Finally, the RA will attend our weekly lab meetings where we discuss issues in experimental design and statistical analysis and read current papers in sociolinguistics and psycholinguistics. Linguistic or psycholinguistic coursework is a plus. Comfort working with computers is important, but no prior programming experience is necessary.

Charles Yang

Project 1: The Natural Selection of Dialects

We are fascinated by the way we talk, especially the differences in the way we talk. To wit, the most emailed story in the history of New York Times is a quiz that can fairly accurately identify the dialect region of the speaker (http://www.nytimes.com/interactive/2013/12/20/sunday-review/dialect-quiz-map.html). It's fun to talk about "hoagie" vs. "sub", or "parhk the carh at Harvarhd yard", but the scientific questions of dialects run much deeper. How do dialects emerge, change, and die? Since language is spoken by humans, what mechanisms in our cognitive and linguistic system are responsible for the rise and fall of languages?

A very similar set of questions arises in the study of evolutionary biology: How do genetic variants arise, spread, and come to dominance? Indeed, it was Charles Darwin who famously noted the similarities between language change and biological change. In recent years, and thanks to technological developments, linguists have gathered a rich body of data on the distribution and change of dialects, especially in North America. Furthermore, linguists and psychologists have come to a good understanding of how humans learn and process languages, and are begun to quantify the cognitive effort of language use in a dialect contact situations. For instance, many regional American English speakers (New England, California, etc.) do not distinguish the vowels in COT and CAUGHT, which are distinctly different in other regions including New York and Philadelphia. Laboratory studies as well as fieldwork suggest that, somewhat surprisingly, speakers who has more homophonous words (e.g., Boston as opposed to Philadelphia speakers) are in fact confused less often in language perception.

Building on these findings, we have constructed a mathematical model in which the dialects compete for supremacy in a mixture situation. The dynamics of dialect competition turn out to be strikingly similar to the mathematical models of natural selection in evolutionary genetics. This has enabled us to calculate, and predict, the demographic condition—e.g., the percentage of dialect speakers in the population—that would lead to dialect change and spread.

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The student researcher in this project will construct new datasets for 20-30 well documented cases of language/dialect changes concerning consonants and vowels. If opportunities present themselves, the student will also work with other Penn faculty members to conduct speech perception experiments to estimate the mutual confusability of dialects. The dialect model will be submitted to additional empirical tests to establish its validity as a general theory of language change. The student will be exposed to the broad literature on language change that intersects linguistics, psychology, computer science, and mathematical biology, and will gain experience with quantitative data analysis, automatic processing of large language datasets, and the art and practice of computational modeling.

Project 2: How Children Learn Words

The mother says "Cat!" while pointing to the kitten in the backyard. Common sense tells us that children learn words by attending to the associations between words and the objects they refer to. Indeed, the English philosopher John Locke speculated that to teach children words, "people ordinarily show them the thing whereof they would have them have the idea; and then repeat to them the name that stands for it, as “white”, “sweet”, “milk”, “sugar”, “cat”, “dog.” (An essay concerning human understanding 1690).

Modern research on how children learn language has largely discredited the common sense view. The associations between words and objects turn out to be not reliable at all. For instance, one study finds that when the word "open" is uttered by the mother, an open object (such as a door), or an observable act of opening, is only present 50% of time. When the child is instructed to "see" something, the intended object is perceivable only 30% of time (think "see the movie"). That is not to mention that many words--such as the verb "believe" and the noun "idea"--are not directly observable. Even when "grandma" is brought up, she might as well be in Canada.

Despite these seemingly insurmountable challenges, children are expert word learners, capable of learning on average 20 words on a single day. And they rarely make mistakes. How do they do that? This project is a study of word learning by children in a rigorous and quantitative fashion. A major question drives our research: Does Big Data help?

The primary tool of investigation in this project is computer simulation. There is now a large body of data that documents how children interact with their caretakers linguistically as well as socially. The first step of this project is to quantity the complexity (and unambiguity) of how word meanings are mapped onto word sounds. This may shed light on why some words learned earlier than others. One hypothesis is that the earlier words are more frequent ones but another hypothesis is that these are words with lower degrees of ambiguity, which can be measured as the number of non-target objects that are co-present in the environment. The second component of the word learning project is to implement, and test, several competing models of word learning that have been proposed in the recent literature. One school of thought holds that the child keeps track all, or many, co-occurrence correlations between words and their potential

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words: it is hoped that in the long run, dogs, rather than cats, are more likely to be present when the word "dog" is uttered. Another view holds that the child only entertains only one candidate meaning of a word; she holds on to that meaning as long as it is confirmed (e.g., when "dog" is heard, there is indeed a dog in the environment) but abandons it when it is disconfirmed (no dog when "dog" is heard) and adopts a new meaning. Most studies of word learning are done under lab conditions. Here the two components in the present project come together: what kind of learning model works best when tested on data that realistically represent language learning in the wild?

The student researcher in this project will be exposed to the current research in word learning that has primarily been conducted in the lab. He/she will have opportunity to participate in word learning experiments in the labs of Psychology Profs. John Trueswell and Lila Gleitman who have been collaborating with us on this project. The student will be involved in data annotation for which detailed documentation is expected to ensure replicability. The student will study and modify the computational models of word learning developed by our and other research groups. The evaluation of the models will follow the standard practice in natural language processing, which will be useful for the development of skills in computational sciences and technologies.

Project 3: Poka Constraint

Languages display dependencies between pronouns (he, it, etc…) and noun phrases (John, the car, the tallest blue mountain, etc…). When we hear a sentence like “John said he has an apple” we interpret “he” as being some Male figure, likely John but it could be somebody else. In sentences like “He ate an apple while John watched TV”, “he” and “John” can no longer co-refer. Such relations usually appear in all languages and don’t have to be learned. But some restrictions are language-specific, in which case a child has to learn the restriction from language input she receives in the first years of life. We investigate one such restriction that appears in Russian in sentences like “while he ate an apple, John watched tv” (“Poka on jel jabloko, Dzhon smotrel televizor”), where unlike English, “John” and “he” cannot refer to the same person.

We are developing a statistical model that uses two statistical methods known as Bayesian modeling and the Size Principle in order to establish a relationship between the input the child receives (actual heard language) and the grammar they learn (the language-specific restriction on co-reference). The ideal student would have familiarity with Russian, have exposure to introductory statistics and linguistics, have some experience coding/programming, and possess strong written and spoken communication skills. In turn, they would gain experience working with computational language researchers, gain valuable experience setting up a statistical model of learning and behavior, and learn how to extract information from a state-of-the-art language corpus.

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MATHEMATICS

Julia Hartmann/Michael Wibmer

Project 1: Computing relations among solutions of linear differential equations

Understanding the relations among solutions of linear differential equations is a classical and important problem. This project focuses on linear differential equations that depend on a parameter. A transformation of the parameter also yields a transformation of the solution. We are interested in computing the algebraic relations among the original solution and the transformed solution.

The student will primarily deal with first order linear differential equations and only a minimal mathematical background is required, for example as covered in Math114. This project provides the opportunity to learn about differential equations and rational functions and to develop programming skills. The student will experience the steps necessary to turn a mathematical idea into an efficient algorithm. Some prior programming experience with mathematical software such as Matlab or Maple will be helpful. The project will be co-supervised by Dr. Michael Wibmer.

NEAR EASTERN LANGUAGES AND CIVILIZATIONS

Richard Zettler

Project 1: Ur Digitization Project Research Intern

The Ur Digitization Project at the Penn Museum wishes to host a summer undergraduate intern. The project is digitizing and making available all records from the 1922-1934 joint excavations of the ancient city of Ur in southern Iraq. We have released a beta website at www.ur-online.org but there is much work still to be done in adding archaeological and archival information as well as improving existing data through quality control. The intern will work closely with the project manager to examine records, artifacts, images and architectural plans with a focus on increasing the connections among these data--material and object type correlated with location of find, with old and modern photos, and with letters and notes from the field, for example.

The intern will gain experience in researching ancient Mesopotamia and the history of archaeology as well as insight into the issues of digital preservation of cultural heritage. The student will examine and improve data concerning one of the most important ancient cities in the Near East while increasing the interconnections among that data within a digital environment. In

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the process the intern will conduct their own small-scale research project on some aspect of the ancient city, thus testing the site's capability and increasing their own understanding.

Previous knowledge of the Ancient Near East is not required, but an interest in the archaeology and history of the region is desired. The student should be detail-oriented, enjoy looking for patterns in data, and be comfortable with computer data entry.

PHILOSOPHY

Daniel Singer

Project 1: What is It Like to be a Group? - A Computational Modeling Approach

Groups of people, like committees, juries, social clubs, and religious groups, do many things individual humans do: Groups form views of the world, take stances issues, implement policies, disrupt governments, and are the subject of a large range of experiences. There is a burgeoning literature on groups, but what it means for groups to do these things is not well understood. Using agent-based computer simulations, this project aims to extend our understanding of one aspect of groups, namely how groups deliberate and come to have views about the world. The goal is to investigate group deliberation using models that, unlike extant models, take seriously the role of sharing reasons among group members and include group members working together, rather than merely working in tandem.

I am looking for research assistants who are interested in aiding in the construction of computational models, collecting and analyzing data from the models, and participating in discussions of the future of this research in weekly lab meetings. There are no formal prerequisites, but some experience with computer programming, logic, statistics, or a background in philosophy is desirable. Students with no formal background should still feel free to apply, as the relevant skills are easy to learn.

Quayshawn Spencer

Project 1: Racial Pluralism

The Pew Hispanic Center reported in 2012 that 75% of Hispanic Americans do not self-identify as Latino or Hispanic when it's an option as a race. Rather, in all Pew studies and US Census studies, the most common racial self-identification for Hispanic Americans is White. The same pattern holds for Arab Americans. On the 2000 US census, 97% of Arab Americans selected White as their race. However, neither Hispanics nor Arabs are treated like Whites in American

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society. For instance, the FBI reports that Arab Americans experience far more hate crimes per capita than non-Arab White Americans. Also, according to the DOJ, Hispanic Americans experience far more mortgage lending discrimination than non-Hispanic White Americans. So far philosophical race theories have been unable to explain the variation in how we talk about race when self-identifying versus classifying others. However, this research project attempts to explain this variation and much more by defending a radical metametaphysical position that I call "racial pluralism." The research outputs will be one or more articles and a book. The research assistant will help me with background reading, developing arguments, revising articles or chapters, and will help me apply for a federal grant. So, the assistant will receive considerable training in how to do philosophical research and how to secure funding for philosophical research. The assistant should be competent in first-order logic and enthusiastic about the metaphysics of race.

Michael Weisberg

Project 1: Public Understanding of Evolution: Survey and Documentary Project

In a recent Gallup Poll, 46% of Americans reported that they believe humans were created in their present form within the last 10,000 years. These responses stand in sharp contrast to those of biologists, who overwhelmingly accept evolution. Why do Americans overwhelmingly fail to accept that humans have a purely naturalistic origin? and what do they believe about other species and other aspects of evolutionary theory? Although it is tempting to think that Americans' resistance to evolution is explained solely by ignorance or religious fundamentalism, previous research suggests that this issue is considerably more complex. For example, people's understanding of evolution is not correlated with their acceptance of it, but their understanding the provisional nature of scientific theories is. The purpose of this project is to gain a fuller picture of what people in the United States know about the theory of evolution, to what extent they accept this theory, and what explains their beliefs and degree of acceptance. I am looking for research assistants who are interested in aiding in the construction of survey instruments, collating data from existing sources, and conducting face-to-face interviews. I am also looking for research assistants interested in helping to construct documentary film materials for use in evolution education.

No pre-requisites for participation, but some knowledge of evolutionary biology and/or psychological and survey methods is desirable. Enthusiasm for the project is the most important thing.

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PHILOSOPHY, POLITICS AND ECONOMICS

Cristina Bicchieri

Project 1: Betting and Match Fixing in Professional Sports

Corruption in general but in sports in particular is a ubiquitous issue in both amateur andprofessional sports, especially in the form of match-fixing. With higher stakes involved, such distortions create negative externalities not only on the individual but also on the aggregate level, such as loss of media interest, and erode the inherent principle of fair and competitive sports. Betting on sports is a steadily growing business (the market volume for regulated sports betting worldwide is estimated at $58 billion per year) and has become an integral tool in making money off fixed matches. Recently, investigations showed evidence that match-fixing has run rampant in the tennis sport for years and triggered a general discussion regarding the extent to which match-fixing has generally soaked through sports.

We are in possession of a huge one-of-a-kind data set on betting volumes across 50 different sports and hundreds of leagues that allows us to study this topic for the first time and trace suspicious instances of betting behavior. The data spans a time period of 9 years and provides detailed betting data (including the betting volume). The purpose of this PURM project is to capitalize on this data and help the PPE team to look into issues including but not limited to match-fixing. For students, this is a great opportunity to analyze big data, investigate suspicious patterns, and ultimately work at the forefront of crime analysis. Prior knowledge in working with STATA (or a related program) and econometric knowledge is helpful.

PHYSICS AND ASTRONOMY

James Aguirre

Project 1: Building a New Type of Spectrometer for Finding Nearby Earth-like Planets

It has been about 20 years since the discovery of the first “exoplanets” orbiting stars other than our Sun. A powerful method for finding exoplanets is the measurement of the small velocities of the star due to gravitational tugs of an orbiting planet. The velocity is derived from a high-resolution spectrum. We are working to improve the state of the art in this measurement using a new type of superconducting photon-counting detector. This would lead to a high-resolution spectrometer capable of observing low-mass stars with Earth-like planets within 100 light-years of the sun, ideal for further follow-up to determine the planets’ habitability.

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The student would work closely with a graduate student in the laboratory on the low-temperature (below 1 Kelvin) testing of prototype detectors, developing their readout electronics, and integrating them into a working spectrometer design. The student would learn aspects of cryogenic design and operation, high-speed digital electronics, computer programming radio frequency circuit design, optics, and the behavior of superconductors, as well as microfabrication skills at the Singh Center. There is potential for contribution to a refereed publication or publications detailing the results of the laboratory measurements.

Project 2: The Philadelphia Community Radio Telescope: a Resource for Teaching and Outreach

The student will help in the continued conversion of the 10-meter satellite dish on the roof the Enterprise Center at 46th and Market into a teaching and outreach tool for Philadelphia schools, including Penn courses and local high schools. We are developing a camera for this satellite dish which will make an image of the sky a radio wavelengths. The student would help develop curricula and materials for using the telescope, including a public-facing web page, which present the technical aspects of its operation and the uses and interpretation of the images and data produced. In addition, the student would help in the testing of a mini-radio telescope based around a Dish Network satellite dish, which can be taken to classrooms and science fairs.

The student will learn both technical aspects of radio astronomy and instrumentation, as well as communication of scientific ideas to high school students, undergraduates, and the general public. Documenting the educational materials and activities is an essential part of the work, including the possibility of writing up the material for publication in refereed journals and press releases.

Project 3: Finding the first galaxies in the universe: by looking where they aren't

The direct detection of the first galaxies is enormously difficult due to their faintness, but it is possible to observe their effects as they ionize the hydrogen between galaxies when the universe was only a few hundred million years old. This is possible because hydrogen emits and absorbs radio photons in its ground state, the detection of which is possible for instruments operating the FM band. We are currently analyzing an extensive archive of data from the Precision Array for Probing the Epoch of Reionization (PAPER; http://http://eor.berkeley.edu) and have begun collecting data from the new Hydrogen Epoch of Reionization (HERA; http://reionization.org) instrument.

The student would work closely with a graduate student on the development of algorithms for processing and analyzing this data. All data analysis software is written in Python; previous experience with this or some data-oriented programming language is strongly preferred. Some knowledge of astronomy and astrophysics is also a plus.

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The student will learn aspects of radio astronomy and interferometry (including signal processing and Fourier theory) and data analysis of large data sets. There is potential for contribution to a refereed publication(s) on the scientific results and/or data analysis methods developed.

Vijay Balasubramanian

Project 1: Adaptive Molecular Sensing in The Olfactory and Immune Systems

The Position, Responsibilities, and Required Background: I seek a student with strong mathematical and computational skills to participate in a biological physics research program that explores the functional organization and dynamics of the early olfactory and adaptive immune systems. The student must have a strong grasp of differential equations and linear algebra, and be a fluent programmer. The student will collaborate with postdocs and graduate students in my lab to build theoretical models of molecular sensing in the olfactory and immune systems, and to test the models with experimental data.

Rationale: The binding of molecules with each other is the basis of life at every scale from viruses to the whale. Some such processes have a lock-and-key character, where particular molecules guiding behaviors are sensed by specific receptors. But organisms dealing with open environments face more complex molecular sensing challenges. For example, the olfactory system must identify and discriminate odor mixtures drawn from an enormous space of volatile molecules (perhaps a million types) using very few odor receptors (O(1000) in mammals). Similarly the adaptive immune systems of vertebrates and bacteria are tasked with "sniffing out" potential threats drawn from diverse and evolving pathogen populations. How can bounded systems and circuits process and represent molecular spaces that are much larger than themselves and that are varying in time? They must adapt to the structure and statistics of the space that they are trying to sense. The goal of this project is to develop and test theories of such adaptive sensing.

Project 2: Statistics of Natural Scenes and the Perception of Visual Textures

The Position, Responsibilities and Required Background: I seek a student with strong mathematical and computational skills to participate in a biological physics research program exploring the functional organization of the visual system. The student must have a strong grasp of linear algebra, and be a fluent programmer. Knowledge of image processing, machine vision, and machine learning techniques will be helpful. The student will collaborate with postdocs and graduate students in my lab to explore the statistical structure of natural images and the relation between these statistics and the perceptual salience of different classes of visual texture.

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Rationale: Human beings have a remarkable ability to detect the presence, however weak, of some kinds of visual patterns and correlations in images. However, behavioral studies show that other kinds of visual patterns are very hard to see, even when they are mathematically prominent in an image. Why are some patterns easy to see, while others are practically invisible? This project will seek to show that visually salient patterns are highly variable across natural image patches and thus highly informative about the world, while "invisible" patterns contain less information about the structure of natural images.

Mark Devlin

Project 1: The Balloon-borne Large Aperture Submillimeter Telescope - BLAST

BLAST is a NASA funded high altitude balloon program. We are currently integrating multiple components of an upgraded instrument. The student could be in involved in mechanical design and construction, software for controlling the instrument, or electronics integration. The student will work with an experienced team of graduate students and postdocs. The project may involve traveling to NASA's Columbia Scientific Balloon Facility in Texas to assist with integration. Anyone on this project is sure to learn a lot!

Project 2: The Atacama Cosmology Telescope - ACT

ACT is an ongoing project to study the Cosmic Microwave Background from a 17,000 ft. mountain top in northern Chile. We are currently working on designing new components to extend the capabilities of the instrument. Students with interests in mechanical design or software design will find lots to do. While we have sent undergraduates to Chile in the past, it is not guaranteed and will depend upon the students experience, maturity, and passing a medical exam to clear them to work at high altitudes.

Eleni Katifori

Project 1: Investigating the topology of the coronary vasculature

The healthy function of the various organs in the human body, and consequently of the body as a whole, depends in part on the topology and function of the vascular system that permeates them.In fact, specific modifications in the veins and arteries in the body are known in some cases to be precursors of various diseases.

In this project we will use network theory to investigate if certain characteristics of the coronary vasculature correlate with disease. The student will use computer algorithms already developed in the Katifori lab, as well as commercial software to quantify the topology of the blood vessel

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network in images obtained via coronary angiograms. Then, through statistical analysis of graph theoretical metrics, the student will be looking for potential correlations of network characteristics with coronary disease.

The project is interdisciplinary and requires good programming knowledge of python or matlab, as well as physics, and an interest in biomedical applications.

Project 2: The topology of the network of semantic relations in the English language

The words of the english language can be loosely grouped together based on their semantic meaning: such is the function of a thesaurus. The same word can appear in multiple groups, establishing this way a network of word interrelations that carry information about concepts and ideas. For example, the word bread links to the word nourishment, which in turn links to the word meal etc, which are all related to food.

In this project the student will be using the database WordNet (https://wordnet.princeton.edu/wordnet/) to study the network of word relations. As a first step, the student will learn how to use and navigate through the WordNet database and subsequently be responsible for data extraction and data analysis. The student will be using network theory to quantify aspects of the network and study some of its properties. Eventually, we hope to develop tools that relate the topological characteristics of the lexicographical network to how ideas and concepts are connected to each other.

The project requires good programming knowledge of python or matlab, as well as physics, and an interest in computational linguistics.

Philip Nelson

Project 1: From Photon to Neuron: Light, Imaging, Vision

The student will participate in many phases of bringing a new book to completion. The book is the primary textbook for Penn's PHYS280, and is nearly ready for wider distribution. There is no similar book yet in existence. This year's students found it to be very exciting; they wrote remarks such as "An amazing course, teaches you important skills in physical modeling and research-type problem solving, highly recommend to anyone who is interested in the interdisciplinary interface between physics and biology." Topics included in the book include the quantum character of light and its applications to superresolution imaging (Nobel Prize 2014), human vision, and a host of other natural phenomena and related instrumentation techniques.

The student on this project will get exposure to this hot material before the rest of the world, as well as an inside look at the process of creation.Tasks at hand include photo research to source the many images from primary research literature; translation of computer codes from one language to another; reading and critiquing assigned problems, their solutions, and other aspects

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of the Instructor's Guide; finding and addressing obscure points in the text and figures; creating online digital resources such as databases; creating permanent archives of cited Web pages; and more. The student will meet about twice weekly with the mentor for the duration of the project to discuss everything.

Arjun Yodh

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

Undergraduate students will join on-going projects that utilize diffusing light to probe tissue physiology of the brain. The exact project will depend on the latest developments in our lab. Briefly, our biomedical research is oriented towards optical monitoring of deep tissue physiology, i.e., millimeters to centimeters below the tissue surface. The diffusion (random walk) model for light transport permits experimenters to quantitatively separate tissue scattering from tissue absorption, to accurately incorporate the influence of tissue boundaries and interfaces, and to use light at different wavelengths to carry out tissue spectroscopy. The diffusion approximation also provides a tractable basis for tomographic approaches to image reconstruction. Lastly, dynamic diffuse optical methods monitor the speckle fluctuations of scattered light, which in turn are sensitive to the motions of red blood cells (i.e., blood flow). Collectively this work makes possible construction of novel instrumentation for non-invasive extraction of regional information about tissue blood flow, total hemoglobin concentration, and blood oxygenation, among other factors. The research in this project will measure cerebral blood flow, oxygen dynamics, and oxygen metabolism during functional activation (e.g., in healthy adults), during management of brain injury, especially stroke, and even during surgical procedures. Students will learn about and develop state-of-the-art electro-optical instrumentation for this purpose; they will learn to analyze the optical signals, and they will opportunistically apply these tools in the clinic along with my graduate students and post-docs.

Project 2: Physics of Soft Materials: Colloids, Liquid Crystals and Emulsion

Undergraduate students will join on-going experimental projects that utilize optical microscopy, laser spectroscopy and micro-manipulation, wet chemistry and more, in order to understand the phase behavior, dynamical properties, and mechanics of soft materials. The exact project will depend on the latest developments in our lab. Briefly, on possible set of experiments seeks to understand how local structure drives assembly, rearrangement and deformation in disordered colloidal particle packings. This research develops and utilizes sample systems with unique “knobs” for experimental control, including microgel (NIPA) particles whose diameter can be tuned with temperature. In disordered and partially ordered colloidal solids we will carry out experiments to elucidate the parameters which make a material “soft”. Another (different) project will study liquids with exotic elasticity: liquid crystals. Chromonic liquid crsytals are new. They live in water and compared to traditional thermotropic LCs used in displays they twist

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extremely easily. This leads to formation of chiral structures from achiral mesogens. Our experiments will probe fundamental properties and self-assembly of these novel materials, e.g., confined in drops, capillaries, etc. Finally, flow resistance variation across LCLC phases will facilitates study of new phenomenology in model multi-phase drop drying and deposition (i.e., new coffee-ring effects).

Project 3: Non-invasive Optical Imaging and Monitoring of Breast Cancer

Undergraduate students will join on-going projects that utilize diffusing light to probe tissue physiology of breast cancer. The exact project will depend on the latest developments in our lab. Briefly, this biomedical research is oriented towards optical monitoring of deep tissue physiology, e.g., in the middle of the breast. The diffusion model for light transport permits experimenters to quantitatively separate tissue scattering from tissue absorption, to accurately incorporate the influence of tissue boundaries and interfaces, to use light at different wavelengths to carry out tissue spectroscopy, and it provides a tractable basis for tomographic approaches to image reconstruction (Diffuse Optical Tomography, DOT). Collectively this work makes possible construction of novel instrumentation for non-invasive optical imaging and monitoring breast cancer. Depending on progress, we expect the undergraduate research to enter into one of two projects. The first project will complete and utilize a multi-modal DOT-MRI clinical breast imager within a standard-of-care hospital MRI scanner at the Hospital of the University of Pennsylvania. One goal for this instrument is to utilize soft spatial priors from MRI to help reconstruct tumor optical properties with greater fidelity. The combination of optical and MRI biomarkers will be explored for improved cancer characterization via computer aided diagnosis (CAD). The second project is oriented towards monitoring the evolution of breast cancers during therapy (e.g., neoadjuvant chemotherapy). In this project we aim to identify and characterize the "remodeling" of the tumor during treatment; ultimately, the optical information could be used to guide treatment.

POLITICAL SCIENCE

Daniel Hopkins

Project 1: Moneyball and Politics

Do you enjoy using data to understand how the world works? Do you frequently question the conventional explanation for how the world works? Did you find yourself checking fivethirtyeight.com to see their writers' 2016 forecasts, or watching election polls closely? If so, you may be interested in this 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 collective understanding of political behavior. We'll try to understand why some political issues are strong

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predictors of how people vote while others are not. What role does self interest play in shaping which candidates voters are likely to support? I am particularly interested in students who are organized and who are willing to learn new computing skills. Statistical skills and/or coursework in political science helpful but not required.

Project 2: Discrimination and Partisanship among Immigrants to the U.S.

Today, the U.S. is home to more than 40 million people born in other countries, and how those immigrants and their children are incorporated into American politics will shape the political landscape for generations to come. I am looking for help with a project in which I've been examining how perceptions of discrimination shape first-generation Latino/a and Asian American immigrants' attitudes toward the political parties. There are various pieces of this project on which I could use help, from analyzing reams of survey data to making sense of prior research in political science, sociology, and social psychology. Applicants who have some familiarity with American politics, statistics, Spanish, or Mandarin especially encouraged to apply.

Michael Horowitz

Project 1: The Future Of War: Technology, Proliferation, and International Security

This project focuses on the future of international politics, and the role that the proliferation of key military technologies might play in shaping global politics over the next generation. States such as China and Russia, as well as non-state actors such as ISIS present challenges to the international system. Part of that challenge involves their ability to utilize their military forces to threaten others inside and outside of their territories. This project seeks to track and understand the spread of critical technologies at present and over the next generation, including but not limited to drones, other military robotics, semi-autonomous weapons, 3D printing, cruise missiles, and submarines. By determining how and why these technologies are spreading, we can advance scholarly understanding in this vital area. The project will also focus on the commercial applications and dual-use nature of some of these technologies in order to understand the intersection between military and commercial demand in the proliferation process.

Student researchers will be responsible for tracking proliferation trends in important areas of the world, and for particular technologies. This will require in-depth research both online and in the library to produce coding and research writeups. Student researchers will also be responsible for communicating with members of the defense media and other experts to verify research findings.

Professor Horowitz would prefer students with interest or experience in international relations, international security, technology, or related areas, but all are welcome to apply.

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Ian Lustick

Project 1: The Effect of the Israel Lobby in the US and in Israel

President George Washington's Farewell Address is one of the most celebrated speeches ever delivered by an American President. Much of the speech is devoted to warning of the dangers associated with any domestic group whose attachment to a foreign country is too strong—whether marked by love or hate. For example: " Excessive partiality for one foreign nation and excessive dislike of another cause those whom they actuate to see danger only on one side, and serve to veil and even second the arts of influence on the other. Real patriots who may resist the intrigues of the favorite are liable to become suspected and odious, while its tools and dupes usurp the applause and confidence of the people, to surrender their interests." A key portion of the book I am writing focuses on the implications of Washington's analysis, when combined with Madisonian understandings of American government as a political marketplace, for the emergence, operation, and effects of the Israel lobby. The research's main focus is on the consequences of the lobby's success on the trajectory of Israeli politics, but it will illuminate as well both the lasting strengths and abiding challenges of American democracy as structured by the Founding Fathers. This opportunity will be most suitable for students with strong backgrounds in both American politics and Arab-Israeli relations. Work will involve collecting, reading, sorting, and analyzing a wide range of library materials, notes, and previously collected materials.

Project 2: Thinking about State Demise: Israel as a Case in Point

States are born, and they develop, but they also pass away. The political transformation questions posed by the rather sudden but drastic demise of capable, powerful states, such as Yugoslavia, Czechoslovakia, the Soviet Union, Pahlavi Iran, Franco's Spain, Qaddafi's Libya, apartheid South Africa, and, perhaps, Baathist Syria, are crucial but rarely if ever posed as distinct topics for scholarly consideration. How is it that impressively capable states can, relatively suddenly, vanish? What explains, in other words, the demise of states? One key problem facing the development of answers to the questions posed by state demise is definitional. The Pahlavi state in Iran is gone, but Iran itself remains, within the same territorial borders. The same is true in South Africa. The Soviet Union and Yugoslavia, on the other hand, no longer have even territorial referents.

In this paper I will advance a proto-theory of state demise for explaining variation in the causes, suddenness, and violence based on how deeply institutionalized was the state project at the point of its demise. The paper will use the Israeli case to test the plausibility of this approach. Political discourse in Israel (and, outside the country, about Israel) is saturated with arguments about which of dozens of factors might mean that "the state will not survive." The paper will treat this discourse as raising difficult questions about the meaning of the state "not surviving," the conditions under which state demise could take place, and what that might look like. The

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proto-theory advanced here will be used to analyze the discourse, both to evaluate the theory and to understand its implications for meaning, probability, timing, and process by which the State of Israel could meet its demise.

Michele Margolis

Project 1: Make America Great Again? Evangelical support for Donald Trump

It is the eve of the Iowa caucuses, and pollsters, politicians, and political scientists do not know what the results will be. One group that will prove decisive in the Republican caucus is Born-again or Evangelical Christians. Making up about 60% of likely Republican caucus goers, these religious conservatives are key to the outcome. Interestingly, electoral support among this group (as well as its leaders) has been divided between Ted Cruz, an evangelical Christian who speaks regularly about his faith and faith-based policies, and Donald Trump, a thrice-married man who, by all accounts, is not very religious. If you find this division surprising, you may by interested in this PURM project. My research focuses on using data to try and understand how and why evangelicals come to support a political candidate. I am particularly interested in candidates who are organized, willing to learn new computing skills, and want to get their hands dirty in data.

Project 2: Death, Destruction, and Politics: How does bad news influence public opinion?

The news is filled with death and destruction. Stories about Ebola, terrorism, and police shooting are commonplace in the media today. But how do these stories about death and pain affect our political opinions? Can Americans form rational political opinions in response to such emotionally laden news stories? A new research project will try to answer these, and other related, questions. I am looking for students who are interested in exploring how Americans form opinions in response to bad news. In particular, I am interested in students who have experience or want to learn how to develop, design, and run survey experiments.

Marc Meredith

Project 1: Can Voting Reforms Reduce Inequality at the Local Level?

Two factors distinguish mayoral and other local elections from other American contests: turnout is remarkably low and more affluent voters tend to participate at higher rates than other voters. At the same time, states and local jurisdictions have wide leverage to conduct elections as they see fit. This combination of features leads to a question relevant to scholarly and policy debates on elections: can we identify policy interventions (i.e. election day registration and convenience

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voting reforms) that reduce inequality in local elections? Knowledge of this question is limited in the academic literature, but advances in management and analysis of "big data" may be helpful to expand on what we already know about local elections. Interested students will, in the course of this project, become familiar with assembling a set of data from academic sources and official election results and with statistical analyses of these data. Familiarity with Stata is beneficial, but not required.

Rudra Sil

Project 1: Russia Reconsidered: The Fate of a Former Superpower

The project title is actually the title of a book I am working on. The anticipated completion date is in Spring 2017, but a substantial amount of writing will be done during Summer 2016. The research mentee will be expected to assist with gathering relevant data, essays, and op-eds that will be used to develop a distinctive reading of Russia that seeks far more nuance than is evident in typical narratives about Putin's Russia among policy-makers and mainstream media. The basic thrust of the book is to show how these narratives permeate different domains - from the political system and economic reform to analyses of foreign policy, oil & gas revenues and demographic trends - and then use a wider range of empirical data and a comparative-historical framework to produce a more qualified and finessed story of Russia's long-term trajectory. Situating current trends against the sweep of Russia's history dating back to the 19th century, and comparing them to trends in other non-western large countries harboring regional ambitions, combines to produce a more "normal" image of Russia -- not "normal" in the sense that Russia is like all other countries, but "normal" in the sense that other countries/leaders that have the vast territories, resource balance, and human development level of Russia would probably act more like Putin (in the 2000s) than like Yeltsin (in the 1990s). The long-term implication is that Russia, while it cannot be expected to a friendly country with robust liberal capitalist democracy, is also just pursuing its own goals and ambitions moving forward rather than seeking to return to the Cold War (as often suggested in standard narratives). Knowledge of Russian a plus but not required. Some prior coursework on Russia (e.g., in history, political science etc.) would also be helpful.

Project 2: Varieties of Petro-states

This is a continuation of a project that began last year. This is part of an ongoing effort to capture the differences among "petrostates," countries that depend significantly on revenue from fossil fuel exports (especially oil and gas) for their revenue and GDP growth. A common view is that petrostates are often too "lazy" to invest in non-energy sectors, while relying on the export revenue to buy off opposition and maintain the political status quo (often in the form of an authoritarian regime). This project is designed to show that petrostates come in all sizes and

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shapes, occupying a fairly wide spectrum in terms of just how much they conform to the aforementioned general view. That is, some are more dynamic than others in redirecting resources into new capital projects or updating infrastructure, while others tend to be more prone to corruption and stagnation. Much depends on (a) the extent of dependence on oil/gas as opposed to other sectors when it comes to exports, GDP growth and revenue; and (b) the design of the institutional structure set up to manage oil and gas production and the revenue it generates. Thus far, the project has yielded a comparative study of Norway and Saudi Arabia, prepared by a PURM student last year. This year, the idea will be to gather more updated data on energy shifts, especially in light of falling oil prices, while developing another comparative study involving two other petrostates (possible candidates are: Iran, Nigeria, Mexico, Brazil, Azerbaijan and Kazakhstan).

Rogers Smith

Project 1: The Politics of American Citizenship Laws in the 20th Century

At the start of the 20th century, U.S. citizenship and immigration laws created structures of racial and gender hierarchy. Through legal and political struggles in the first 2/3 of the 20th century, those structures were formally dismantled; but a range of new controversies over meaningfully equal citizenship emerged. Having previously written on 19th century citizenship laws, I am writing a book on citizenship in the 20th century. Main remaining research needs are analyses of congressional debates over specific citizenship issues during these years to identify systematically content themes and the coalitions favoring different positions. We will do this through a mix of old-fashioned interpretation and, insofar as possible, content analysis software.

Project 2: Racial Alliances in Modern American Urban Politics

My frequent co-author Desmond King and I are engaged in a study of the evolving coalitions that contested racial policy issues in a set of U.S. cities over the last four decades. The next research steps are to locate participants in the coalitions we have identified, as well as to identify other coalition members, and to conduct a combination of surveys and in-depth interviews. The research assistant would assist both with the identifications and with further background research that can help tailor survey and, especially, in-depth interview protocols appropriately.

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PSYCHOLOGY

Sudeep Bhatia

Project 1: Memory and Preference

What is your favorite film? What about your favorite food item? Often when people make these sorts of assessments, they rely on information stored in their memories. In this project we will examine how this information is learnt and represented, and how it influences preferences and choices. We will use psychological models, and will test our models using experimental human data. Duties will include performing literature reviews, programming and implementing experiments, and managing and analyzing data. Applicants should have completed some course work in psychology, cognitive science, or economics.

Dianne Chambless/Melissa Hunt

Project 1: Coping with Crohn's and Colitis

I am currently running a randomized controlled trail (RCT - the gold standard in science and medicine for proving that a treatment works) of a cognitive behavioral self-help workbook for people with chronic GI disorders (inflammatory bowel diseases like Crohn's and ulcerative colitis). I need a highly responsible student who is interested in behavioral health and/or clinical psychology to take over day to day management of the project for the summer. Duties will include patient recruitment, managing all study data, follow-up and data collection, and all patient contacts (via e-mail). I may well be speaking at monthly IBD support groups in June and July and the student is welcome to accompany me to those meetings. The student will gain experience with cognitive-behavioral therapy, research methodology with psychotherapy outcome and clinical trials, IRB protocols, and data management and analysis using SPSS. Students will work directly with and be supervised by Dr. Melissa Hunt, who is the Associate Director of Clinical Training in the Department of Psychology.

Delphine Dahan

Project 1: Coordination in language use during unscripted conversations

One of the defining characteristics of human language is that it can be used to refer to entities in the world. However, generating and understanding referring expressions is a complex and challenging cognitive process because there is a potential many to many mapping between referring expressions and their potential referents. A speaker might refer to the same person as, “Jim”, “Jim Kenney’, ‘the new mayor of Philadelphia’, ‘the man I met last week’, ‘the man’, or

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'a man I met last week. Most of these referring expressions could have many possible referents, e.g., there are many Jims, more than one Jim Kenney and multiple men that the speaker might have met. In order to establish reference successfully and efficiently, the speaker must choose a form that specifies the referent appropriately, giving the addressee sufficient information to identify the referent, for purposes of the current conversation, while not giving irrelevant detail. Conversely, the addressee must provide appropriate signals to confirm whether or not the referring expression is understood. This requires participants to take into account relevant aspects of what is mutually known.

Most of what is known about using language collaboratively to establish reference in common tasks comes from studies with college students. This study population has been highly successful at performing the tasks and has shown little variability. However, college students may be particularly skilled in the kinds of interactions that are used to study conversation. Preliminary data demonstrate that, when including participants recruited from the community at large, people vary widely in their ability to successfully use language in order to collaborate on a common task.

The research taking place in the lab aims to characterize how people from various ages, educational levels, and socio-economic status use language to collaborate during unscripted conversations in an instructional setting, one in which participants aim to convey information to each other. The proposed studies will assess: a) the degree to which people differ in the way they accomplish this task; b) whether different linguistic behaviors may be associated with different levels of success; and c) how flexible people may be in adjusting their linguistic behavior based on feedback on communication efficiency, and/or their interlocutor's own linguistic behavior.

We invite people to the lab to participate into a matching game: Participants sit on either side of a table separated by an opaque barrier. In the first two series, each participant is given an identical set of cards; each card displays the image of a black complex geometric configuration on a white background, which can be seen as the silhouette of an object (a so-called 'tangram'). One participant is assigned the role of director and instructs the other, the matcher, which cards to select from their card set in order to reproduce sequences that only the director can see. We examine how accurate matchers are, and if errors are made, we examine the source of difficulties in referential success by analyzing the form of the referring expressions people choose to use, how these expressions evolve with repeated reference, and the types and frequency of the coordination devices used to establish reference.

Students will be working in collaboration with the faculty member and other members of the lab to code and analyze the audio-recording of unscripted conversations that have been collected and participate in the collection of new conversations.

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Harvey Grill

Project 1: What factors predispose individuals to obesity? Individual differences in response to satiation signals

Obesity is a disease and a major world health issue. Thus, it is important to understand the etiology of this disease, as a large population is either obese or overweight while approximately 33% of the adults US population is lean. My lab is interested in investigating what accounts for these individual differences in obesity proness/resistance. This study will explore individual differences in responses to satiation signals (gastrointestinal signals that inhibit further eating, e.g. cholecystokinin, glucagon-like peptide-1, peptide YY) and how responses to them may correlate with future weight gain using a rat model. Here, we hypothesize that individuals that are less responsive to post-meal satiation signals will have a greater propensity for weight gain. Follow up studies will be performed, when appropriate, to determine the neural mechanisms that mediate the effects to be seen. This project will involve peptide injections; behavioral analysis (e.g. food intake measurements, progressive ratio responding analysis, etc.), ELISAs, and follow up studies may involve molecular techniques such as qPCR and Western blotting. An example of a related experimental approach we would be open to exploring to approach to the same question would hypothesize that individual differences in consumption sweet and sweet fat [high-energy diets] will correlate with future weight gain of

Students will be trained by lab members and will be expected to eventually work independently on the experiments within this project.

Project 2: Role of central GLP-1 receptor signaling in food reward

In the face of the current obesity epidemic, it is important to understand at the neuroendocrine level the control of food intake and weight gain. Overeating is driving the elevated rates of obesity and overweight and what is driving overeating is the availability of tasty, energy dense, and cheap food. Liraglutide, a GLP-1 analogue, was recently FDA approved to treat obesity. However, the neural substrates involved in mediating the food intake reduction by this drug are not fully known. Recent studies have suggested that GLP-1 reduces food intake at least in part by acting on the brain to reduce food reward. Experiments within this project will examine novel brain regions (e.g. paraventricular nucleus of the thalamus, PVT) and their contribution to the control of food reward. This project will involve central GLP-1 agonist microinjections and extensive behavioral analysis using paradigms such as conditioned place preference, progressive ratio responding, and reinstatement of food seeking. The project would also seek to explore the connections of the PVT that collective act as a circuit controlling food reward. As such neuroanatomical and cell signalling techniques would be used to address those questions.

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Students will be trained by lab members and will be expected to eventually work independently on the experiments within this project.

Joseph Kable

Project 1: Psychological and neural mechanisms of decision-making

This project will employ an interdisciplinary approach to understand the psychological and neural mechanisms of choice, drawing on methods and ideas from social and cognitive neuroscience, experimental economics, and personality psychology. Students will get exposure to neuroscientific methods such as functional magnetic resonance imaging (fMRI), quantitative analysis of behavioral deficits in neurological patients, noninvasive brain stimulation, and eye-tracking. Students will learn how to use computer presentation software (E-Prime, Psychtoolbox, PsychoPy or Qualtrics), data analysis software (Matlab, Excel, or SPSS), and important statistical concepts including t-tests, correlation, ANOVA, non-parametric tests, multiple linear regression, logistic regression, and nonlinear optimization.

Ayelet Ruscio

Project 1: Measuring Physiological Reactivity to Everyday Events in Anxiety and Depression

Psychologists have long known that anxious and depressed individuals differ from healthy individuals in their physiological reactions to significant events. However, reactions have been studied almost exclusively in laboratory settings, limiting the events to which participants can be exposed and raising questions about generalizability to real-world settings. Fortunately, recent collaboration between scientists and industry has resulted in the development of ambulatory devices capable of measuring psychophysiological responses outside the laboratory. Our lab has begun using these wrist-worn devices, in conjunction with smartphone ratings of event characteristics, to investigate changes in physiology (skin conductance, motor activity) following events in the daily lives of anxious, depressed, and healthy individuals. Of particular interest is how these groups react to everyday positive and negative events, and how reactions in turn affect clinical symptoms. Ultimately, this research has the potential to identify biomarkers that signal vulnerability for persistent emotional disorders.

This project is ideally suited for a student who is interested in the intersection between clinical psychology and neuroscience, physiology, or bioengineering. The student will be trained in psychophysiological assessment and will interact with clinical populations. Given the novelty of these procedures, the student will work closely on developing methods for isolating, extracting,

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and analyzing event responses from the continuous stream of ambulatory psychophysiological data collected. The student will also collect data from clinical participants and assist with the daily operations of this study. The project will be co-mentored by Professor Ruscio and postdoctoral psychophysiologist Dr. Mathersul. For more information about our research see https://sites.sas.upenn.edu/ruscio-lab/pages/research.

Project 2: Measuring Thoughts in Real Time to Understand the Inner Experience of Anxiety and Depression

Anxiety and depression are often found in the same individuals. This has generated interest in psychological processes that may increase risk for both conditions. Clinicians have observed that both anxious and depressed individuals have a tendency to get "stuck" in a cycle of negative thinking that is hard to control. However, the difficulty of measuring thoughts without disrupting their natural flow has hampered researchers' ability to study this promising risk factor. Our lab recently developed an innovative thought-tracking procedure that allows participants to report the valence and intensity of their thoughts, second-by-second, using a specially designed joystick device. In the current study, participants will use this device to track their thoughts as they prepare for, and recover from, a significant stressor: giving a videotaped speech in front of a panel of judges. The thought streams of anxious, depressed, and healthy participants will be compared to examine the timing and intensity of negative thoughts and the extent to which thoughts get "stuck" during preparation (worry) versus recovery (rumination).

This project is ideally suited for a student interested in clinical psychology, biological bases of behavior, or bioengineering. Given the novelty of these procedures, the student will work closely on developing methods for extracting and analyzing key cognitive variables from the continuous stream of data collected. The student will also collect data from clinical participants, serve as a "judge" in the stressor task, and assist with the daily operations of this study. More information about our research can be found at https://sites.sas.upenn.edu/ruscio-lab/pages/research.

Project 3: Relationship between Physiological and Subjective Arousal in Anxiety

Anxiety disorders have significant, negative effects on quality of life. The physiological nature of the anxiety response (e.g., racing heart, muscle tension, difficulty breathing) is particularly debilitating. Research suggests that a mismatch between the subjective experience of anxiety and the actual physiological response, especially in stressful contexts, may contribute to the maintenance of anxiety. However, overestimation of physiological arousal has mainly been observed in people who experience panic attacks. Less is known about individuals whose bodily symptoms are more subtle (e.g., muscle tension; feeling "keyed up" or restless), yet still critical to their experience of anxiety. The current project will expose clinically anxious individuals to a stressful (public speaking) task. Measures of psychophysiological arousal (heart rate, sweat rate, muscle tension, motor activity) will be compared to subjective perceptions of bodily arousal

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assessed throughout the task. Of particular interest is how closely subjective experiences match physiological responses in anxious versus healthy individuals, and the extent to which subjective anxiety modulates the intensity and duration of physiological responses.

This project is ideally suited for a student interested in the intersection between clinical psychology and neuroscience, physiology, or bioengineering. The student will be trained in psychophysiological assessment and will help develop a system for mapping subjective ratings onto physiological data. The student will also help collect data from clinical participants and assist with the daily operations of this study. The project will be co-mentored by Professor Ruscio and postdoctoral psychophysiologist Dr. Mathersul. More information about our research can be found at https://sites.sas.upenn.edu/ruscio-lab/pages/research.

Daniel Swingley

Project 1: Computer simulation of bilingual infants learning Catalan and Spanish

Infants are well-adapted to learn multiple languages simultaneously, but sometimes surprising behaviors arise from the interaction of two languages. When we consider bilingual infants that are learning Spanish and Catalan at the same time, we notice that they behave strangely in laboratory tests of their vowel perception abilities. At the same time, it is known that Spanish-Catalan bilingual adults sometimes make speech errors by substituting vowels for each other.

This led us to consider a hypothesis linking these facts. We developed a computer program that simulates how children learn vowels and words at the same time. When we run such simulations with the types of speech errors adults make, we see how kids may mislearn certain vowels. In turn, we developed further simulations that model infant behavior in order to link these erroneous vowel categories to actual child behavior on laboratory tests.

Now, we need a student researcher to work with these simulations to systematically explore the proper parameters and inputs/outputs, document the relationships between adult speech and child perception, and potentially improve the simulations. Given interest, the student would participate in the write up of the results and gain authorship in an academic publication. In participating in this project, they would gain experience working with faculty and researchers at Penn and other institutions, and gain valuable experience working with statistical/probabilistic models and simulations and interpreting results of scientific investigations.

The ideal student will have experience with statistics, probability, linguistics/psychology, and scripting/programming, at least at the introductory level (or a keen interest in learning about these topics). The project is being led by postdoctoral researcher Yakov Kronrod.

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Philip Tetlock

Project 1: Accountability systems, predictability, and risk propensities ***Rising Sophomores only***

Do accountability systems make people perform better or worse in predictable and unpredictable environments? Decision-makers often operate in dynamic environments such as financial markets, battlefields and operating rooms (Hastie, 2001). Even though past research well-documents the conditions under which decision-makers naturally deviate from behavior expected from rational utility maximization (Edwards, 1954; Kahneman & Tversky, 1979; Samuelson & Zeckhauser, 1988; Simon, 1959), scholars in judgment and decision-making remain at odds over whether decision-makers are better served by being held accountable for following a process or being held accountable solely for outcomes.

This study examines how being held accountable affects task performance in predictable and unpredictable environments. We hypothesize that the relationship between accountability and task performance is mediated by risk propensities (e.g., committing errors of omission or commission). The novel experimental task requires subjects to make a prediction. The manipulations are accountability type, environmental predictability, while exposed to risks of committing errors of omission and commission. We will also be running a group version of this experiment. The research assistant will help with design of the experimental task, maintenance of the experimental server, data preparation, survey management and some basic data analysis tasks.

Sharon Thompson-Schill

Project 1: Imaging Human Thought

Students will learn how to decode thought patterns from data obtained while human volunteers are undergoing Functional Magnetic Resonance Imaging. This project is supported by the National Eye Institute. We use analysis of brain patterns to understand brain changes associated with learning and memory in humans. Applicants should have some coursework in psychology, cognitive science, or neuroscience (preferably all of the above) and should be comfortable with both Mac and PC computer systems. For this particular position, the applicant must also be comfortable with basic statistical concepts and also must have some programming ability (e.g., Matlab).

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Project 2: Effects of non-invasive stimulation of human brain on thought, language, and memory

Students will learn how to design and administer an experiment involving either Transcranial Magnetic Stimulation or Transcranial Direct Current Stimulation to human volunteers, in order to assess the effects of transient alterations of neural activity on complex cognitive functions. This project is supported by the National Institute on Deafness and Communicative Disorders. Applicants should have some coursework in psychology, cognitive science, or neuroscience (preferably all of the above) and should be comfortable with both Mac and PC computer systems.

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; 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 whether they can think scientifically. As part of this project, we present children with different kinds of scientific reasoning tasks, asking them to construct experiments or draw conclusions from a set of observations. By learning more about how children understand science and how they reason scientifically, we 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 reading the scientific literature, 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 learn from stories?

Stories are important teaching tools in childhood. Even though the events depicted in them are fictional, stories nevertheless present some information that is true in reality, which children should learn. For example, the Berenstain Bears books are meant to teach children about the value of sharing or not eating too much junk food, not that bears live in houses or wear clothes.

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But how do children know which pieces of information are only true in the story, and which should be exported into reality?

To answer this question, this project presents preschool-aged children with fictional stories and asks whether they will apply information presented in these stories to real life. These stories vary in their degree of fantasy, with some being entirely realistic and others containing many fantasy elements. Children are asked whether the information presented in these stories could possibly be true, and we will test how the type of story they hear might change their answer to that question. Learning more about children's imaginations and their interactions with stories can help us to create better educational media and to understand more about how their critical-thinking capacities develop.

The student will assist the professor in all aspects of conducting and running psychological studies on this topic. Duties will include reading the scientific literature, 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.

RELIGIOUS STUDIES

Justin McDaniel

Project 1: Wealth and Buddhism: How a Monastic Religion developed into a Religion of Prosperity

Wealth and Buddhism have often been depicted in modern textbooks, films, and scholarly studies as enemies of each other. Buddhism is often described as the world's largest monastic tradition and the saffron and gray robes of nuns and monks are symbols of poverty, humility, and discipline. However, recent scandals involving Buddhist monks flying in private jets and carrying expensive luggage and the opulent décor of many monasteries throughout Asia have raised questions about the influence of wealth and materialism on Buddhist monastic life.

In this project, the student researcher will undertake two dynamic, but related research agendas. First, s/he will do searches in Buddhist canonical and post-canonical texts (translated into English, but knowledge of Buddhist languages like Sanskrit, Pali, or Chinese would be welcome) for references to expensive gifts to monasteries and descriptions of wealthy Buddhists (often called Mahasetthi). S/he will chart out these references. In the second half of the project, the student researcher will look at hundreds of slides of monasteries, statues, murals, and reliefs throughout the Buddhist world to identify examples of the celebration of extreme wealth and opulence.

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The student will also have opportunities (depending on funding) to visit museum collections in Washington DC, Philadelphia, and New York, to help develop a large database of images and textual references about wealth and Buddhism. Finally, the student and mentor will discuss comparative studies of prosperity religions and different sects of Christianity, Islam, and Hinduism that celebrate extreme wealth. This is excellent preparation for careers in Asian Studies, Art History, Religious Studies, Linguistics, Literature, Anthropology, Art History, and Museum Studies. No previous knowledge of Buddhism or Buddhist languages is required, but any student who has previous experience is welcome.

ROMANCE LANGUAGES

Kara Moranski

Project 1: The role of meta-analytic talk in foreign language development

This student will work with Dr. Moranski on an ongoing research study within the field of applied linguistics whose goal is to identify and analyze meta-analytic talk in speech data collected from adolescent learners of Spanish. Meta-analytic talk refers to instances in which learners discuss certain metalinguistic elements of the target language (vocabulary, grammar, etc.) in their native language (English). Current research shows that this type of metalinguistic talk has several benefits to language learners and can have implications for target-language use and accuracy. This study is the second phase of a long-term research project with Dr. Paul Toth at Temple University and therefore will grant the student the opportunity to experience cross-institutional collaboration in social science research.

The student will be trained in how to use Transana speech-analysis software in order to assist with data transcription and coding. Though the Transana analysis will be a key component of the student's contribution, s/he will be involved in all major aspects of the project: compiling structured abstracts for the literature review, developing a grounded coding scheme, and conducting statistical analyses. This research assistantship will provide an excellent opportunity for students interested in social science research to experience how quantitative and qualitative methods are triangulated to study human behaviors and learning processes. It is strongly preferred though not required that applicants have some background in basic statistics and/or linguistics. Applicants should have beginner-level proficiency in Spanish, as this is the proficiency level of the learners whose speech will be analyzed.

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SOUTH ASIA STUDIES

Lisa Mitchell

Project 1: Protest & Public Space: Collective Assembly and the History of Indian Democracy

Historians of contentious politics have asserted that collective forms of state-directed protest first emerged in post-industrial Europe, appearing sometime between the 1780s and the 1840s before spreading elsewhere around the world. South Asian historians, too, have largely supported this chronology when attributing Gandhi's non-violent mass political innovations of the early 20th century to his exposure to post-industrial European influences. Yet archival evidence from India suggests that state-directed forms of contentious collective assembly, including many non-violent forms of collective protest, existed in India at least as early as the 1660s.

An undergraduate student researcher is needed to work along with Professor Mitchell and one graduate student research assistant to compile, organize, and analyze historical documents from India from the 17th-19th centuries. Some of these primary sources have already been transcribed into a searchable format, while others still exist in image form and will need to be transcribed. The student may also be asked to collect additional primary sources on Indian collective protests using Penn's print, microfilm, and digital collections. Some knowledge of Indian history (or an Indian language) would be an asset, though not required. This work is part of a larger book project that offers a much longer genealogy for the South Asian forms of non-violent mass politics that first attracted global attention during the Indian anti-colonial nationalist mobilizations of the early 20th century. Sources offer a critique of existing histories of mass politics, as well as a new method for approaching our understandings of the state.

Deven Patel

Project 1: Text and Textile: Working on a 15th century scroll from the Smithsonian

I am currently working on a book on a very famous scroll manuscript in the Freer Gallery of the Smithsonian (Washington DC) and part of this project entails going through the W. Norman Brown papers. W. Norman Brown founded South Asian studies at Penn and is one of the great Sanskritists of the twentieth century. He worked on this scroll and the poem that lies at the heart of the scroll. We need to review his archives from the Penn Library. Also, the research assistant would be working hands-on to go through the literary text (in translation), help with collecting bibliographical sources, and hopefully visit the gallery to consult the scroll. The student needs to have an interest in literature, art history, and (if possible) classical India.

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Project 2: An Anthology of Sanskrit Poetry

A publication that I am almost finished with is a translation of 2,500 verses of Sanskrit poetry from the 13th century. This would be an excellent opportunity for a student to help with polishing the translation, learning about Sanskrit literature and Sanskrit culture, and be involved with the process of annotating the translation. The student will also learn how to use the Devanagari script, type the transliterated text into the computer, and learn how an edition is made. Students will spend time both reading and suggesting edits for the translation as well as typing in the text. We will also consult original Sanskrit manuscripts of the text

Ramya Sreenivasan

Project 1: An Emotional History of the Household in north India, 1500 - 1800

I am currently undertaking research for a book on a history of the household in northern India between 1500 and 1800. I intend to write this as a history of relationships, obligations, and emotional ties between members within and beyond the household. While the family is the staple of popular Hindi cinema (Bollywood) today, with its increasingly global audience, no history has been written of how the northern Indian family came to be the way it is understood today. Nor has a history been written of how different it was in the past, which is my aim in the book.

To that end, I am looking for an undergraduate to help conduct archival research from the United States. Tasks would include undertaking database searches and physical searches at the Van Pelt library at Penn, to accumulate and index articles relevant to this topic. This could include reading microfilm, making photocopies, and organizing material. An interest/ experience in India or in gender issues or in the sociology of kinship is welcome, but not required. This project would be a great way for a student to gain insight into how a social scientist conducts research, giving the student valuable skills for later in his/her academic career.

THEATRE ARTS

Rosemary Malague

Project 1: Attention Must be Paid: Staging Linda Loman in DEATH OF A SALESMAN

This projected book project centers on Arthur Miller's play, Death of a Salesman, with primary focus on the staging of the character Linda Loman. Written as a devoted and traditional housewife in the 1940s, in a work that clearly centers on the lives and choices of American men, Linda is a problematic character. This project aims to conduct a comparative examination of

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historical performances of this canonical role, tracking the similarities and differences, and proposing how a contemporary production might pay attention to this Linda, staging her with a feminist sensibility, while remaining faithful to the playwright's vision.

This project brings together study of dramatic literature, history of productions, acting and directing practices, gender studies, and cinematic representations of Death of a Salesman; therefore, it might be of interest to students in English, GSWS, Cinema, History, and Theatre Arts.

Research tasks will include the following:

- Study of the character of Linda Loman on the page;

- Gathering and summarizing literary analyses of this role;

- Gathering and summarizing reviews of historical productions;

- Search for and examination of memoirs, biographies, and interviews that shed light on production processes (example: Arthur Miller's memoirs; Elia Kazan's memoirs and published directors' notes; etc.)

- Examination of filmed versions of the play, alongside reviews of them.

- Search for lesser-known revivals directed by women and/or with feminist sensibility.

Research may bring us to archives in New York, and into conversation with living actors and directors who collaborated on these productions.

Project 2: Plays by Contemporary American Women: A Scene Book for Actors

No scene book for students has ever been edited from a feminist perspective, providing students not only with female-authored material, but also with empowering scenes for women. This project will also take into consideration matters such as race, ethnicity, and gender, including trans actors.

This project is underway, with many scenes already selected, and others to be targeted and added.

Student tasks would include:

- Reading and summarizing plays, highlighting scenes for inclusion in the book;

- Researching the process of acquiring rights to reprint these scenes in a new collection.

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A student who participates in this project would receive published acknowledgment of research assistance.

Though students of English, Theatre Arts, Comp Lit, Cinema Studies, and GSWS might find this of particular interest, all are welcome to apply.

Project 3: "Regrouping: A Feminist Portrait of Stella Adler, 1941-1951"

For an article on the acting teacher Stella Adler, this research project includes work on archival material, specifically transcribing letters between Stella Adler and her husband, Group Theatre founder Harold Clurman. The letters are spicy (and sometimes salacious) and have never been published. I am seeking evidence of their mutual influence, and of Adler's self-transformation from actor to master teacher.

Several publications that might emerge from this research project. The first is an article on Adler herself; the second is an article about her volatile relationship with her husband; the third--and perhaps most immediately enticing--is the publication of the letters themselves.

Students interested in American history, theatre, women's studies, and biography might find this project of particular appeal.

Tasks will include:

- organizing documents photographed, scanned, or copied from the archive;

- transcribing handwritten letters and other papers;

- conducting historical research about the people and events mentioned in these letters (including famous figures in literature, theatre, music, politics, etc.).

This will result in an article and possibly a book-length project; student researchers would receive published acknowledgment.

URBAN STUDIES

Elaine Simon

Project 1: Making a Digital Exhibition: Demolition of University City High School as a Story of Urban Redevelopment and Contested Space

I took a series of photos of the demolition of University City High School at 36th & during the spring, summer, and early fall of 2015. The high school was one of 23 schools that the School District of Philadelphia, desperate for funds, closed in 2014, despite efforts by students and

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teachers to keep it open. It was built on a tract of land that was part of Penn's involvement in developing a science/tech hub during the 1960' urban renewal period. The school site was purchased by Drexel University and is now slated for another development into luxury housing, educational, and commercial uses. Using the photos that I took as one type of digital documentation, I would like to create a digital exhibition that adds historical and oral history materials to tell the story of the experience of urban spatial transformation juxtaposed with a depiction of how place is contested and the forces that account for that contestation.

I would like assistance both doing historical research and with digital collection and production. This would entail searching for image resources, including: pictures, drawings, photographs, maps, charts, etc. –and creating or locating audio resources such as music, speeches, interviews, and sound effects. I don't have a specific idea at this point of what the final product will look like, so I also welcome a creative student with skills in digital design and production to help in creating a visual exhibition. Through this exhibition, I would like to expose audiences to issues related to the impacts of urban redevelopment and public school closings such as gentrification, equity, and equitable access to opportunities in the city.

VISUAL STUDIES

Ian Verstegen

Project 1: Postmodern Arnheim

In 1974, psychologist Rudolf Arnheim published his classic Art and Visual Perception. A standard book used in art foundation courses, it nevertheless has an uneasy position in a postmodern art world. Often Arnheim's interest in the expressiveness of shapes and colors is labeled 'modernist,' and seen as contrary to the appropriation aesthetics following in the wake of Duchamp or Warhol. What is the relationship of formal elements and postmodern art? This PURM project is intended to address this question by cataloging the formal features of contemporary works, and explaining the relationship between the two aesthetics of modernity and postmodernity. After focused readings and discussions with the grant leader, the student will take part in a survey of art faculty at Penn and other artworld individuals in the Philadelphia area, and begin to compile a series of works that continue to utilize formal elements to develop postmodern contents. Once the series is complete, the student will lay out a website with the findings. This website will be useful to teachers around the world who want to begin to address postmodern concerns already in foundation year. This project is ideal for a student interested in fine arts, history of art, visual studies, with some digital skills in web design. The final project can be useful as a research or design project, for which the student can take credit.

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Dental Medicine

ORAL MEDICINE

Mel Mupparapu

Project 1: Impact of dental radiographic quality on patient treatment planning at Penn Dental Medicine

Dental radiographs constitute both intraoral and extra oral radiographs that are offered to the patients at Penn Dental Medicine. Due to the advances in technology, the film-based radiographs are now replaced with digital modalities like CCD/CMOS based sensors. Due to various technical and positioning issues, the radiographs may show errors in acquisition and do not entirely capture the objects of interest. These pitfalls may lead to inadequate treatment planning. The purpose of this research project is to look into the radiographic quality of images obtained at Penn Dental Medicine using the MiPACS system and investigate the most frequent causes for the errors and also figure out mechanisms to reduce or eliminate errors. The ultimate goal is to reduce radiation doses to patients and improve the quality of care at Penn Dental Medicine. The student will be trained in the identification of radiographic errors, MiPACS computer software & calibrated to assess the extent of errors. The project will require an IRB approval as patient data will be accessed remotely. Upon gathering the data pertaining to the radiographic pitfalls, it will be reviewed and conclusions drawn. The student will also be trained in accessing and viewing some clinical data (under faculty supervision) pertaining to the treatment planning. The impact of poor radiographic quality on the treatment planning decisions will be determined if any. This project might interest potential dental school applicants, but is open to all undergrads. Knowledge of basic computer applications like Word, Excel, power point and Photoshop are essential.

PATHOBIOLOGY

Nataliya Balashova

Project 1: Role of cholesterol in bacterial toxin binding to immune cell membrane

Kingella kingae, a Gram-negative bacterium of the Neisseriaceae family, is a normal inhabitant of oral cavity of children. Increasingly, K. kingae has been identified as a causative agent of skeletal and heart infections in children. K. kingae produces a toxin of RTX-group, RtxA that

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plays a key role in the organism virulence and can kill white blood cells. The mechanism of RtxA interaction with host cells has not been characterized yet.

Our studies will focus on understanding mechanisms of RtxA binding to cell membrane, a critical step in the action of toxins on immune cells. Some RTX-toxins have recently been shown to bind require cholesterol for binding with the host cell plasma membrane. Analogous to other RTX-toxins, RtxA contains putative cholesterol binding CRAC motifs. Through the use of defined toxin mutants we will identify RtxA CRAC elements required for the toxin binding and activity. Chemical cholesterol depletion of cells membranes, specific cholesterol inhibitors as well as blocking of CRAC sites will be used to investigate RtxA binding to cholesterol on human monocytes.

In this project the students will have the opportunity to learn techniques such as protein purification, cell culture, genetic experiments, data collection and data analysis. We are looking for a motivated pre-med or pre-dental student with some background and interest in biology. We anticipate that the initial summer project will lead to a long-term commitment and ultimately an authorship on a publication.

Project 2: Intracellular membrane damage by bacterial RTX toxins

RTX toxins are a family of membrane-damaging proteins secreted by Gram-negative bacterial pathogens. Many of these toxins specifically bind and kill immune cells expressing beta 2-integrins. Recent data indicate that RTX toxins could be delivered to the host cell lysosome by an endocytic pathway.

We hypothesize that toxins are able to damage the lysosomal membrane and release from the lysosome. The lysosomal membrane composition and environment facilitates membrane disruption. The toxin causes damage to other intracellular membranous organelles and plasma membrane after escape from lysosome.

The fluorescently labeled toxins will be used to analyze the toxins' intracellular trafficking. Using live confocal imaging we will follow toxins binding to organelle's membranes (mitochondria, lysosome, and nucleus) and lysis of cellular organelles in immune cells. We will also study the effect of toxins on gradient-purified organelles in vitro. SOFA (single organelle flow analysis) will be applied to sort purified and fluorescently labeled mitochondria and lysosomes by flow cytometry. In addition, the purified lysosomes will be analyzed by confocal microscopy and tested for Cathepsin D release after treatment with RTX toxins.

This project is ideally suited for undergraduate participation. In this project students can learn protein purification, cell culture, immunological approaches, microscopy, data collection and data analysis. We are looking for a motivated pre-med or pre-dental student with some

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background and interest in biology. We anticipate that the initial summer project will lead to a long-term commitment and ultimately an authorship on a publication.

Project 3: Antibiotic resistance in oral bacteria biofilms

The Gram-negative bacterium Kingella kingae is part of the normal oropharyngeal mucosal flora of children under four years old. K. kingae can enter the submucosa and cause infections of the skeletal system in children including septic arthritis and osteomyelitis. The organism is also associated with infective endocarditis in children and adults. Adherent communities of bacteria known as biofilms play a role in the pathogenesis of many chronic infections including skeletal infections and infective endocarditis. We found that biofilm formation is common among K. kingae clinical isolates. Bacteria that attach to a surface and grow as a biofilm may be protected from antibiotic killing. We would like to identify the level of antibiotic resistance, specifically to penicillins and cephalosporins, in K. kingae biofilms. This project is a part of collaborative study with CHOP.

This project is ideally suited for undergraduate participation. In this study students can learn such methods as bacterial culture, microscopy, antibiotic resistance identification, data collection, and data analysis. We are looking for a motivated pre-med or pre-dental student with some background and interest in biology. We anticipate that the initial summer project will lead to a long-term commitment and ultimately an authorship on a publication.

PREVENTIVE AND RESTORATIVE SCIENCES

Fusun Ozer

Project 1: Inactivation of matrix metalloproteinase-8 by extracellular Matrix Protection Factor-2 (ECPF-2) in dentin cavity walls

The exact mechanism by which the resin-dentin interface of the resin composite restorations fails to maintain an effective seal is not yet adequately understood. However, degradation of an exposed demineralized organic matrix of dentin at the cavity walls has been observed without the presence of bacteria, a determination has been made that endogenous, host-derived enzymes are responsible for the degradation of the dentinal matrix. Specifically, MMP-8, a collagenase enzyme, is believed to play the largest role in the degradation of the organic component of dentin, which is composed primarily of Type I Collagen fibers. However, certain MMPs also appear to have protective metabolic functions, unrelated to pathology of the extracellular matrix. Even today, most MMP Inhibitors are incapable of targeting specific MMP sites and enzymes,

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and instead inhibit multiple matrix enzymes, some of which are those enzymes exhibiting protective functions in various regions of the body. As a result, the contemporary focus has changed in the direction of first creating a more selective MMP Inhibitor, catered specifically towards pathogenically-acting MMP enzymes or pathogenically-acting MMP binding sites, and second towards localization of the therapeutic effect, in order to avoid unforeseen generalized/global consequences. The Matrix Protection Factor-2 (ECPF-2) peptides (subtypes 2a and 2b) being tested in this study are selective inhibitors of a single MMP substrate binding site, allowing each "inhibited" MMP enzyme to fulfill normal metabolic functions on alternative substrates within the tissue. This study will provide significant information to determine if selective inhibition of MMPs is effective in stabilizing resin-dentin interfaces including hybrid layer of cavity walls and dentinal bond strength after in vitro aging. The ECPF inhibition of MMP-8 will be translated to clinical applications by future development of a new resin bonding system, containing peptide inhibitors tailored to specific MMPs.

Project 2: Influence of PVM/MA copolymer on bacterial adherence to dentin and resin composite surfaces

The aim of this study is to investigate the effects of one-bottle adhesive bonding agents containing a copolymer of methylvinyl ether and maleic acid (PVM/MA) in preventing colonization of the dentin and resin composite material surfaces by Streptococcus mutans. Integration of PVM/MA into dentin bonding agents is hypothesized to reduce plaque retention by inhibiting the initial adhesion of bacteria to the bonding- treated dentin and resin composite surfaces. This proposed project is quite significant in integration of PVM/MA into an adhesive dentin bonding agent to develop a novel dentin bonding system that can reduce plaque retention by inhibiting the initial adhesion of bacteria to the bonding-agent-treated margins of restorations and dentin surfaces. The development of this new antibacterial bonding agent has the potential to make an impact on oral health care, in particular for the high-caries-risk patients (medically compromised, children, and elderly patients).

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Design

CITY PLANNING

Stefan Al

Project 1: Using Digital Mapping Systems and Unmanned Aerial Vehicles to Document South China's Informal Settlements

UN-HABITAT estimates that about a third of the developing world's urban population live in informal settlements, yet we know little about their urban structure. Recent developments in digital mapping systems and unmanned aerial vehicles allow for high-resolution digital imagery that could help create digital models and a database. I plan to use these new technologies to document informal settlements in South China in order to enhance our understanding and to raise awareness of residents' living conditions.

This research is an extension of my previous work about informal settlements. I recently published Villages in the City, a book about Chinese urban villages. Architectural Record named it "one of the best" books on informal urbanism, and "a fabulous piece of architecture and design graphica... The book succeeds by investigating and advocating for the informal without fetishizing it."

But the book's research was done in 2011, before UAV's were widely commercially available. With virtually no available government data about informal settlements, my research team had to manually create digital maps based on low-resolution aerial footage. This process was both time-consuming and led to relatively imprecise, granular maps. Moreover, the available aerial footage was often out-of-date. In contrast, UAV's provide high-resolution and up-to-date aerial footage at a relatively low-cost.

Students' duties would include making diagrams of informal settlements and building a digital database of 3D maps. Students would have to be familiar with graphic design software such as Adobe Illustrator.

Project 2: Sustainable Urban Form: A Comparative Analysis of Asian High-Density Blocks

This project aims to analyze existing high-density urban blocks in order to propose urban design guidelines that can shape rapidly developing Asian cities in a sustainable way. Throughout Asia's developing countries, as well as globally, there is a massive population movement from rural areas to cities. High-density urban form that promotes a high quality of life, equitable public realm, and optimal environmental performance is crucial in achieving a sustainable city.

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There is a massive population movement from rural areas to cities throughout developing countries, and in particular in Asia. For instance, China alone plans to add 90 million people to its cities by 2020 (Urbanization Plan 2014-2020). The United Nations Populations Divisions estimates that 93% of the world's urban growth will occur in developing nations, of which 80% will be occurring in Asia and Africa (UNFPA, 2007). Either existing cities could be densified, or new cities could be built. In either case, high-density urban form that promotes a high quality of life, equitable public realm, and optimal environmental performance is crucial in achieving a sustainable city.

The qualities of urban form can be measured. For instance, continuous street frontage, which contributes to making streets lively, can be calculated per block. The amount of publicly accessible open space can be measured per block, and point to the equity of the public realm. Moreover, recent environmental simulation software tools have made the analysis of wind, daylighting conditions and energy consumption of urban blocks easier.

Students' duties would include making diagrams of urban blocks and assist in analyses. Students would have to be familiar with graphic design software such as Adobe Illustrator.

Amy Hillier

Project 1: Experience of Transgender Youth in Philadelphia Public Schools

This participatory action research project aims to engage transgender youth from The Attic, a local LGBT center, in understanding the current experiences of other transgender youth in the Philadelphia public schools. Of specific interest are the resources and forms of support they find most helpful and the barriers or challenges to their full participation in school. Our research process will focus on interviews with youth and school administrators. This research will serve as a baseline for future research to evaluate the impact of a possible new School District policy to support transgender and gender non-conforming youth.

Megan Ryerson

Project 1: Incentivize it and they will come: How local governments are leveraging air service incentive programs to grow air service ***Rising Sophomores only***

Airport operators occupy the complex space between managing a major economic generator for their region and operating a piece of municipal infrastructure that generates significant environmental emissions. Airports make this complex tradeoff when deciding on funding and implementing Air Carrier Incentive Programs, which are municipal and airport-funded programs

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to waive fees for airlines launching new routes. In this work, an undergraduate research assistant will assist me in developing a methodology to estimate the air traffic, investment costs, and environmental emissions from new flights launched under air carrier incentive programs. The research assistant will also assist with understanding the economic value of incentivized flights.

I am looking for an undergraduate to assist me in expanding on my baseline work in this exciting new area of transportation research. The student will be responsible for 1. Collecting data on air service incentive programs (using library resources and contacting airports); 2. Merging the data from (1.) with large publicly available aviation databases; 3. Estimating the cost, pollution, and economic benefits from incentivized flights using data and statistical methods. The student would be expected to perform these duties and to help prepare a document discussing the method and the results.

I am looking for a student with an understanding of statistics, an ability to code in R or to learn quickly, and a passion for transportation and aviation economics, operations, and policy. I am also looking for a student who is comfortable working on a diverse team and presenting results to different transportation audiences. This project is an exciting opportunity for a student who is interested in transportation operations, transportation policy, and analytical methods.

DEPARTMENT OF CITY & REGIONAL PLANNING
PROGRAM IN HISTORIC PRESERVATION

Francesca Russello Ammon

Project 1: Historic Preservation in Philadelphia and Beyond

The Athenaeum of Philadelphia is interested in developing an exhibit on the history and legacy of Charles Peterson, the founder of historic preservation, to open in fall 2016. Peterson was critical to the founding of the Historic American Buildings Survey (a National Parks Service organization that practices preservation through documentation), the postwar urban renewal of Philadelphia's Independence Mall and Society Hill neighborhood, and the establishment of historic preservation on the federal policy stage. The opening of the exhibit will coincide with both the 100th anniversary of the National Parks Service and the 50th anniversary of the Historic Preservation Act of 1966. Over the course of the summer, the selected student will work on the research for this project—both at the Athenaeum and in other local archives—and the development of the exhibit itself. The final product will curate a range of information and objects, ranging from archival documents to visual media. This project is especially well suited

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to students interested in urban history, public history, historic preservation, and exhibition design.

FINE ARTS

Kenneth Lum

Project 1: Artist assistant: Layout assistant-presentation visualizer

I am in need of a student versed in graphic layout and design for the production of text based works of art as well as for the composing of presentation dossiers for art presentations. A student should also have some skills in visualizing software, again to assist in the conceptualization of works of art.

LANDSCAPE ARCHITECTURE & REGIONAL PLANNING

Raffaella Fabiani Giannetto

Project 1: Georgic Grounds and Gardens: From Palladio's Villas to American Plantations

Georgic Grounds and Gardens: From Palladio's Villas to American Plantations is a book manuscript that examines the gardens--both those on paper and the actually planted--and productive grounds of Andrea Palladio's villas in Renaissance Veneto and their reception in the similarly productive and Neo-Palladian contexts of 17th- and 18th-century England and colonial America. The main objectives of this project are the following:

a) to contrasts Palladio's gardens with contemporary gardens of central Italy—so far the subject of more critical studies;

b) to investigate the English response to the challenge of missing garden instructions in Palladio's architectural treatise, the Quattro Libri and,

3) to show that the legacy of Palladio vis-à-vis American gardens does not consist in the imitation of his garden layouts, as has been claimed, but rather in the appropriation of the classical villa culture in which his gardens participated.

Highlighting regional distinctions in the gardens of Italy and investigating the role of England in the transmission of villa culture from Italy to America allow for both a more nuanced approach to the study of the reception of Italian gardens abroad and a more accurate rewriting of a chapter of American garden history.

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I seek an undergraduate research assistant whose primary responsibilities would include acquiring primary and/or secondary sources by searching library databases and/or archives; compiling and updating a bibliography; keeping correspondence with image copyright holders. The ideal candidate is a student who has taken (or is going to take) courses in Art History; Romance Languages; History; English; Architecture or Landscape architecture. Knowledge of Photoshop (scanning images at high resolution) is desired and a reading knowledge of Italian is preferred (but is not indispensable).

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Education

APPLIED PSYCHOLOGY & HUMAN DEVELOPMENT

Kelsey Jones

Project 1: Time for Reflection: Using Children's Literary Magazines to Improve Racial Literacy in Schools and at Home

Reflections is a literary magazine that seeks to build children's racial literacy skills using developmentally appropriate approaches to tackling the daily racial issues children face. Reflections encourages the building of traditional literacy skills through non-fiction and fiction stories, engages children in conversations about day-to-day and broad racial conflicts through interactive and multi-modal activities and games, and provides young people with strategies for managing racial stress. Children also need support from adults as they develop a deeper understanding of racial issues; two "Grown Up Guides" accompany each issue of Reflections, providing a step-by-step guide for caregivers and educators who want to use the magazine to begin and sustain difficult and important conversations about race. These guides include conversation prompts, suggestions for classroom lessons and activities, in-school and at-home exercises, and tips for helping children manage racial stress.

Undergraduate researchers selected for this summer project will work closely with a postdoctoral fellow and a team of graduate students. You will be responsible for creating material for the magazine including stories and activities for children as well as material for the supplementary adult guides using theories focused on developmental psychology, race in education, and teacher education. You will also learn how to conduct rigorous qualitative research; specifically, you will be asked to develop protocols for interviews and focus groups with children, caregivers, and educators using data from larger surveys. There will also be opportunities to contribute to publications with potential for authorship for undergraduate researchers who show deep commitment to the project.

Howard Stevenson

Project 1: EMBRacing Black Familial Racial Stress: Improving Racial Socialization Competency

The EMBRace (Engaging, Managing, and Bonding through Race) family clinical intervention seeks to increase racial socialization (RS) competence (or the way parents teach their children about the racial world around them) to improve the quality of Black parent-adolescent relationships. Competent families who problem-solve difficult racial experiences can

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demonstrate improvement in family accord, academic achievement, and psychosocial well-being. RS training for family dynamics includes skills development of RS knowledge, stress management, and coping as well as delivery skills of affection, protection, and correction.

For undergraduate researchers interested in clinical/community/developmental psychology, families, and/or race, our summer project offers the opportunity to contribute meaningfully to the continued development and implementation of EMBRace while building expertise in applied psychology theories. Working closely with a postdoctoral researcher, you will have the opportunity to develop a qualitative and observational coding scheme that will help to establish themes within Black family communication. This project offers authorship opportunities on forthcoming papers and reports and hands-on experience with data analysis and software. There are also opportunities to develop creative marketing tools for EMBRace, such as training videos, media (e.g., commercials), and to display for conferences.

EDUCATION, CULTURE, & SOCIETY

Krystal Strong

Project 1: Political Training Grounds: Youth, Democracy and Pedagogies of Politics in Nigeria

With limited opportunities to participate in Nigeria's troubled political system, which only recently transitioned to constitutional democracy in 1999, university students believe the campus is a "political training ground" for experimenting with democracy and acquiring leadership experience. For over three years, I conducted ethnographic fieldwork on campuses in southwestern Nigeria among student "politicians," who were in the process of developing what I conceive of as "professional" political identities, after students had for generations acted as agitators against the military state through radical student activism. I invite a dynamic student interested in issues related to education, political leadership and activism, and democracy to contribute to the development of a book manuscript based on this research, which is tentatively titled, "Political Training Grounds: Students and the Future of Post-Military Nigeria." Specific tasks will include transcription of audio and video interviews; data cleaning, coding and analysis; and, depending on familiarity with film editing, basic editing of a documentary film project based on this work. This experience will introduce the student researcher to fundamental components of ethnographic and international research with prospects for further participation on this and future projects related to student leadership in Africa (Nigeria, Kenya, and South Africa) and the United States.

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EDUCATIONAL LINGUISTICS

Betsy Rymes

Project 1: Using Research in Sociocultural Linguistics to Engage All Learners in the English Language Arts Curriculum

The goal of this research is to reduce inequality in youth outcomes by bridging the gap between sociocultural linguistic research and the practice of Language Arts teachers. I am currently investigating how the high school Language Arts classroom potentially can make multiple varieties of speaking—and attitudes about those varieties—visible. I am also studying how that new language awareness can enhance the study of the Language Arts curriculum. To do so, I hope to draw attention to the variety of experiences and ways of speaking that make up all students' everyday lives, bringing Language Arts students who usually don't talk about each others' language differences into conversations about their language.

Student researchers will be directly involved in the following activities:

1) Identifying, through participant/observation in 11th grade classrooms, potential connections between students' language practices, sociocultural linguistic research, and curricular goals;

2) Collaborating with researchers and with high-school teachers to create and co-teach lessons that integrate knowledge of sociocultural linguistics into the curriculum, designing modules that will will help students

a. explore language around them

b. build connections to each others ways of speaking

c. build connections to literature in the curriculum

d. develop an inquiry stance toward language by conducting exploratory language research as "Citizen Sociolinguists."; and

3) Working with teachers and the researcher to understand the best way to build modules that both

a. build a foundation for citizen sociolinguistics starting; and

b. account for the range of approaches teachers might take across "tracked" classrooms.

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Students will need to have some working knowledge of sociolinguistics, interest in teaching and education, and be able to travel by train to Swarthmore for teaching and observation of courses in the Swarthmore/Wallingford school district.

HIGHER EDUCATION

Marybeth Gasman

Project 1: Hispanic Serving Institutions: Pathways to the Professoriate

This project is funded by the Mellon Foundation at $5.1 million. It is focused on moving Latino junior at Hispanic Serving Institutions into Ph.D. programs at research institutions and then on to the professoriate. We are running the programming and also working on a longitudinal assessment of the students and faculty involved in the program. There are opportunities to be involved on the ground level of this study.

Project 2: Historically Black Colleges and Universities: Leaders and Teachers in STEM

This project is funded by the Helmsley Trust at $1.5 million. It is focused on identifying success models in science, technology, engineering, and math to help students and institutions across the nation. There are opportunities for research, coding, writing, and other aspects of research.

David Grossman

Project 1: Course Design: Social Justice Education

Students at Penn committed to social justice engage through a variety of means, including courses (such as Academically-Based Community Service courses and traditional courses related to specific topics); specific community service or advocacy activities, and involvement in forums across campus where pressing issues are discussed, to name a few. But there does not exist a course – or, more importantly, a developmental set of courses – that focus on praxis (the linking of theory and practice) through which students can combine their engagement and learning across issues of interest over time. We envision researching and constructing courses that will enable students to integrate and cultivate their academic and community experiences at every level of their undergraduate studies.

The PURM student researcher would support the faculty mentor in researching pedagogical practices, curricula, and Penn's earlier work in this area – including an extensive, year-long planning process through which Civic House has already initiated some of this work. The

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student researcher would have the opportunity to consult with Penn faculty, staff, students, and community partners, as well as educators at other colleges and universities. The student will gain experience in basic library research, service-learning pedagogy (and general pedagogy), and in interviewing faculty, staff, students and community partners. The ideal applicant will be well-organized, possess demonstrated research and writing skills, and have a demonstrated interest in education, social justice, and civic engagement.

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

While Penn students have numerous opportunities 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 they 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 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, staff, students at Penn and elsewhere and potential community partner organizations. The ideal applicant will be well-organized, possess demonstrated research and writing skills, and have a demonstrated interest in education, social justice, and civic engagement.

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

The University's self-study in support of its decennial accreditation in 2014 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.

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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, although not required) to help illustrate the above-mentioned connections and to assist the faculty mentor in developing recommendations for future practice and research. The ideal applicant will be well-organized, possess demonstrated research and writing skills, and have an interest in civic engagement in higher education.

READING/WRITING/LITERACY

Amy Stornaiuolo

Project 1: Write4Change: An online global writing community for youth

We are looking for an undergraduate researcher interested in international education, educational social media, writing, and social justice to join our collaborative research team. We are both developing and studying a global writing community for youth called Write4Change, which links adolescents who are writing to make an impact on their communities and the world more broadly. Currently connecting over 130 young people in six countries (South Korea, the US, Wales, Canada, Pakistan, India), we are growing the community and designing a multilingual web-based platform that integrates collaborative composing tools, visualizations, and mechanisms for sharing and interacting with other users around the world. We are looking for someone to join our team during this development phase, particularly for the summer expansion of the project to US based writing camps affiliated with the National Writing Project. The summer internship will involve working with a local writing camp (affiliated with the National Park Service) as a field researcher, acting as a researcher and facilitator in the online Write4Change community, attending weekly research meetings with the international and local research team, participating in data analysis and grant writing, and engaging with the team in designing the new platform.

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TEACHING, LEARNING, & LEADERSHIP

Rand Quinn

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

The goal of this project is to chronicle San Francisco's long struggle over school desegregation in the powerful wake of Brown v. Board of Education. In doing so, we will examine the trajectory of student assignment from a remedy for state discrimination to a tool for achieving diversity.

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 and other stakeholders; (3) cataloging past and present school district student assignment policies and schemes; (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; and (5) providing other research assistance, as needed.

Project 2: Logics of school reform: Portfolio management in Philadelphia

The goal of this project is to assess public engagement on portfolio management reform for Philadelphia schools. We will focus on the sets of practices, ideas, and values held by community stakeholders regarding market-based reforms in education, and how they shape policy problems and solutions. Primary duties include: (1) conducting a literature search; (2) coding interviews conducted with educational influential in Philadelphia; and (3) providing other research assistance, as needed.

Project 3: Understanding the Network Evolution of Charter School Philanthropy

We will examine the manner by which charter philanthropic networks have evolved since the founding of the charter management organizational form. Primary duties include: (1) conducting a literature search on private philanthropy and charter schools; (2) constructing a panel dataset of charter school philanthropy; and, (3) Provide other research assistance, as needed.

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Engineering and Applied Sciences

BIOENGINEERING

Jason Burdick

Project 1: Shear-thinning and Injectable Hydrogels for Tissue Repair

We are designing a class of materials that have shear-thinning and self-healing properties that allows us to inject the material via a syringe directly into tissues. These materials are engineered to act as controlled release carriers for either therapeutic molecules or for cells that can aid in tissue repair. A student working on the process would be involved in characterizing properties such as the viability of entrapped cells, the release profiles of single or multiple therapeutics, and the properties of the materials that would permit injectability. Part of this project may also involve the use of the material in 3D printing applications where the hydrogel acts as the ink in printing of tissue constructs.

Christopher Fang-Yen

Project 1: Microfluidic assays for touch sensation in C. elegans

Touch may be the least understood of all the senses. In collaboration with Martin Chalfie (Columbia University) we are using engineering, imaging, genetic, and computational approaches to investigate the underpinnings of the touch sense in the model roundworm C. elegans. The student will develop and apply a novel microfluidic device to assay touch response behavior in normal and mutant worms. The student will learn how to culture and maintain worms, design and fabricate microfluidic devices, use a microscope to record behavioral movies, and analyze data using MATLAB.

Project 2: Investigating lifespan and healthspan using the WorMotel

Understanding the mechanisms responsible for aging, and discovering means by which aging can be slowed, is a problem of enormous medical and biological importance. We are using engineering, imaging, genetic, and computational approaches to study the biology of aging in the model roundworm C. elegans. In this project, the student will use a novel microfabricated 'WorMotel' multi-well device for imaging hundreds of worms simultaneously to investigate how anti-aging treatments affect the worms' lifespan and healthspan. The student will learn how to culture and maintain worms, fabricate and fill WorMotel devices, operate a worm sorting machine, use an imaging system to record behavioral data, and analyze data using custom MATLAB software.

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Project 3: Controlling the mind of a worm using light

The roundworm C. elegans is an attractive model for understanding how neural circuits create behavior, because of its compact, well-mapped nervous system containing only 302 neurons. The student will conduct behavioral experiments using optogenetics-- a method for controlling neural activity with light-- to help decipher how the worm crawls and swims through different environments. He/she will learn how to culture and maintain worms, set up imaging chambers devices, use a microscope to record behavioral movies, and analyze data using custom MATLAB software.

Daniel Hammer

Project 1: Engineering self-assembly of protein nanostructures

Protein self-assembly is ubiquitous in nature. The aim of this project is to harness naturally occurring proteins to engineer novel self-assembling nanomaterials, such as vesicles. These nano-structures could be used for practical applications, such as targeted drug delivery. The summer student will become proficient at molecular biology techniques, such as cloning and protein purification, and will also have the opportunity to use advanced imaging technologies.

Brian Litt

Project 1: MatLab Analytics Toolbox for IEEG Portal

The IEEG.org portal is a cloud-based data storage and analysis platform for interfacing with large time-series datasets, primarily of neurophysiological origin such as EEG. Accordingly, the IEEG.org portal offers the community an unprecedented opportunity for large-scale, reproducible, and collaborative analysis - critical in this era of increasingly complex and expensive studies and analyses. The goal of this project is to facilitate the analysis of data on the Portal by developing a Matlab toolbox to quickly interact with, annotate, and analyze neurosignals in a standard way. Applicants should be familiar with object-oriented programming, with experience writing in Matlab and an ability to work in a team environment. Students may expect to develop experience with cloud-based tools, team-based software development, Matlab, Java .mex development, signal processing and basic machine learning.

Project 2: Characterization of transparent graphene devices for interfacing with "living electrodes"

The development of implantable devices to record and stimulate neural circuits has led to breakthrough discoveries on the connectivity and functionality of the brain in healthy and diseased states. Despite the great advances of implantable electrode technologies, however,

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spatial resolution is still inadequate to resolve the dynamics of the neural circuits over large brain areas. Optical recording techniques based on calcium or voltage sensitive fluorescent probes now allow monitoring up to thousands of cell simultaneously. However, these techniques do not provide the necessary temporal resolution to decode the firing patterns of the neural networks.

We have developed novel transparent electrodes for simultaneous electrophysiological and optical recording. These electrodes are composed by a thin layer of a graphene, a highly conductive, flexible and transparent material. In collaboration with Cullen lab we will use these devices to interface with "living electrodes," 3-D scaffolds of neural cells to be implanted in vivo for neuromodulation of host neural networks.

The project will require electrode assembly, characterization of the in vitro electrochemical properties and fitting the acquired data with models to determine the equivalent circuit parameters of the contact impedance between the electrodes and the neural tissue. The project will also require analyzing the in vivo electrophysiological and optical recordings using Matlab codes.

Andrew Tsourkas

Project 1: Developing transferrin receptor bispecific antibodies that cross the blood brain barrier

Monoclonal antibodies represent one of the most important and successful strategies for treating patients with cancer, inflammation, autoimmunity, and various other diseases. However, their ability to treat diseases of the central nervous system (CNS) has been severely limited due to their inability to traverse the blood-brain-barrier (BBB). One approach that has shown promise in facilitating the delivery of antibodies across the BBB utilizes the transferrin receptor (TfR) to drive receptor-mediated transcytosis. However, current methods for making “bispecific antibodies” that can independently target both the TfR and a disease biomarker within the brain are technically challenging, requiring months to years to develop. Recently, we developed a technique that allows for the production of bispecific antibodies in less than a day. We would like to extend this approach and create a universal platform that can rapidly convert any off-the shelf antibody into a bispecific antibody that can traverse the BBB.

Students working on this project will use genetic engineering approaches to create unique fusion proteins that can site-specifically and covalently label the constant region of full-length antibodies. The fusion protein will include a TfR-targeting domain that will drive transcytosis. The final bispecific antibody constructs will be tested in a cell culture system to assess the efficiency of crossing brain endothelial cells that have formed tight junctions. The student will be

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closely monitored by a post-doctoral fellow in the lab. Experience with PCR, ligations, transformations, and other basic molecular biology techniques are preferred.

Beth Winkelstein

Project 1: Biomechanics of Painful Injury

The only prerequisites are having an interest in mechanics and quantification of physics. The student will assist with acquiring and analyzing a host of biomechanical measurements ranging from those on tissues to those on human volunteers as well as cells. A willingness to perform digitization and/or matlab would be a plus - we can teach how to use Matlab and other software packages but there should be an interest in understanding how the body moves, how it can become injured and how those measurements relate to other physiological outcomes. Having an engineering or physics background would be preferable. Responsibilities include assisting with experiments and analysis as well as performing computational routines. Must be willing and able to work with a team.

Project 2: Neurophysiology of Pain

This project involves the integration of neurophysiology and cellular assays in the context of pain. Some work may include assisting with performing electrophysiological experiments to quantify neuronal responses in vivo. Definitely, will include performing analysis of those data - but we are willing and able to teach the student how to do that. Our lab focuses on defining the mechanotransduction pathways which lead pain and incorporates pain assays with cellular assays and neurophysiological techniques. No experience necessary but there should be an interest in understanding the nervous system and a willingness to work hard. A background in bioengineering and/or biology is preferable but not necessary. Responsibilities include assisting with experiments and analysis as well as the possibility of performing wetlab techniques like PCR, Western Blot, and immunohistochemistry. Must be willing and able to work with a team.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Ravi Radhakrishnan/Whelton Miller

Project 1: Modeling Coordinated Regulation of Autophagy and Translation

Cellular regulatory systems are complex, and we lack a predictive understanding of how system-level properties depend on molecular properties and molecular interactions. These interactions can now be manipulated clinically using molecularly targeted drugs, such as protein kinase inhibitors, but because of the aforementioned complexity, the best therapeutic strategy for

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intervening to alter the behavior of a (dysfunctional) regulatory system is often unclear. To address this capability gap, we propose to formalize mechanistic knowledge about an important cellular regulatory system, the molecular network controlling autophagy and translation/protein synthesis, to obtain computational models capable of providing causal explanations for empirical observations and of making testable non-obvious predictions and thereby guiding experimental investigations. It is expected that modeling will be informed by data obtained through established experimental collaborations, such as measurements of site-specific post-translational modifications (PTMs)1. The immediate goal of the proposed project is to understand the effects of feedback and feedforward loops on activation of autophagy and repression of translation.

The overall objective is to create a core C/C++ code that will analyze 3D chemical data. The student(s) will also have the task of compiling data from previous projects. The student(s) will submit an abstract to a local American Chemical Society (ACS) meeting. Upon acceptance, the student(s) will present a poster. If significant progress is made, an article will be submitted for publication. Initial targets for publications will be peer-reviewed journals. Programming (C/C++), and Linux command-line experience will be necessary for successful progress.

Project 2: Development of Computational Tools for 3D Analysis of Protein-Protein and Protein-Ligand Interactions

Identifying principle interactions for rational drug design is critical to the design of these second-generation compounds. One method is the use of shape similarity comparison methods, as well as identifying other similar aspects e.g. electrostatic potential. We hope to develop an alternative method using structural identification techniques to identify similar aspects of potentially active compounds, in particular their shape and orientation in the binding pocket. The goal of this study is to not only to understand the relationship between the various protein mutations, their structure and function in the ligand protein interaction, but to recognize a potential pattern based on mathematical modeling, capturing the structural information with the aim to understand those interactions. We plan to work on developing a new method based on shape similarity as well as molecular behavior; and in the process develop a chemical database of active ligands organized according to their potential protein interactions. Developing this technique will focus on chemical structure, as well as molecular orientation.

The overall objective is to create a core C/C++ code that will analyze 3D chemical data. The student(s) will also have the task of compiling data from previous projects. The student(s) will submit an abstract to a local American Chemical Society (ACS) meeting. Upon acceptance, the student(s) will present a poster. If significant progress is made, an article will be submitted for publication. Initial targets for publications will be peer-reviewed journals. Programming (C/C++), and Linux command-line experience will be necessary for successful progress.

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COMPUTER AND INFORMATION SCIENCE

Norman Badler

Project 1: Animating Individuals in a Community *Rising Juniors only*

Create knowledge bases and animate simulated human activities in an urban or community context. The environments may be ancient (such as an archaeological site), historical (someplace interesting), or modern (such as the Reading Terminal Market in Philadelphia). Various research components contribute to this goal, including directed simulation, interactive virtual reality, mechanisms and types of person-to-person interaction, user presence as a participating agent, modeling appropriately attired and outfitted human models, human responses to environmental conditions, and agent behavior authoring (user interface) tools. The student will work with 3D modeling tools and our own population animation system to model, simulate, and integrate individual and group behaviors on a community-wide scale. The student will work in a team with other computer science students and use in-house and commercial computer graphics and animation software. Computer programming experience is required. The student will benefit from working in an interdisciplinary team, building a real application system, exposing new problems to resolve, and contributing to publications.

Stephen Lane

Project 1: Investigation of Subliminal Eye Tracking for Virtual Reality (VR) Applications

Currently there is a great deal of interest in creating "immersive cinema" experiences in which the user views and interacts with 3D content using a head-mounted virtual reality display (HMD). Unlike traditional filmmaking where the director creates a visual narrative by effectively positioning and orienting the camera in order to focus the viewer's attention on objects of interest in the scene (e.g. characters, events, actions, etc.), in immersive filmmaking the director has no direct control over where the user looks or what they see. That is, although the director can position the camera in a 3D scene, it is the user who determines what is of interest and how they should move their head and eyes to focus their attention on the associated objects of interest in the scene. As a result, one of a director's main visual story telling tools (i.e. creating visual sequences through positioning and orienting of the camera) is considerably impaired and/or limited when creating immersive cinema experiences.

This project intends to address this limitation by investigating how state-of-the art eye tracking technology, in conjunction with visual stimuli presented to a user in a head-mounted display system, can create subliminal visual cues that direct the user's focus of attention to particular locations in a scene (without the user consciously knowing why they looked at the object and/or

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location). User focus of attention will be determined by the gaze direction of the eyes. As part of the project an HMD device will be retrofitted with eye tracking capabilities and various visual stimuli parameters (i.e. shape, color, texture, animation, etc.) will be modified to determine their effectiveness in directing the user's focus of attention to particular locations as a function of eye sacade distance (i.e. angular separation between fixation points), background color, background textures and lighting. Successful completion of the project will provide directors with a new set of visual story telling tools for effectively directing user's focus of attention in immersive cinema experiences.

ELECTRICAL & SYSTEMS ENGINEERING

Cherie Kagan

Project 1: Photophysics of Two-dimensional Organic-Inorganic Hybrid Perovskites

Organic-metal halide hybrid perovskites are an attractive material for the study of fundamental physical and chemical processes as well as engineering next-generation electronic devices. Efficiencies of perovskite solar cells are already greater than 20%, approaching the efficiency of conventional silicon solar cells. Additionally, perovskite solar cells are able to be fabricated using low-cost solution processing, which has the potential to greatly reduce the cost of solar energy. While most of the community is focused on fundamentals and applications of the 3D perovskite methylammonium lead iodide, by replacing methylammonium with a larger organic cation, a layered 2D quantum well structure spontaneously forms. The increased quantum confinement leads to a large exciton binding energy as well as atypical dynamics for relaxation of photoexcited charge carriers. At low temperature, we have demonstrated that hot photoexcited electrons and holes fluoresce before relaxing to the lowest excited state. By manipulating the stoichiometry of the organic and inorganic components of the perovskite, the layer thickness can be increased, allowing the thickness of the inorganic framework to be tuned from a single layer to bulk 3D perovskites. We aim to understand the fundamental physical and chemical properties that govern the charge carrier dynamics in these reduced dimensional systems.

A PURM student will work under a Ph.D. candidate in the Kagan Lab and will synthesize many organic-metal halide hybrid perovskites as well as perform spectroscopic and electronic characterization of the synthesized materials. The student will learn how to synthesize perovskites, use various optical and electronic spectroscopic techniques including UV-Visible absorption and Fourier-transform infrared spectroscopy, photoluminescence, and photoconductivity, and work up the data to eventually be included in a publication.

Students in chemistry, physics, materials science and engineering, or chemical engineering.

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MATERIALS SCIENCE AND ENGINEERING

Russell Composto

Project 1: Antibacterial properties of metal ions in oral microbial system ***Rising Juniors only***

A current research project in our laboratory is focused on dental plaque, the community of microorganisms that creates a biofilm on teeth. How this biofilm grows on a pellicle consisting of charged polymers is an important topic in preventive dentistry. Our goal is to understand fundamental properties of biofilms formed on hydroxyapatite surface (HA is as a biomimetic ceramic similar to bone and enamel) and develop new methods to enhance the bactericidal activity of antimicrobial agents to prevent biofilms from growing. First, students will grow dental plaque on HA surfaces and study fundamental properties of dental plaque such as growth rate and viscoelasticity. In addition, antibacterial properties of metal ions against dental plaque will be studied. Lastly, HA nanocrystal coating will be processed using biomimetic mineralization methods and characterized to determine if their structure is similar to the native HA ceramic. Experience with biofilms and materials characterization tools is desired. Adequate training for basic characterization will be provided.

Project 2: Solvent Annealing of Polymer Nanocomposites

Polymer nanocomposite materials, materials consisting of nanoparticles surrounded by a polymer matrix, are promising materials for airplanes, solar cells and electronics. The properties of polymer nanocomposite materials depend on the position of nanoparticles in the polymer matrix. When polymer nanocomposite materials are fabricated, often times the nanoparticles do not have the desired position in the polymer matrix. One approach to control nanoparticle position in polymer nanocomposites is to expose a polymer nanocomposite to a solvent, a process called solvent annealing. The solvent swells the polymer nanocomposite and the nanoparticles diffuse to the desired position. The objective of the project is to study solvent annealing of polymer nanocomposites. The project entails fabricating, solvent annealing and then characterizing polymer nanocomposites. To fabricate the nanocomposites nanoparticles will initially be prepared. Since the student working on the project will be involved in every aspect of it, from nanocomposite fabrication to data analysis and interpretation, this project will be an experience that will help the student design and implement their own research projects in the future.

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MECHANICAL ENGINEERING AND APPLIED MECHANICS

Paulo Arratia

Project 1: Swimming Microorganisms in Chaotic Flows

The main goal of this proposal is to develop fundamental understanding on the effects of flow velocity and shear stresses on the transport, mixing, and swimming dynamics of self-propelled microorganisms. These effects will be experimentally investigated in well-controlled time-periodic flows performed in an electromagnetically driven thin fluid layer placed atop an array of magnets. The knowledge obtained from the proposed work can be potentially useful for the successful design of controllable underwater autonomous vehicles (micro-swimming robots), the prevention of waterborne disease outbreaks associated with drinking water, and development of accurate models for the dispersion of planktonic matter in oceans.

Robert Carpick

Project 1: Investigating mechanisms of lubricant additives using the Atomic Force Microscope

The efficiency and reliability of large and complex mechanical systems is fundamentally dictated by the material and mechanical performance of the numerous contacting surfaces in relative motion comprising them. Intrinsically, friction and wear at these macroscale contacts results from the mechanics and chemistry of discrete atomic and nanoscale interfaces. In addition to inherent challenges associated with probing the nanoscale, a fundamental constraint in understanding interfacial phenomena is the inability to directly probe a buried sliding interface. The advent of the Atomic Force Microscope (AFM) has greatly advanced our ability to probe nanoscale phenomena while also tracking the topology of the buried interface. Employing the AFM as a ‘nanotribometer’, our lab has already gained valuable insights into how conventional lubricant additives operate (Gosvami and Carpick et al., Science 2015). A key focus of our current research is furthering this understanding of conventional additives as well as identifying novel materials for the next generation of high performance lubricant additives.

The incoming undergraduate researcher will assist an existing postdoctoral researcher by conducting hands-on experiments on an AFM, and potentially other complementary lab instruments, in addition to conducting data analysis on a range of software, including MATLAB, etc. This research is heavily focused on publication and there will be opportunities for co-authorship on peer-reviewed journal articles as well as presenting at research symposia. Prior experience operating an AFM is not a prerequisite for this position.

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Katherine Kuchenbecker

Project 1: Exploring Human-Robot Interaction Experimental Data

The Penn Haptics Group seeks an undergraduate student to help analyze datasets gathered by our haptic human-robot interaction researchers. This team has explored aspects of human-human and human-robot hand-clapping by gathering data from a variety of interaction experiments. These datasets have yielded some results, but part of the gathered movement data (hand position, velocity, and acceleration over time) has not yet been analyzed. An undergraduate researcher could help us discover trends in this data to improve our scientific understanding of social motor coordination.

A student working on this project would have the opportunity to augment their MATLAB and/or Python scripting skills. They would also get to test different machine learning techniques throughout the data analysis. Programming and machine learning skills are valuable in today's job market, as well as in many engineering courses. This student would have access to existing data processing pipelines, but their summer task would be to build on these algorithms and try new data processing techniques on the experimental datasets. The PhD student who gathered this data would mentor the PURM student throughout this process, as would Professor Katherine Kuchenbecker, the PI of the Penn Haptics Group.

Additionally, all students working in the Haptics Group have opportunities to network at weekly lab meetings, occasional seminars, and other research-related events. The PURM student's main contribution would be to this project, but they would be exposed to other exciting haptics research and have chances to engage with other researchers in our lab as well.

Project 2: Designing Interactions with the Baxter Research Robot

The Penn Haptics Group seeks an undergraduate student to help design human-robot interactions with the Rethink Robotics Baxter Research Robot, a human-sized humanoid robot that is inherently safe and collaborative. A PhD student on the haptic human-robot interaction research team has programmed this robot to play simple hand-clapping games with humans. Such abilities can be expanded to additional interaction scenarios, from simple high-fives to complicated physical therapy interactions. An undergraduate researcher could help us explore and implement new interaction possibilities on the Baxter robot.

While designing human-robot interactions, a student working on this project would learn about the state of the art in human-robot interaction. They would also engage with the Baxter software development kit (SDK), including learning Robot Operating System (ROS), one in-demand skill for modern roboticists. Existing project code libraries would serve as a cornerstone resource, but by the end of the summer, the PURM student would be expected to write software to accomplish a new Baxter interaction behavior. The PhD student who designed the existing hand-clapping

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interaction would mentor the PURM student throughout this process, as would Professor Katherine Kuchenbecker, the PI of the Penn Haptics Group.

Additionally, all students working in the Haptics Group have opportunities to network at weekly lab meetings, occasional seminars, and other research-related events. The PURM student's main contribution would be to this project, but they would be exposed to other exciting haptics research and have chances to engage with other researchers in our lab as well.

Changchun Liu

Project 1: Smart Pipette: A Device for Rapid Plasma Separation at the Point of Care

Plasma extraction or separation from raw whole blood is usually required for blood-based clinical diagnostics. Centrifugation is one the most widely used methods for plasma separation in biomedical laboratories. However, centrifugation is not suitable for on-site or bedside applications. Recently, our lab has developed a superhydrophobic plasma separator for point of care diagnostic application (Changchun Liu et al., Lab Chip, 2016,16, 553-560). In this project, we further propose to design, fabricate and test a new, simple, smart pipette for rapid (≤3 min) plasma separation. The PURM student will primarily: 1) design and optimize the smart pipette with the Solidworks software, 2) fabricate the device using either 3D printing technology at the MEAM AddLab or laser cutting technology at the MEAM shop, and 3) test the device with a post-doctoral researcher. Prerequisites: Experience in Solidworks software is helpful.

Project 2: Smartphone-based Multiplex Molecular Diagnostics

Nucleic acid amplification-based diagnostics offer rapid, sensitive, and specific means for detecting and monitoring the progression of infectious diseases. However, this method typically requires extensive sample preparation, expensive instruments, and trained personnel. All of which hinder its use in resource-limited settings, where many infectious diseases are endemic. Our lab has demonstrated a minimally-instrumented, chemical heating, smart cup for point of care molecular diagnostics (Shih-Chuan Liao, et al., Sensors and Actuators B: Chemical, 2016, doi:10.1016/j.snb.2016.01.073). In this project, we propose to program a smart phone for multiplex molecular diagnostics based on our current smart cup molecular diagnostics platform. The PURM student will primarily: 1) develop a smart phone app based on Android platform for fluorescence detection, image processing and data analysis, and 2) evaluate and test the app's performance in multiplex molecular diagnostics. Prerequisites: Experience in smart phone app development is helpful.

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Kevin Turner

Project 1: Robotic grippers based on switchable adhesive surfaces

Insects and lizards, such as the gecko, achieve adhesion to a wide variety of surfaces via gripping pads that are covered with micro- and nano-structures. These small-scale structures result in adhesion that is strong and switchable, i.e. can be changed from strong to weak through direction of loading. We have recently developed synthetic micro-structured polymer adhesives that offer strong and switchable adhesion, similar to the gecko. The objective of this summer undergraduate research project is to design, fabricate, and test robotic grippers based on these microstructured adhesives. This project will involve computational modeling to design the gripper, microfabrication and 3D printing to fabricate the adhesive and gripper, and mechanical testing to evaluate performance.

Mark Yim

Project 1: Robotic warehousing: picking and stowing items using autonomous robots ***Rising Juniors only***

In this project, we seek to apply our novel robotic arm system, which we call the spiral zipper arm, to the task of robotic warehousing, where the robot is expected to autonomously pick/stow items from/into shelves. Automated picking/stowing a wide range of items will become economically important in the near future, especially in e-commerce, but it still remains a great challenge and the only commercially viable solution at the present time is hand picking/stowing by human workers. We are looking for a well-motivated undergraduate researchers to contribute to this project. The successful candidate will help graduate researchers create hardware/software systems for autonomous robotic warehousing and conduct experiments in an interdisciplinary team setting with computer scientists and/or electrical engineers. Skills and techniques that will be learned include robot hardware/software design/implementation and experimental robotics. Knowledge in statics/dynamics and some coding experience is required.

SYSTEMS ENGINEERING

James Won

Project 1: Brain overload.. Or underload? - Mental workload, stress, fatigue, vigilance, human in the loop, automation

Increasing implementation of advanced technology has greatly improved quality of life and satisfaction in some areas, but has introduced new areas of system “brittleness” when the

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operator of a task experiences vigilance decrement due to boredom or fatigue. Research in mental workload has attempted to identify the "sweet spot" of workload/arousal in which the operator is able to maximize his/her performance. Models such as the Yerkes-Dodson law attempt to characterize the spectrum of human performance, from very low workload to being overloaded. Electroencephalogram (EEG) measurements of brain activity may yield insights into this type of characterization of mental workload. A simple, minimally intrusive headset could provide these EEG measurements, and by leveraging previous research on the relationship between EEG and workload, this project could begin to make a characterization of the spectrum of mental workload. This project could also identify the types of appropriate external stimulation that can lead to maximal performance, while identifying levels of distraction that increase the multi-tasking cost and workload, leading to degraded performance.

Project 2: Humans and Automation course curriculum development

This would involve curriculum development towards a new project-based course focused on the relationship between humans and automation: how to diagnose appropriate levels of automation for a task/system, how to implement that level of automation, and how to measure the effectiveness of the integration of the automation. Lastly, an examination of the effect of automation on system resiliency, and how effective human-in-the-loop integration can mitigate effects of system brittleness induced by the increased automation. Project development for the course and overall course development would be required of this project. Student would be expected to explore the implementation of lego programming kits for course exercises.

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Law

CERL

Claire Finkelstein

Project 1: Liability and the Non-State Actor in Asymmetric Conflict

The Center for Ethics and the Rule of Law (CERL) is an academic center that unites preeminent scholars and practitioners from around the world to engage in multi-disciplinary conversations on the legal, ethical, and political issues of war and national security.

CERL offers the opportunity for undergraduates to join the CERL team in timely research and programming on the Focus Topic of Liability and the Non-State Actor in Asymmetrical Conflict. CERL's study of this topic will address the profound challenge in international security posed primarily by two terrorist organizations, Al Qaeda and the Islamic State of Iraq and Syria (ISIS). It is of critical importance that policymakers and academics improve their own and others' understanding of the status of non-state actors under international law and custom, and that they work to clarify, articulate, and eventually disseminate a common legal and ethical framework to guide military leaders in asymmetric conflict.

The project is a collaboration with Penn's Perry World House and Wharton's Zicklin Center for Business Ethics Research that consists of in-depth research on the topic and individuals working and contributing to the field, a two-day interdisciplinary conference, follow-up outreach, and publication of an edited volume of original essays.

Students will work under the supervision of Professor Claire Finkelstein and participate in CERL's activities to augment their research skills and learn from a real-world perspective. The project offers the unique opportunity to make critical professional contacts, which may serve to open doors to future job opportunities.

CTIC

Christopher Yoo

Project 1: Connecting the Unconnected

The Center for Technology, Innovation and Competition (CTIC) is initiating a new project on innovative approaches to connecting the unconnected. One of the central problems confronting the world is increasing the number of people connected to the Internet. According to estimates,

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only 3.1 billion of the 7.3 billion world inhabitants were connected to the Internet as of July 2015. The adoption problem is particularly acute in Africa, Latin America, and Asia, where adoption rates continue to lag behind the global average.

Many communities and companies are exploring new approaches to supporting connectivity. Most rely on established technologies such as community-based WiFi, while others are more experimental, such as Google's balloon-based Project Loon, Elon Musk's satellite-based initiative, and Facebook's drone-based Connectivity Lab.

We will be collecting the best scholarly work quantifying the benefits of Internet adoption, collecting and analyzing new data on innovative approaches for connecting new communities and overcoming demand-side barriers to adoption, and finding compelling stories highlighting connectivity's benefits. This position requires excellent organizational, research skills, and writing skills. It will be especially helpful to students interested in careers in technology policy, community development, developing societies, sociology, law, and international governance.

CTIC is an academic center at the University of Pennsylvania Law School that is dedicated to promoting foundational research in technology policy, intellectual property, privacy, and other fields related to law and technology.

LAW

Jean Galbraith

Project 1: Corruption, Human Rights, and State Behavior: Does Disclosure Make a Difference?

Some nations behave well towards their people, while others are corrupt or violent. In conjunction with Jeremy Tobacman (an Assistant Professor at Wharton), I am working on a paper about whether and how international oversight can make nations behave better. The paper will empirically examine the effectiveness of oversight mechanisms established in several international treaties. We hope that our findings will help international policy-makers as they implement oversight mechanisms and as they design new ones in the future.

We are looking for a student who will assemble relevant data; analyze it in Stata; make production-ready tables and figures in Excel; and document everything in clear and sharp prose. Depending on how long this project takes, we may also ask the student to work on other projects related to international law or to development economics.

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Medicine

ANESTHESIA

Alexander Arriaga

Project 1: Patient activation in surgical patient safety

There is a growing epidemic of elderly surgical patients who are poorly prepared for the complexities of the United States (US) healthcare system. This is in the setting of an ever increasing number of elderly having surgery at the end of life, with expenditures for this population being significantly higher than that for others. There is an abundance of research aimed at "fixing the healthcare system" to address the complexities of a surgical episode. Surprisingly, there is a paucity of research work aimed at "strengthening the patient" to make him/her better prepared to handle an inherently imperfect system. The specific aims of this project are to take a multi-layer health services research approach to improve patient activation and patient resilience to the complexities of the healthcare system.

Students that are considering pre-medical studies, graduate studies in health services research, or otherwise have an interest in clinical research are encouraged to apply. It will be a priority to provide the student with critical skills relevant to becoming a medical-student and/or junior scientist. These skills include: (1) learning the basic principles of human subjects research; (2) learning how to navigate the medical literature and differences between popular medical journals; and (3) being a part of interesting projects, understanding them well, and learning how to summarize them concisely for medical/graduate school interviews or job applications.

Project 2: Provider resilience in surgical patient safety

In 2008, the cognitive psychologist James Reason wrote a book titled The Human Contribution, where he spoke about the role of the "human as a hero, a system element whose adaptations and compensations have brought troubled systems back from the brink of disaster on a significant number of occasions." There are heroes in medicine every day that save surgical patients from systems errors, yet definitions of these concepts and ways to measure them are poorly understood. Despite the intuitive connection between medical education, patient care, and resilience to the stressors of the medical system, this concept of human resilience has been largely understudied in healthcare.

This project aims to determine the connections for these topics in depth, including lessons from fields outside of medicine and future directions for medical education and patient care. Students that are considering pre-medical studies, graduate studies in health services research, or otherwise have an interest in clinical research are encouraged to apply. It will be a priority to

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provide the student with critical skills relevant to becoming a medical-student and/or junior scientist. These skills include: (1) learning the basic principles of human subjects research; (2) learning how to navigate the medical literature and knowing the difference between popular medical journals; and (3) being a part of interesting projects, understanding them well, and learning how to summarize them concisely for medical/graduate school interviews or job applications.

Seema Bhatnagar

Project 1: Determining sex differences in orexins' functions and underlying substrates

Stress can lead to the development of mental disorders such as post-traumatic stress disorder (PTSD), anxiety, and depression. The incidence of these disorders is much higher in women. Currently, we do not understand the gender-related neurobiology of these disorders, which hinders progress in effective treatments for these stress-related illnesses. This project seeks to address this problem by examining the neurobiology of sex differences in repeated stress in a rodent model. The hypothalamic neuropeptides orexins are known to regulate stress responses and attentional/arousal processes. We observed that females have more orexin mRNA, activation of orexin neurons, and release of orexins in the cerebrospinal fluid. In the proposed project, we will examine morphological and electrophysiological differences in male and female orexin neurons before and after stress.

Students will collect primary data while working with animals, assist in surgical and stress procedures, conduct behavioral testing and analysis, section brains and perform immunohistochemical staining for orexin neuron activation, learn to trace morphological structures of orexin neurons, collate all data, conduct statistical analyses and present results in lab meetings. Students will be mentored by a postdoctoral fellow on a day-to-day basis and will be meet with the PI once a week to discuss progress on the project as well as any other issues relevant to the student (career choices, coursework etc.). The lab offers a dynamic and diverse environment and places a high value on a positive and valuable research experience for undergraduate students.

Project 2: Investigating the role of the posterior paraventricular thalamic nucleus in habituation to repeated stress

The primary goal of the Bhatnagar laboratory is to understand the neural substrates underlying stress and stress-related psychiatric disorders. One important aspect of the stress response that we study is habituation, a process that is disrupted in post-traumatic stress disorder. Habituation refers to a decreasing response to the same stressor over time. Previous work from our lab has identified the posterior division of the paraventricular thalamic nucleus (pPVT) as a brain region that mediates habituation. We are currently investigating whether neuronal activity-induced

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expression of specific genes is necessary for habituation. The techniques required to complete this project include immunohistochemistry, behavioral analysis, and brain sectioning. The Bhatnagar laboratory currently employs four postdoctoral fellows and two technicians. Each employee has successfully trained high school and/or undergraduate students in these techniques.

The techniques that the PURM students will be trained in serve as excellent stepping-stones for developing scientists. The principles of immunohistochemistry may be applied to a wide range of protein quantification assays (e.g. Western Blot and ELISA). A thorough understanding of the principles required to correctly score the behaviors analyzed in this project can be employed to quantify many other behaviors. Sectioning brains is a useful technique that practically all neuroscientists must learn and helps students develop an in-depth understanding of neuroanatomy. Students will also have the opportunity to present their results at weekly lab meetings throughout the summer, allowing them to develop public speaking skills that will undoubtedly be useful throughout the remainder of their academic and professional career.

Project 3: Sex differences in pPVT projections to limbic structures following stress

Repeated exposure to a stressor initiates a physiological process called habituation that decreases the physiological responsiveness to the same stressor. Impaired stress habituation is thought to be the underlying etiology of psychiatric disorders such as post-traumatic stress disorder (PTSD), anxiety and depression. Interestingly, females have a higher incidence of psychiatric disorders. The process of habituation involves the posterior paraventricular thalamus (pPVT), whereas the symptomatology in psychiatric patients stems from abnormalities in limbic structures (medial prefrontal cortex (mPFC), basolateral amygdala (BLA)). The mPFC and BLA both receive input from the pPVT. Currently, we do not know the importance of pPVT inputs to the mPFC and BLA in mediating the symptomatology in psychiatric patients; nor do we know if gender differences in these pPVT inputs contribute to the gender disparity in patients.

This project will compare the number of mPFC and BLA projecting pPVT neurons in female and male rats following repeated restraint stress. Students will collect primary data while working with animals, assist in surgical and stress procedures, conduct behavioral testing, section brains, perform immunohistochemical staining for the fluorescently labeled pPVT projections, collate all data, conduct statistical analyses and present results in lab meetings. A postdoctoral fellow will mentor the students on a day-to-day basis. Students will meet with the PI once a week to discuss the project and other relevant issues to the student (career choices, coursework, etc.). The lab offers a dynamic and diverse environment and places high value on a positive and valuable research experience for undergraduate students.

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Akiva Cohen

Project 1: Synaptic plasticity in the Amygdala following traumatic brain injury

Mild to moderate brain injury leads to an array of neuro-psychological symptoms e.g., anxiety, irritability and depression. Alterations in the basolateral amygdala synaptic plasticity may contribute to these symptoms. Generation of live brain slices together with extracellular recordings techniques will be employed to investigate several forms of synaptic plasticity including long-term potentiation and depression.

Project 2: How does Brain injury effect epilepsy

Mild to moderate brain injury can lead to post-traumatic epilepsy. However, the reverse situation has yet to be investigated. That is, how does a brain injury effect established epilepsy. In order to study this question, we will use a transgenic animal with genetic epilepsy that has electrographic seizures. We will conduct skull based EEG recordings to see how brain injury alters the seizures. We will examine seizure frequency, duration and severity. The student will become proficient in implanting electrodes into rodents, recording and reviewing rodent EEG." Furthermore, Dr. Kathryn Davis, an epileptologist in the Penn Epilepsy Center, is a co-investigator on this project and will provide mentorship in EEG interpretation and translational epilepsy research.

Roderic Eckenhoff

Project 1: Molecular Pharmacology of general anesthetics

Novel molecules with anesthetic properties are made in collaboration with William Dailey (Chemistry), and these are characterized physically, biochemically, and pharmacologically. In some cases, the molecules are photochemically activated to discover novel anesthetic targets and binding sites within those targets. The student will work with team members to perform experiments, collect and analyze data, participate in lab meetings, and present their work at the end of the experience.

Project 2: Anesthetic photolabel synthesis ***Rising Juniors only***

In collaboration with William Dailey (Chemistry), we design and synthesize novel anesthetic photolabels and click reagents for deployment in anesthetic pharmacology studies. This complex synthetic work requires that the student have successfully completed organic chemistry and the associated lab.

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David Eckmann

Project 1: Assessing intracellular transport via quantum dot diffusion

Within living cells, a complex interplay exists between biochemistry and mechanics, which is further influenced by the fact that the cell interior is a very crowded chemical space. The volume fraction of proteins within the cytoplasm can reach up to 40%. This large volume fraction limits diffusion of molecules and organelles within the cytoplasm and therefore affects the rates of chemical reactions in the cell. This project will assess intracellular transport of quantum dots in living cells, particularly human dermal fibroblasts, and their cancerous counterpart, fibrosarcoma. Quantum dots enter the cell through microinjection and their spatial coordinates are captured by tracking their fluorescence signature as they diffuse within the cell. This project is an effort to broaden our understanding of how small particles on the size of tens of nanometers travel inside the cell. The implications are important for drug transport and research with DNA-based therapeutics. The incoming student will work on instrumentation to culture cells, inject quantum dots and manipulate particle tracking software to analyze data. This includes interfacing fluorescence microscopy with single particle tracking and developing matlab protocols for analysis. This project will provide an excellent opportunity to learn cell culture, cell injection, microscopy, and Matlab programming. The student will be closely mentored by a post-doctoral researcher in the lab. No prior experience is required.

Meghan Lane-Fall

Project 1: Handoffs and Transitions in Critical Care (HATRICC)

Post-surgical handoffs of patients requiring intensive care threaten patient safety. These patients are transferred from one site and team of care to another, and they are often incapacitated and thus unable to participate in their care. Loss of critical information occurring in the transition process predisposes to error and preventable harm. The Handoffs and Transitions in Critical Care (HATRICC) project is employing qualitative and quantitative methods to improve and measure the postoperative handoff process in two Penn surgical intensive care units. This project has been ongoing since 2014, and we have successfully created and implemented a standardized operating room to intensive care unit handoff process.

Students joining the project over the summer will participate in data collection that will help us determine the sustainability of this improvement effort. Responsibilities will include in-person observation of handoffs, medical record reviews, and qualitative data analysis. Students will join a multidisciplinary research team, learn about qualitative and quantitative research methods, collect data in a clinical environment, and will have opportunities to shadow clinicians (physicians, nurses, and others involved in patient care) from intensive care, anesthesia, surgery, and trauma.

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This opportunity is ideal for students with some clinical experience (e.g. EMT, medical scribe, hospital volunteer), but we will consider all interested students. Interested students will be able to continue participation in the project after the summer. Previous students involved in this project have gone on to medical school and nursing school. For more information about this project, please visit our website at http://www.hatricc.com.

Project 2: Post-intensive care syndrome

People experiencing a devastating traumatic injury need intensive care and invasive, often painful procedures to sustain life and facilitate recovery. For those patients who survive their injury, recovery does not end in the intensive care unit (ICU). Rather, these survivors must grapple with functional dependence, pain, depression, and post-traumatic stress disorder as they seek to re-establish health and normalcy.

In this project, we seek to understand the patient and family experience of recovering from traumatic critical illness by conducting interviews and neurocognitive testing at multiple time points after traumatic injury. As a part of this project, the PURM scholar would conduct patient and family interviews in patients' homes, conduct neurocognitive testing, participate in weekly team meetings, and assist with a systematic review of the literature on post-intensive care syndrome. No specific background is necessary, but students should be willing to have difficult discussions with patients and families, be willing to travel to patient's homes (transportation provided), and be willing to work around patients' schedules, which may be outside of business hours. Interested students will be able to continue participation in the project after the summer.

Renyu Liu

Project 1: Opioid Receptor Pharmacology

This project involves working on investigating opioid and mu opioid receptor interactions using highly engineered human mu opioid receptor.

The student will work closely with a postdoc and the PI.

Duty: Assist the postdoc on the project by using surface plasma resonance (SPR), circular dichroism, etc.

Prerequisites: Motivation in working with the team for the opioid pharmacology.

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BIOCHEMISTRY & BIOPHYSICS

Hua-Ying Fan

Project 1: Identify determinants critical for chromatin remodeling by the Cockayne syndrome B protein

The goal of this study is to identify residues in the Cockayne syndrome protein B (CSB) chromatin remodeler that couple ATP hydrolysis to nucleosome movement. The basic unit of chromatin structure is the nucleosome, which consists of ~147 base pairs of DNA wrapped around an octamer of histone proteins. Although nucleosomes are needed to condense the ~2 meters of DNA into a cell's nucleus, they restrict DNA access to factors that utilize DNA, such as transcription and DNA repair proteins. Chromatin remodelers regulate this access by altering DNA-histone contacts. Thus, these enzymes play critical roles in cell growth, differentiation and development. Importantly, aberrant chromatin remodeling underlies several diseases, including cancer and developmental syndromes.

One of our research directions is to determine how the CSB remodeler is distinct from other chromatin remodelers and how its unique features equip this enzyme to help repair DNA. We have engineered a CSB derivative that can hydrolyze ATP but is unable to couple ATP hydrolysis to nucleosome movement. This is a key reagent to understand how the biochemical activities of this remodeler are used for DNA repair. The derivative that we generated contains a 366 base pair deletion that lies outside the ATPase domain. This project will use molecular biological approaches (site-directed mutations and cloning), somatic cell genetics (introduction of new CSB derivatives into cells and assaying their activities), and in vitro chromatin remodeling assays using purified proteins, to more precisely define the residues important for chromatin remodeling by CSB.

BIOSTATISTICS & EPIDEMIOLOGY

Yong Chen

Project 1: Statistical modeling of the fundamental diagram

Background: Transportation systems suffer from lack of efficiency. These inefficiencies have a tremendous impact: 2.8 billions of gallons of wasted fuel and 5.5 billions of wasted hours yearly in 2011; nearly one third of CO2 emissions in US; and deaths because of accidents (130,000 in 2013, fourth leading cause of death in US). New technologies allow big data collection from

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infrastructure and user sensors. Even if these data were analyzed in a number of studies, it is still missing a comprehensive approach based on a synergistic combination of statistical inference, modeling, numerical and analytic tools. This project aims to use model-guide statistical analysis of traffic data to provide innovative tools to support transport agencies decision-making.

Method: It has been well acknowledged that there are substantially more variations in flux when the density is higher than a critical density, compared to variations in the flux at density lower than the critical density. To account for such extra variation, we propose to model the density-flux relation as a mixture of distributions by allowing the critical density and maximum flux to be dependent on measured external conditions (e.g., weather condition, day of the week, indicator of a special event, number of lanes). We are looking for students to work together on more flexible statistical modeling for density-flux relation at a particular sensor. This is a joint collaboration with researcher at Rutgers University and University of Houston.

Requirement: Working experience with R and statistical computing, and basic knowledge on statistics such as regression models.

Tentative timeline: 2 weeks (literature review); 2 weeks (method development); 2 weeks (simulation studies); 4 weeks (data analysis and manuscript writing).

Project 2: Evaluating the impacts of measurement error on association studies using EHR data

Motivation: The deployment of electronic health records (EHR) systems offers the promise of aggregating information for clinical research and improved health care delivery. Since EHRs contain large populations with diverse disease conditions, they have the potential to act as platforms for generating sets of cases and controls for clinical and translational research. However, it is well know that EHRs are not designed for research purpose, so the disease outcome and important clinical covariate variables identified from EHR is subject to measurement error.

Method: We are looking for students to be involved in the development of statistical methods to deal with outcome misclassification and covariates measurement errors. Specifically, we will first empirically evaluate the impacts of outcome misclassification and covariates measurement errors, and then to develop statistical models to deal with these problems, with a focus of modified hypothesis testing procedure and biased corrected estimation methods. This will be a collaborative work with researchers at CHOP and/or University of Texas Health Science Center.

Requirement: Some working experience with R and statistical computing, and basic knowledge on statistics such as regression models.

Tentative timeline: 2 weeks (literature review); 2 weeks (method development); 2 weeks (simulation studies); 4 weeks (data analysis and manuscript writing).

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Project 3: Statistical Inference of Copas Selection Model for Publication Bias Correction with Partial Identification

Background and method: Publication bias occurs when the published research results are systematically unrepresentative of the population of studies that have been conducted, and is a potential threat to meaningful meta-analysis. The Copas selection model provides a flexible framework for correcting estimates and offers considerable insight into the publication bias. However, maximizing the observed likelihood under the Copas selection model is challenging because the observed data contain very little information on the latent variable.

We are looking for a student to work together on a novel statistical inference procedure to account for the partial identification of the Copas model. In particular, we will provide an information bound for test of publication bias under small or moderate sample size settings.

Requirement: Working experience with R and statistical computing, and working knowledge on statistical inference.

Tentative timeline: 2 weeks (literature review); 2 weeks (method development); 2 weeks (simulation studies); 4 weeks (data analysis and manuscript writing).

Blanca Himes

Project 1: Visualizing Relationships Among Demographic and Environmental Variables with Asthma Prevalence in Philadelphia

Asthma is a chronic inflammatory lung disease that affects over 25 million Americans. Marked disparities in asthma prevalence by race/ethnicity and socio economic factors have been observed, and efforts to reduce such disparities span a wide range of disciplines. The overall goal of this project is to better understand the relationship between demographic and environmental variables and asthma prevalence in Philadelphia. Using publicly available data, which includes air quality, pollution, litter and housing data, as well as secured data from University of Pennsylvania Health System patients, we will (1) conduct regression analyses to identify relationships among these variables, and (2) visualize the geographic distribution of these relationships. Data analysis will be performed using R (if the student has not used R before, he or she must be willing to learn). Student must be an enthusiastic, driven, and mature individual who is looking for research experience as preparation for graduate or medical school, or a position that requires data analysis.

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Project 2: Identifying Transcriptome Changes That Characterize Pulmonary Arterial Hypertension (PAH)

The overall goal of this project is to better understand the genomics of pulmonary arterial hypertension, a rare disease characterized by remodeling of the small muscular pulmonary arteries that leads to right-sided heart failure and death. The project consists in identifying differentially expressed genes related to PAH using public and private data, as well as relating top genes to known biological pathways. Because PAH is 2-4 times more common in women than in men, analyses will also investigate gender differences in gene expression to the extent possible. Main duties include data collection from online repositories, meticulous organization of data, and literature searches. Subsequently, data will be analyzed using R (if the student has not used R before, he or she must be willing to learn). Student must be an enthusiastic, driven, and mature individual who is looking for research experience as preparation for graduate or medical school, or a position that requires data analysis.

Jason Moore

Project 1: Automated data science assistant

The Computational Genetics Laboratory seeks a research assistant to aid in the development and application of an open source data science project called TPOT (Tree-based Pipeline Optimization Tool, github.com/rhiever/tpot). This position entails gathering data sets and user entries from data science competitions such as Kaggle, and comparing the performance of our automated data science system, TPOT, to that of expert data science practitioners. The ultimate goal of this project is to produce a research report detailing where TPOT excels and where it struggles in these competitions, and how TPOT can be improved to overcome these challenges. Computer sciences / programming skills are required.

Project 2: Artificial intelligence analysis of human genetics data

We are looking for assistance with a project to apply artificial intelligence (AI) methods to the genetic analysis of complex human diseases. We have developed over the last 10 years a powerful AI method that is ready for application to complex data. Diseases of interest include lung cancer, bladder cancer, Alzheimer's, glaucoma, and others. The project will involve carrying out an AI analysis, summarizing results, interpreting results, and perhaps preparing a manuscript for publication. Our AI algorithm was mentioned in this article in Popular Science magazine: http://www.popsci.com/how-artificial-intelligence-can-make-drugs-better-and-faster. Data science skills are required.

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Project 3: Genetic analysis of transplant rejection

Penn is leading an international consortium to identify genetic risk factors for rejection of organs following transplantation surgery. We have access to genetic and clinical data on approximately 30,000 donor-recipient pairs. We are particularly interested in how the genomes of the donors and the recipients interact to influence rejection. The student will work with the team to participate in the development and application of data analysis pipelines for the analysis of this large and complex set of data. Data science skills are required.

CANCER BIOLOGY

Irfan Asangani

Project 1: Characterization and therapeutic targeting of Epigenetic Regulators in Cancer

Prostate cancer is the most common non-cutaneous malignancy and second leading cause of cancer-related mortality in men of the Western world. While effective surgical, radiation, and androgen ablation therapy exists for clinically localized prostate cancer, progression to metastatic castration-resistant prostate cancer (mCRPC) remains essentially incurable. Our laboratory studies the molecular epigenetic events associated with mCRPC. Specifically, we are investigating the role of HMTase (Histone Methyltransferases) and Bromodomain containing (BET) proteins in androgen receptor (AR) mediated transcription and their role in metastasis. Furthermore, we are investigating the molecular mechanisms of resistance to epigenetic targeted therapies, and testing novel combinations of drugs to treat cancer. Students involved in this project will learn and employ molecular biology techniques such as DNA/RNA/protein extraction from cancer cells, Real-time PCR, cloning, Chromatin Immunoprecipitation (ChIP), and western blot analysis. In addition, they will learn fundamentals on next-generation sequencing (NGS) approaches such as RNA-seq, ChIP-seq, RIP-seq etc.

David Feldser

Project 1: Deconstructing tumor progression in the mouse #1

We are focused on mouse models of cancer. We have developed model systems to regulate cancer genes in established caners in the mouse. Our goal is to determine the natural function of tumor suppressor genes in the hopes of co-opting these pathways as novel therapeutic strategies. Project involves hands-on work in cancer imaging in the mouse as well as molecular and tissue-based assays. More lab info can be found at http://www.med.upenn.edu/feldserlab/

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Project 2: Deconstructing tumor progression in the mouse #2

We have developed tools to interrogate the capacity of any gene of interest to function as a tumor suppressor within developing cancers in the mouse. We are focused on genes that have been implicated as tumor suppressors based on cancer genome sequencing studies but for which no functional significance has yet been established. Project involves hands-on work in cancer imaging in the mouse as well as molecular and tissue-based assays. More lab info can be found at http://www.med.upenn.edu/feldserlab/

Xiaolu Yang

Project 1: Cellular Systems that Degrade Misfolded Proteins Related to Neurodegenerative Disease ***Rising Juniors only***

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

Students interested in the project would be working closely with lab members to further elucidate the mechanisms involved in protein quality control systems in mammalian cells. The lab is currently exploring several potential therapeutic options for the treatment of well established neurodegenerative diseases which the student would additionally aid in the development of.

Student responsibilities would include learning and developing sterile technique and proper lab bench skills. Students will specifically learn and perform, under guided mentorship, fundamental experiments using biochemistry to test the outstanding questions the group is aimed at understanding. These techniques would include but are not limited to PCR, western blot analysis, mammalian tissue culture, rodent sample preparation/genotyping. The student would also be responsible for organizing and presenting scientific data in a collaborative and critical environment.

The Yang lab is looking for students are are truly passionate and interested in pursuing a career in research. Our research range streches wide to include cancer, neurodegenerative disease, apoptosis, and cell metabolism with numerous projects happening at all times creating an intense research environment and incredible opportunity for young scientists to learn and develop skills. We are specifically interested in ambitious, organized, and focused students who take direction

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well and have no issue admitting mistakes. Prior lab experience would be ideal but not necessary.

Project 2: Tumor Supressor p53's Role in Cancer Metabolism ***Rising Juniors only***

p53 plays a preeminent role in blocking tumor formation and is the single most frequently mutated gene in human tumors. p53 is activated by various tumor-promoting stresses and effectuates a range of anti-proliferative and repair responses. We are investigating the regulation and functions of p53, as well as its structural homologue p73. We previously identified a complex that stabilizes the principal p53 antagonist Mdm2 and are now examining how this complex controls p53 activation. We also revealed a role for p53 family proteins in modulating cellular metabolism, particularly the production of NADPH, the reducing equivalent required for biosynthesis and anti-oxidant defense. We are further studying how these proteins act as both sentinels and regulators for metabolism, coordinating metabolism with cell fate decision, and how these functions may be compromised in tumor cells. We are also investigating other metabolic alterations in tumor cells that enable their survival, proliferation, and metastasis.

Students interested in the project would be working closely with lab members to further elucidate the mechanisms involved in protein quality control systems in mammalian cells. The lab is currently exploring several concerted pathways involved in cancer metabolism and cellular protection against cancer and stress. The student would aid in the continuation of such work.

Student responsibilities would include learning and developing sterile technique and proper lab bench skills. Students will specifically learn and perform, under guided mentorship, fundamental experiments using biochemistry to test the outstanding questions the group is aimed at understanding. These techniques would include but are not limited to RT-PCR, western blot analysis, mammalian tissue culture, and various techniques to measure changing biochemistry. The student would also be responsible for organizing and presenting scientific data in a collaborative and critical environment.

The Yang lab is looking for students are are truly passionate and interested in pursuing a career in research. Our research range streches wide to include cancer, neurodegenerative disease, apoptosis, and cell metabolism with numerous projects happening at all times creating an intense research environment and incredible opportunity for young scientists to learn and develop skills. We are specifically interested in ambitious, organized, and focused students who take direction well and have no issue admitting mistakes. Prior lab experience would be ideal but not necessary. Interest in attending graduate school or research as a career is a must.

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CARDIOVASCULAR MEDICINE

Yuli Kim

Project 1: Evaluation of Quality of Care Delivered to Adults with Congenital Heart Disease

Dramatic improvements in the treatment of infants and children with congenital heart disease (CHD) have resulted in a recent increase in the number of adults living with this condition. The new subspecialty of adult congenital cardiology focuses on this emerging population. One of the challenges of providing long-term care for adults with congenital heart disease is the lack of consensus about what constitutes quality care (i.e. what practice patterns improve patient health outcomes). A panel of experts recently published the first set of quality indicators for individuals with secundum atrial septal defects, coarctation of the aorta, Eisenmenger syndrome, d-transposition of the great arteries, tetralogy of Fallot, and any CHD that required the Fontan procedure.

The purpose of this project is to investigate quality indicator completion patterns in an adult congenital heart disease clinic and clinics for several other adult cardiology specialties to evaluate the best setting for management of these conditions and current gaps in quality of care. The student will be mentored by the medical director of the Philadelphia Adult Congenital Heart Center, a joint program of the Children's Hospital of Philadelphia and Penn Medicine. Emphasis will be placed on developing competency in clinical research through involvement in protocol preparation, data collection, data analysis, and presentation of results. Additionally, the student will have unique clinical opportunities to shadow cardiologists and cardiothoracic surgeons to learn more about the management and treatment of these congenital heart defects.

CELL AND DEVELOPMENTAL BIOLOGY

Stephen DiNardo

Project 1: The mechanical basis of collective cell shape changes in developing epithelial tissues

How do our organs adopt their proper shape as they develop (a process called "morphogenesis")? "Form is function", meaning that for an organ to work correctly, it must be shaped correctly to suit its particular function in the body. Thus, failures in morphogenesis can cause developmental disorders. When epithelial cells assemble to first form an organ, they adopt the lowest energy configuration, resembling a honeycomb of individual hexagonal cells. However, for the organ to work properly, its cells must adopt more complicated geometries. This requires: 1) proteins that

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generate force and 2) components that position the force-generating proteins to direct cell shape changes.

In this project, you will investigate these two types of molecules in morphogenesis using the fruitfly as a model system. The cells in developing epithelia in fruitfly undergo a stereotyped rearrangement from hexagonal to rectangular cell packing – a high-energy geometry. You will investigate 1) how the cellular "muscular" skeleton (the actomyosin cytoskeleton) is remodeled to drive these shape changes and 2) what signaling molecules spatially regulate the remodeling. You will learn cutting-edge microscopy, including immunofluorescence, live imaging and laser ablation. Additionally, you will learn about fruitfly development and how to manipulate genes. Responsibilities will include performing and designing experiments, reading research papers, processing and analyzing microscopy images, communicating findings, and formatting data for presentation/publication. No specific prerequisites are necessary. Most importantly, we are looking for students with a strong interest in cellular and developmental biology and who show enthusiasm for learning advanced microscopy.

Project 2: How are stem cells in an organ instructed to behave properly?

Stem cells are the key to how tissue renewal occurs in many of our organs. Unfortunately, there are limitations in our knowledge of how stem cells are regulated, and these limitations compromise our understanding of tissue renewal, and limit our ability to grow stem cells in culture - a necessary step for their use in regenerative medicine. Stem cells are regulated by their local environment, with instructions sent by neighboring cells; instructions that tell the stem cell when to divide, how many cells to produce, etc. Unfortunately, the stem cell neighborhood is often too poorly characterized to be understood well.

To overcome such fundamental limitations in our knowledge, we use a powerful model organism, the fruitfly Drosophila, where we can study stem cells and how their local environment instructs their behavior in a very clear way. In this project, you will study the embryonic development of an organ, and how the stem cell environment within that organ is initially created. You will learn cutting-edge microscopy, including immunofluorescence and live imaging. Additionally, you will learn about embryo development and how to manipulate genes. Everyday activities will include executing experiments, interpreting their results, and communicating your findings. You will also have opportunities to read and discuss primary research papers. While no specific prerequisites are necessary, we are looking for students with interest in the biology of cells and embryos.

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DERMATOLOGY

Thomas Leung

Project 1: Understanding how mice regenerate ears

Regenerative medicine is charged to restore normal tissue structure and function after injury. In mammals, traumatic injuries typically heal with a fibroblast- and collagen-rich response, producing a fibrous scar rather than full reconstitution of cellular subtypes and functional tissue architecture. Using innovative tools in genetics, we have developed a mouse model of ear regeneration, where we can follow individual cell types (skin, cartilage, blood vessels, immune cells, fibroblasts) through the regeneration process and begin to dissect how tissue regeneration works. This project seeks to understand the cellular and molecular mechanisms that drive mammalian tissue regeneration. Here, the student will be trained in mouse animal husbandry, molecular biology techniques (RNA isolation, PCR, cDNA synthesis, qPCR, Western Blot, chromatin immunoprecipitation), gene editing (CRISPR), and immunohistology. They will work directly with the principal investigator. We hope that this summer project will lead to a long-term commitment to the lab.

Project 2: Studying how human skin heals

Our group studies how injured tissues heal, and in some cases, how injured tissues regenerate without a scar. We have innovated new methods for studying these processes in mice and humans, and discovered cellular, molecular, and genetic mechanisms governing wound healing and tissue regeneration. We have developed a system to grow human skin in a tissue culture dish; this model consists of keratinocytes and fibroblasts and reproduces architecturally faithful human tissue. We will use this system to study how human skin heals in response to trauma. Here, the student will be trained in tissue culture/tissue engineering, molecular biology techniques (RNA isolation, PCR, cDNA synthesis, qPCR, Western blot, chromatin immunoprecipitation), molecular cloning, gene editing (CRISPR), and immunohistology. They will work directly with the principal investigator. We hope that this summer project will lead to a long-term commitment to the lab.

Todd Ridky

Project 1: Tissue Engineering to Study Human Skin Pigmentation and Skin Cancer ***Rising Sophomores only***

Generating new genetically-defined human tissue models of normal pigmented skin, and invasive skin cancer is a major research focus. These models incorporate normal structural, and pigment-producing cells from human skin, in an engineered, architecturally faithful 3-

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dimensional context recapitulating the microenvironment of normal or cancerous skin. Cancer cells are engineered to harbor genetic changes in central oncogenic drivers associated with spontaneous human malignancy. These new human tissue models are designed to complement conventional transgenic murine and cell line-based studies by overcoming limitations of cost, speed, and physiologic relevance through a standard experimental platform that is relatively inexpensive, rapid, and based on primary human cells in composite 3-D human tissue.

The engineered skin is used as a platform to define mechanisms regulating pigment production in skin, and to develop topically deliverable drugs that modulate skin color. The tissues are also used to define pathways that covert normal skin cells to invasive cancer, and to develop new therapeutics for human malignancy.

Biology or other life science majors are eligible.

Students will be given the opportunity to participate in all phases of the project including isolating and growing human cells from fresh tissues, and using viral-based gene delivery methods to introduce specific oncogenes. Students will then use the genetically altered cells to generate 3D human tissues grown either in culture incubators or in mice. Tissues and tumors will be followed by various imaging techniques including in vivo bioluminescence and fluorescence. Tumors will be harvested and analyzed using PCR, immunofluorescence, deep sequencing, and microarrays. Bioinformatics approaches will be used to identify potentially important drug targets, and to develop hypotheses. The hypotheses will be tested by attempting to block cancer development using drugs, antibodies and RNAi. Students will be expected to read relevant literature and develop proficiency in all of the experimental procedures used.

Students will be actively engaged in developing physiologically relevant 3-D models of normal and cancerous human skin. Engineered tissues will be generated through incorporation of tumor associated genetic changes and cancer stem cells. The models will then be used to identify central elements necessary for key steps in cancer progression including invasion and metastasis. Various strategies will be used to attempt to block cancer growth and spread including using drugs, therapeutic antibodies, CRISPR and RNAi technologies. Analogous approaches are used to understand mechanisms controlling skin color, and to begin altering pigment production to correct scars, increase resistance to UV sun damage, or to alter skin color for cosmetic benefit.

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DIAGNOSTIC RADIOLOGY

Joel Stein

Project 1: Optimization of Intracranial Electrode Trajectories in Epilepsy

Epilepsy patients whose seizures cannot be controlled with medication may be candidates for surgery. Those without an obvious structural abnormality on brain imaging often undergo placement of intracranial electrodes to map epileptogenic brain regions. These electrodes are also useful for research purposes, for example allowing investigators to measure brain activity while patient volunteers perform memory tasks. Modern stereotactic and robotic surgery techniques facilitate increasingly precise and targeted placement of electrodes into the substance of the brain. We are developing software tools to analyze each patient's brain anatomy from high resolution MRI and provide optimal trajectories for sampling of structures in the medial temporal lobe within appropriate anatomical and surgical constraints. In assisting on this project, the student will learn about multi-modality brain imaging, anatomy, segmentation, and co-registration and develop components for user interface, trajectory optimization, and electrode visualization. Coursework in neuroscience or computer science is recommended and some programming experience is required. In particular, familiarity with MATLAB would be a plus. This project is co-mentored with Drs. Kathryn Davis and Sandy Das in the Department of Neurology.

ENDOCRINOLOGY, DIABETES & METABOLISM

Raymond Soccio

Project 1: Probing the role of regulatory genetic variation in diabetes and obesity

Most natural genetic variation that drives phenotypic differences among individuals does not lie in coding regions of genes, but rather in regulatory "switches" that turn genes on or off. Transcription factors (TFs) bind to regulatory elements and determine expression levels of target genes. The Soccio Lab aims to discover mechanisms by which genetic variation in non-coding regulatory regions of the genome predisposes to metabolic diseases like diabetes, obesity, and dyslipidemia, and how his may be exploited for precision medicine. The nuclear receptor TFs PPARγ and PPARα represent prime opportunities to study functional regulatory variation. Both are drug targets for metabolic diseases, with thiazolidinedione PPARγ agonists used in type 2 diabetes and fibrate PPARα agonists used in dyslipidemia to lower triglycerides and raise HDL cholesterol. We have deployed next generation sequencing methods to identify genome-wide those regulatory PPAR elements that are naturally polymorphic in mice or humans. A number of exciting candidates have emerged, in which metabolically relevant loci harbor natural regulatory

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variation that may determine gene expression, drug response, and disease risk. The summer project's focus will be one such candidate locus, assaying cells and tissues for genetically-determined selectivity in TF binding, gene expression, and function. The student would prepare DNA/RNA to perform PCR reactions, gel electrophoresis, and other molecular assays, with additional opportunities for cell and mouse studies, protein assays, and sequencing. Research like this on functional regulatory variation is an emerging new frontier in human genetics, and will contribute fundamentally to understanding of individualized disease risk and treatment.

FAMILY MEDICINE

Kent Bream

Project 1: Guatemala Health Initiative- Understanding, Preventing, and Treating Diabetes

The Guatemala Health Initiative has partnered with the community of Santiago Atitlán and the Hospitalito Atitlán since 2005. In 2015, we began implementing a second collaborative project to understand, prevent, and treat Diabetes Mellitus in the Sololá region of Guatemala. There is currently an epidemic of diabetes globally but particularly in the Maya populations of Central America. The project works to open 20 new detection and education centers around Lake Atitlán, train 300 healthcare workers in prevention and DM care, educate children 12-17 years old, and publish informational booklets in the local languages. This public health program runs through 2018.

The Penn PURM student will serve a critical role in the ongoing evaluation of the impact of this Diabetes project. This includes data collection while in Guatemala as well as data analysis and reporting when returning to Philadelphia. Students will be expected to perform community based population and public health work. This work requires traveling to different communities around the lake, working closely with local hospital staff and maintaining rigorous data recording. Students must speak Spanish and be able to spend the entire summer in Guatemala.

Project 2: Sayre Health Center Community Health Assessment

The Sayre Health Center is a federally qualified health center located at 59th street in West Philadelphia. The health center seeks student research assistants to asset with the community health survey of 2016. Students should have an interest in community health in underserved US populations. Students should have an understanding of the "social determinants of health" as background to this work.

Research assistants will work with qualitative and quantitative data to understand the biomedical and perceived health needs of the Cobbs Creek community surrounding Sayre Health Center. The PURM student will serve an essential role in preparing a report to the federal government

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describing the results of the community health assessment. This data will be used in health service planning for the next five years,

GASTROENTEROLOGY

Jonathan Katz

Project 1: Regulation of esophageal epithelial cells by KLF4

The transcription factor KLF4 has important functions in cell growth, differentiation, and function. Here we will define the functions and downstream mediators of KLF4 in esophageal epithelial cells. These studies have implications for normal homeostasis, for tissue injury and repair, and for cancer.

GENETICS

Sarah Tishkoff

Project 1: Helminth testing in gut microbiome studies on Africans

This research proposes to assess fundamental questions about human adaptation to helminth disease and diet by characterizing the gut microbiomes and parasites status of Cameroonian hunter-gatherer populations with comparative populations practicing other types of subsistence. Parasites endemic to the environments of our sampled populations include soil-transmitted helminths (STH) and schistosomes (hereafter referred to collectively as “helminths”), which are implicated in gastrointestinal illness, and may have roles in the structure and function of gut microbial communities. Commensal gut microbes have co-evolved with their hosts and helminths may have as well, given their antiquity in predating the emergence of man as a species, their low rates of evolution (compared to bacteria and viruses), and their ability to sustain themselves in small human populations.

The broad goals of this research are to test for associations between the gut microbial composition in diverse African populations with helminth quantification to elucidate factors that can influence human physiology and may have played a role in shaping human evolution. The student will assist with plasmid preparation for quantitative PCR and conduct qPCR tests on extracted DNA to assess presence of fecal DNA for the most common species of endemic soil-transmitted helminths (Ascaris lumbricoides, Trichuris Trichiura, Necator americanus) and Schistosoma (Schistosoma mansoni, Schistosoma haematobium) implicated in gastrointestinal dysbiosis. Competitive candidates will possess a strong understanding of biology, with

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preference given to students with laboratory experience and a background in molecular genetics/parasitology/microbiology.

Project 2: Cataloging African genomic diversity using reference-free, de novo assembly methods

Next-generation sequencing analyses of human genomes typically involve aligning short sequence reads to a reference genome. Variants in the sequenced samples are, therefore, differences between the samples and the reference genome. While the human reference genome (HRG) continues to improve in representation, identifying genetic variants among samples that are highly divergent from the HRG remains a challenge. In particular, populations in Africa are known to carry a high level of genomic diversity, most of which are not found in the rest of the world. However, genetic studies that contribute to the development of HRG mainly came from European and Western African populations. This creates bias in understanding the full spectrum of human genetic variation.

One solution is to use de novo assembly approaches to construct contigs from reads independent of the reference genome. We seek to apply de novo assembly methods to obtain an unbiased catalog of genomic diversity in African populations.

The student will assist with analyzing high coverage whole genome sequence data from ethnically diverse African populations using software that can simultaneously assemble sequenced reads and identify variations in the sampled populations, independent of any reference genome. Using the assembled genomes, we can construct accurate haplotypes which are key to the understanding of demographic history and selection pressures in Africa that shape the current genomic diversity. Competitive candidates will have strong computational skills and, ideally, a strong understanding of biology. This is an ideal position for a student who wants to obtain experience doing bioinformatics analysis.

Project 3: Characterization of Genomic Structural Variation in Ethnically Diverse Africans

Africa is thought to be the ancestral homeland of all modern human populations within the past 200,000 years. It is also a region of tremendous cultural, linguistic, climatic, and genetic diversity. Despite the important role that African populations have played in human history, they remain one of the most underrepresented groups in human genomics studies. A comprehensive knowledge of patterns of variation in African genomes is critical for a deeper understanding of human genomic diversity, the identification of functionally important genetic variation, the genetic basis of adaptation to diverse environments and diets, and the origins of modern humans.

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We have generated high coverage whole genome sequence data from ethnically diverse Africans. We have used computational approaches to predict the location of inversion polymorphisms. One inversion polymorphism that we are particularly interested in characterizing contains candidate loci that may play a role in the short stature trait of rain forest hunter gatherer populations.

This research project will consist of using PCR and sequencing to identify potential inversion breakpoints. A qualified candidate will have a background in genetics or molecular biology and will have some laboratory skills. If the applicant has computational skills, there will also be an opportunity for doing computational analyses of structural variants. This is an excellent opportunity to obtain experience in human genome research.

HEMATOLOGY/ONCOLOGY

Peter Klein

Project 1: Wnt Signaling in Development

Wnts are signaling molecules that play fundamental roles in early embryonic patterning and in the maintenance of stem cells in a pluripotent state. We are investigating how this pathway functions at a molecular level, how it regulates stem cells that form blood and neurons, and how it regulates the development of the early embryo. Project 1 investigates the properties of Wnt proteins that regulate their secretion and signaling. We will specifically be examining Wnt7a and testing whether a mutation identified in a child born with multiple birth defects alters the function of Wnt7a. Experimental approaches that the student will learn in this project will include in vitro transcription of mRNA, microinjection into Xenopus embryos, phenotypic characterization of developing embryos and larva, immunofluorescence methods, and gene expression analysis.

Project 2: Wnt and GSK-3 regulation of hematopoietic stem cell (HSC) self-renewal

Hematopoietic stem cells give rise to all blood cells and also are able to regenerate, or self-renew, over the lifetime of an organism. HSCs are also widely used in stem cell transplants for people with various blood diseases. This project investigates the role of the protein kinase GSK-3 in the regulation of human and mouse HSCs and explores methods to maintain and expand HSCs outside the body for research and therapeutic uses. The project will specifically explore downstream effects of GSK-3 inhibition in HSCs, leukemic stem cells, and related cell types. These experiments involve cell culture, flow cytometry, and biochemical analysis of transmembrane signaling pathways in normal and leukemic stem cells.

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Project 3: Mechanisms of lithium action in neural signaling pathways

Lithium is widely used to treat people with bipolar disorder but its mechanism in this disorder is not known. This lab has shown that lithium directly inhibits GSK-3 and this leads to a number of downstream effects on mouse neurogenesis and behavior. This project will explore the mechanisms of lithium action and the consequences of GSK-3 inhibition in neural stem cells and differentiated neurons and will also explore the direct targets of GSK-3 in mouse brain. The project will involve neuronal cell culture, use of induced pluripotent stem cells, biochemical techniques such as western blotting and immunofluorescence, and modeling of signaling networks regulated by GSK-3. The project also studies the in vivo role of neuronal stem cells in behavior in mice.

HEMATOLOGY/ONCOLOGY/CANCER BIOLOGY

Naomi Haas

Project 1: everolimus and salvage radiation in men with rising psa post prostatectomy

Student will learn organization and reporting of data of clinical entry from a clinical trial and will be involved in manuscript writing and publication

Project 2: dce assessment of patients with metastatic RCC receiving pazopanib

Same

MEDICINE

Leslie Castelo-Soccio

Project 1: Bullying in patients with Alopecia Areata

Alopecia Areata is an immune system disease where the immune system attacks the hair follicles. It can lead to patchy hair loss, full scalp and sometimes body hair loss. Children and adults are affected. The goal of the project is to survey pediatric patients with alopecia about bullying. We would like to see what age groups are most affected and then provide resources for these groups when they see us in the clinic. There would be patient contact as well as research to

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develop the survey tool. Ideal for some one who is premed who wants to see clinical medicine and clinical research. I am a physician scientist and have successfully mentor student before and have students who are now in medical school.

Project 2: Imaging Alopecia- Computer Science and Dermatology

This is a project for those interested in computer vision as well as medicine. This is a collaboration between me a physician scientist and dermatologist and a computer scientist to create smarter ways to look at images taken in the clinic to learn about the disease and a patient's prognosis. Goal is to create an application that physicians can use in the office to help monitor patients on therapy and to provide patients with a prognosis. Some computer programming is a plus. There will be interaction with patients, creation of a patient imaging database and the chance to write and publish. If you have computer science skills the project can include writing code etc. There will be opportunity to shadow me in the hospital or in the outpatient clinic as well. Ideal for students in computer science, students interested in pre-med.

Carmen Guerra

Project 1: Barriers and facilitators to participating in a colorectal cancer screening patient navigation program

Underrepresented minorities have increased rates of cancer incidence and mortality. While some of these dispariries are explained by treatment, much of the disparities are due to unequal access to cancer screening tests. Recent studies have indicated that patient navigation programs, which identify and mitigate barriers to completion of cancer screening tests, can successful increase cancer-screening rates in vulnerable populations. However, many patients decline patient navigation services, limiting the effectiveness of these programs and continue to be non-adherent to the guideline and physician recommended cancer screening tests. We will conduct a qualitative study of patients who refuse colorectal cancer screening navigation services to identify the reasons why UPHS patients who are residents of West and Southwest Philadelphia refuse participation in a patient navigation program and what might make them more likely to participate in the future. The results of this study will be submitted for a scientific abstract presentation and will be used to compose a manuscript for publication.

Project 2: Language as an exclusion criteria for participation in cancer clinical trials

The Abramson Cancer Center of the University of Pennsylvania is one of 45 comprehensive cancer centers nationwide and it is rated as exceptional cancer center by the NCI. That status allows the center to offer access to patients to more than 500 clinical trials that are testing the cancer cures of tomorrow. However, preliminary evidence indicates that not all patients may have access to these trials. This research will determine what proportion of cancer clinical trials exclude patients based on inability to speak the English language. The results of this study will

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be submitted for a scientific abstract presentation and will be used to compose a manuscript for publication and will also be presented to ACC and health system leadership to help better serve all patients with cancer.

Project 3: A retrospective analysis of cancer clinical availability, eligibility and enrollment

The Abramson Cancer Center of the University of Pennsylvania is one of 45 comprehensive cancer centers nationwide and it is rated as exceptional cancer center by the NCI. That status allows the center to offer access to pateints of more than 500 clinical trials that are testing the cancer cures of tomorrow. However, preliminary evidence indicates that not all patients may have access to these trials, either because there is no trial for their disease or because they are ineligible. In this research, we will look at all the patients diagnosed with cancer in 2014 and the inventory of trials available for their disease during 2014. We will determne for what proportion of patients there was a trial available and, if there is a trial available, what proportion of patients were eligible for participation. The results of this study will be submitted for a scientific abstract presentation and will be used to compose a manuscript for publication and will also be presented to ACC and health system leadership to help better serve all patients with cancer.

Emile Mohler

Project 1: Evaluation of Vascular Disease with Near Infrared Spectroscopy

This research study is focused on the creation of a non-invasive method of diagnosis for patients with Peripheral Artery Disease (PAD). Currently, the most widely utilized method of diagnosis for this disease is an Ankle-Brachial Index or Segmental Pressures exam, which uses a patient's blood pressure as a means of diagnosis. However, in those cases where the patient's arteries cannot be compressed due a completely occluded artery, morbid obesity, or other large artifact these exams are inaccurate due to super-normal or false-positive readings. As a result, this increases the demand for a more sensitive and accurate means of diagnosis.

Near infrared spectroscopy (NIRS) is a noninvasive method that can be used to evaluate both the level of microvascular blood flow as well as the level of blood oxygenation, and has not been tested a diagnostic method for PAD. Therefore, it could potentially be used as a means of diagnosis, especially in those cases that are technically limited. By transmitting infrared light through targeted tissue, a detector generates a reading for the blood hemoglobin levels based on theconcentration of reflected light waves that were unabsorbed. The student would assist with this clinical trial and learn about the diagnosis and treatment of vascular disease.

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Project 2: A Phase 2, Multi-center, Randomized, Double-Blind, Placebo- Controlled, Dose Range Finding Study to Evaluate the Safety, Hemodyn

The purpose of this study is to evaluate the effects on blood flow, safety, and efficacy of injections into the leg muscle of human placenta-derived cells (PDA-002) in patients who have diabetic foot ulcer (DFU) with peripheral artery disease (PAD) The study drug that is being tested is called PDA002. PDA002 is a liquid that contains cells made from normal, human placenta (the "afterbirth"). Laboratory studies have shown that PDA002 can dampen down the immune system and increase the growth of blood vessels.

Therefore, it may have beneficial effects in diseases in subjects with Diabetic Foot Ulcer with Peripheral Artery Disease. To date, PDA-002 has been studied in 15 subjects with Diabetic Foot Ulcer with Peripheral Artery Disease. The student would assist with patient recruitment, study visits and learn treatment of PAD.

Project 3: Evaluation of cellular and sub-cellular biomarkers of left ventricular assist device thrombosis

The use of left ventricular assist devices (LVAD) to treat advanced heart failure has progressively increased, particularly with the introduction of smaller continuous flow LVADs. The clinical demand for LVADs is likely to continue to increase with the projected population growth of patients with heart failure. A major impediment to greater implementation of LVADs on congestive heart failure patients is the concern for pump thrombosis, thromboembolic events, hemolysis and bleeding events.

The goal of this study is to further delineate the underlying biology of VAD thrombosis to subsequently provide a precision based approach to the prevention of thromboembolic events in end-stage heart failure patients requiring ventricular assist device support. This pilot study will serve to primarily to determine the baseline VHP characteristics of LVAD patients and determine corroboration previously validated biomarkers to predict thrombosis in ventricular assists devices.

We anticipate that the VHP will provide a novel ability to predict LVAD thrombosis. Our data will help identify those heart failure patients at the highest risk of VAD thrombosis that would consequently benefit from acute intervention. The student would help with patient recruitment, processing of blood samples and data entry. Also, the student would gain insight into treatment of patients with cardiovascular disease.

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Sigrid Veasey

Project 1: Short Sleep Early in Life: Hastening the Temporal Progression of Alzheimer's

The age at onset of symptomatology and the temporal progression of sporadic Alzheimer's disease (AD) can vary by decades. Earlier cognitive decline carries tremendous personal and societal impact, yet little is known of mechanisms influencing the onset and progression of AD. Locus coeruleus (LC) neurons evidence early deposition of tau protein and early degeneration in AD and may contribute to the spreading of tau within the forebrain. Intermittent short sleep (ISS), common in modern societies, disturbs metabolic homeostasis in LC neurons, resulting in mitochondrial hyperacetylation, oxidative neural injury and degeneration. In Preliminary Studies, we find that the amyloid precursor protein (APP) single knock-in mouse (APPki) model of Alzheimer's evidences heightened susceptibility to ISS-induced mitochondrial hyperacetylation and oxidative stress and that ISS produces a robust increase in LC neuronal A-beta1-42 and tau, marked degeneration of LC neurons and earlier cognitive impairment. Remarkably, two months after ISS, LC neuronal tau acetylation and A-beta 1-42 remain elevated, and spatial object recognition is impaired.

The overall hypothesis for our work is that short sleep times early in life increase metabolic stress in wake-activated neurons including LC neurons and that in response to metabolic stress amyloid and tau responses within affected neurons are post-translationally modifed and, in turn, promote feed forward intraneuronal metabolic injury that hastens AD onset and/or progression. To gain insight into the relevance of LC injury from ISS and its influence on AD progression, we propose to implement novel murine models of targeted viral vectors, STOP-LoxP/cre mice and CRISPR/Cas9 LoxP/cre mice to modify LC levels of tau, mitochondrial sirtuin 3 activity, and A-beta1-x, respectively.

We will test the following hypotheses: (1) that ISS is sufficient a metabolic stressor for LC neurons to result in a sustained tau acetylation accumulation in LC neurons and that tau propagation from LC neurons with cell to cell spread of pathological tau is modified by ISS; (2) that improving mitochondrial deacetylase activity improves LC neuron clearance of toxic amyloid and tau, lessens ISS-induced degeneration and delays cognitive decline in the APPki mouse; and (3) that LC intraneuronal A-beta is essential for ISS-increased LC tau acetylation and accumulation, LC degeneration, cortical ISS tau propagation and hastening the progression of cognitive decline. These studies will inform the significance of young adulthood chronic sleep loss in AD progression and advance our understanding of LC intraneuronal A-beta and tau accumulation and metabolic homeostasis interactions in mechanisms of AD progression that in turn will unveil the promise of potential therapeutic targets.

The PURM student will be an integral member of the lab and will select one of these three aims on which to work and will be trained to perform immunohistological and molecular (RT-PCR and/or Westerns/ELISA's) for that particular project. Ideally students should have some college

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coursework in Biology and Chemistry. This is a tremendous lab training experience, an opportunity to be a valued member of a research team, as well as the chance to answer a big question in sleep: what is the importance of sleep?

MICROBIOLOGY

Hao Shen

Project 1: Vacccine against bacterial pneumonia

Pneumonia caused by Streptococcus pneumoniae (Sp) remains a leading cause of serious illness and numerous deaths in children and elderly worldwide. Current pneumococcal vaccine is effective in preventing colonization by inducing serotype-specific antibodies. However, there is an increasing prevalence of infection by serotype strains not included in the vaccine; this highlights the need for a universal vaccine that protects against all serotypes. In our recent studies, we have found that mice intranasal immunized with Sp are protected against challenge with a different serotype Sp strain. Sp infection in lung results in a tremendous CD4+T cell expansion and activation that consisted of mostly IL-17 producing Th17 cells. Adoptive transfer of Sp-specific CD4+ memory T cells provides cross protection against pneumonia and bacteremia, and the protection is dependent on IL-17 produced by memory CD4 T cells. Our results suggest that Sp memory Th17 cells played a key role in providing broad protective immunity against invasive Sp infection in a serotype independent manner. This PURM project seeks to expand on our findings by testing clinical isolates of Sp and analyzing the resulting immune response. The student will culture bacteria and learn how to use a mouse model of Sp infection with clinical isolates and analyze the immune responses using flow cytometry. The results of these studies could be instrumental in developing a universal vaccine against bacterial pneumonia.

Jay Zhu

Project 1: Vibrio cholerae ROS resistance during infection

Vibrio cholerae is a human pathogen which colonizes small intestines of host, resulting in the onset of a severe diarrheal disease known as cholera. In order for V. cholerae to successfully colonize the host, it must express a series of virulence factors, which have been the main focus of the cholera research. However, bacterial pathogenicity is a multifactorial property in vivo that involves host response to infection, and gut microbiome interference of colonization. For example, although the pathology of cholera is not immune driven, it has been shown that minor, but significant inflammation responses in cholera patients and in experimental animal models are induced by V. cholerae infection and likely play a role in the resolution of disease. Little is

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known how inflammation is induced by V. cholerae and how V. cholerae copes with these signals and help its colonization. This project will use genomics, genetics and biochemical analysis to understand how V. cholerae interacts with host and gut microbiome to initiate its successful colonization.

NEUROLOGY

Lama Chahine

Project 1: Cognitive-Behavioral Therapy for Insomnia in Parkinson's Disease

Parkinson’s disease (PD) is the 2nd most common neurodegenerative disorder affecting >4 million in the 10 most populous nations, and this is expected to increase dramatically as the population ages.While it was classically considered a motor disorder, non-motor manifestations invariably occur. Sleep problems are among the most common non-motor manifestations of PD, occurring (by subjective report) in over two-thirds of PD patients, with approximately one-third reporting moderate to severe sleep problems. Insomnia (difficulty initiating and maintain sleep) is one of the most common sleep complaints in PD. Sleep problems in PD are associated with more severe disease manifestations including depression and cognitive impairment, and have significant negative effects on quality of life in PD. The potential etiologies of insomnia in PD are many including motor symptoms and primary sleep disorders such as obstructive sleep apnea. However, in the majority of patients, insomnia occurs in the absence of identifiable and treatable etiologies. In such cases, insomnia may have psychophysiologic components (insomnia marked by worrying about sleep and associated with conditioned arousal in bed). Treatment of insomnia in PD is not well studied, with little evidence available to guide treatment. In particular, little data exist on the utility of non-pharmacologic treatments, which are desirable in PD given the potential adverse consequences (such as daytime sleepiness and increased risk of falls) of the sedative hypnotic agents that are commonly used to treat insomnia in other populations. In the non-PD population, there is robust data supporting the use of cognitive-behavioral therapy for insomnia (CBTi) (administered by a psychologist or other trained professional) which leads to sustained reductions in sleep latency. There are little data on CBTi in PD. This project is a retrospective chart review aiming at collecting preliminary data on the effects of CBTi in PD. This data will be important for designing clinical trials to treat insomnia in PD with behavioral interventions

Project 2: Differences in Subjective Sleep Report Among Patients and their Bed-Partners

Parkinson’s disease (PD) is the 2nd most common neurodegenerative disorder affecting >4 million in the 10 most populous nations, and this is expected to increase dramatically as the population ages. While it was classically considered a motor disorder, non-motor manifestations invariably occur. Sleep problems are among the most common non-motor manifestations of PD,

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occurring (by subjective report) in over two-thirds of PD patients, with approximately one-third reporting moderate to severe sleep problems. The best way to measure sleep problems in PD is not well-defined. Discrepancies often arise between patient and bed-partner report of the patient's sleep. The objective of this project is to utilize data from a prospective cohort study to compare patient and bed-partner responses on multiple different types of sleep surveys that query the the patient's sleep and to determine which show the most consistency over time. This data will be useful in designing optimal sleep questionnaires for PD.

Project 3: Sleep and Sleepiness Complaints Among Depressed Parkinson's Patients

Parkinson's disease (PD) is the 2nd most common neurodegenerative disorder affecting >4 million in the 10 most populous nations, and this is expected to increase dramatically as the population ages. While it was classically considered a motor disorder, non-motor manifestations invariably occur. Depression and sleep problems are among the most common non-motor manifestations of PD. Sleep problems are a core feature of depression in the general population. The sleep manifestations in PD are not well understood. This project will examine responses on questionnaires that query sleep and daytime sleepiness in PD patients with and without depression. Understanding the sleep/sleepiness symptoms that depressed PD patients suffer from will help tailor treatments to improve not only sleep/sleepiness but perhaps also depression in PD.

H. Branch Coslett

Project 1: Effects of Vision and Proprioception on the Body Schema: A study with Transcranial Magnetic Stimulation

Vision of the hand improves participants' accuracy in tactile discrimination and this effect is further enhanced increasing the perceived size of the hand with magnifying glasses. The spatial configuration of the fingers also plays an important role in the detection of tactile stimulation, as the accuracy increases when fingers are spaced apart then when are touching each other. This project explores the relative contribution of vision and proprioception in spatial identification of tactile stimulation and the brain regions, which might modulate these effects. Participants will be asked to identify whether a vibrotactile stimulation was delivered at the ring or middle finger of their left hand placed in four different configurations (all fingers spaced, close proximity between all fingers, only ring and middle fingers touching, ring and little touching, middle and index touching). This task will be performed in three different conditions: looking at the hand in normal vision, with magnifying glasses or looking at an object. This task will be proposed before and after two 20 minutes 1 Hz Transcranial Magnetic (TMS) stimulation over brain regions involved in the above-mentioned effect of vision and proprioception, such as anterior intraparietal solcus (aIPS) and Brodmann area 5 (BA5). We expect that TMS over the aIPS will reduce the effect the vision of the hand, while TMS over BA5 will induce modification of the

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performance across spatial configurations of the finger. The appointed student will be involved in data collection and analysis and will have the opportunity to learn TMS.

Project 2: Visual and Motor Attention: Effects of trancranial Direct Current Stimulation

In graphic copying or gesture imitation, some patients with brain damage show the tendency to perform movements inappropriately, close to, or on the top of the model to be copied. This symptom, known as closing-in (CI), reflects a disorder of the attention-action system in which visual and motor attention converge. The neuroanatomical correlates of CI remain unknown; the phenomenon has been attributed by some to disruption of brain regions involved in copying tasks (e.g., posterior parietal cortex) whereas other investigators argue that it reflects action inhibition deficits associated with dorsolateral frontal cortex. Using transcranial direct-current stimulation (tDCS), a non-invasive brain stimulation technique able to modulate (facilitate or inhibit) cortical activity, this project aims at modelling CI in young adults and investigating its neuroanatomical correlates. Participants (n=24) will be randomly assigned to one of two groups (anterior or posterior tDCS stimulation) and will undergo three counterbalanced tDCS sessions (anodal, cathodal and sham). In each session, after 10 minutes of tDCS stimulation participants will perform tasks known to elicit CI (e.g. graphic copying,, gestural copying, and line drawings in dual task conditions). We predict that the distance between model and copy of an action will decrease after anodal and cathodal but not sham tDCS delivered to the anterior brain region, demonstrating that CI is associated with disruption of the action inhibition system mediated by the dorsolateral frontal cortex. This study require that students learn about the functional anatomy of the action system of the human brain and will provide first-hand experience with tDCS, an emerging experimental technique in cognitive neuroscience.

Sandhitsu Das

Project 1: Application of advanced neuroimaging in epilepsy

Pre-requisites: Familiarity with basic statistical methods and data organization. Experience with UNIX command line environment a plus.

Description: One form of intractable epilepsy is characterized by seizures originating from substructures in the the medial temporal lobe region of the brain. Accurate identification of seizure focus using quantitative, non-invasive imaging techniques can have a positive impact in patient care by reducing cost and morbidity associated with commonly used invasive EEG monitoring methods. High-resolution structural imaging that can reliably delineate these substructures can provide measurements that have the potential for automatic identification of candidate seizure origination zones. A large dataset consisting of 1) annotated intracranial recording sites in patients where seizure activity originated, 2) High-resolution MRI data that can help localize the recording sites within MTL substructures and 3) Comprehensive

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neuropsychological test performance, will be made available to the student. The project will require organization and analysis of this dataset, with the goal of performing a comprehensive validation of the utility of the imaging measurements for prediction of seizure onset zones, as well their relationship to neuropsychological testing. In addition to image visualization, quality check, and statistical analysis, some manual correction of automated anatomical labelings using a graphical tool may also be required. The project offers an opportunity to get hands-on experience in the application of advanced neuroimaging techniques in epilepsy. The project will be co-mentored by Dr. Kathryn Davis (Neurology) and Dr. Joel Stein (Radiology).

Project 2: Development of visualization tools for intracranial EEG data ***Rising Juniors only***

Pre-requisites: Some experience with GUI programming is recommended. Familiarity with UNIX environment required.

Description: Intracranial EEG is an invasive monitoring tool where brain activity is recorded by electrodes implanted inside the human brain in epilepsy patients who are candidates for surgical treatment. A wealth of neurophysiological data are acquired that can provide valuable information for neuroscientists trying to understand the functioning of human brain. This project will involve building visualization interfaces using existing image processing tools to display and analyze these data on three-dimensional computational models of the human brain. These tools will potentially be used by a number of clinical sites for research purposes as well as patient care, and as such promises to be a very rewarding experience for the motivated student. The project will be co-mentored by Dr. Kathryn Davis (Neurology) and Dr. Joel Stein (Radiology).

Project 3: Quantification of hippocampal digitation in temporal lobe epilepsy using high-resolution MRI

Pre-requisites: Familiarity with basic statistical methods recommended.

Description: Hippocampus is a brain structure that subserves learning and memory function, and is often a site of epileptic seizures. In drug-resistant epilepsy patients where no visible abnormality is present in this area on clinical MRI scans, risky invasive procedures are often recommended to localize the seizure zone. Recent advances in high-resolution imaging can potentially identify image features not observable on routine MRI. Periodic undulations of the surface of the hippocampal head region, known as digitations, have recently been postulated as one such imaging marker. In this project, the student will work towards characterizing and quantifying these patterns and evaluate their utility as a marker of seizure onset zones. This project offers the opportunity to work with state-of-the-art neuroimaging data on a problem of high clinical relevance, and upon successful execution would likely lead to at least a conference abstract. The project will be co-mentored by Dr. Kathryn Davis (Neurology) and Dr. Joel Stein (Radiology).

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Kathryn Davis

Project 1: MATLAB-Based GUI for semi-automated labeling of electrodes from post-operative CT and MRI in epilepsy patients

Mentors: Dr. Kate Davis and Dr. Sandy Das

Pre-requisites: MATLAB experience recommended (or willingness to learn it), Interest in user design and experience

Drug resistant epilepsy (DRE) is characterized by seizures that cannot be controlled by medications. It affects more than 1/3 of the world's 60 million patients with epilepsy. Some of these patients may be amenable to surgical therapy or treatment with implantable devices, but this usually requires delineation of discrete structural or functional lesion(s), which is challenging in a large percentage of these patients. This dilenation is done by segmenting signal-recording electrodes from images captured using Magnetic Resonance Imaging (MRI) and Computed Tomography (CT).

This project would require building a MATLAB GUI to assist with the automated labeling of electrodes (as labeled by clinicians at the Penn Epilepsy Center) with electrodes identified computationally using CT and MRI imaging. This GUI would be a user-friendly tool that would help clinicians and neuroscientists easily find electrode centroids and label them so that we can identify which EEG waveform corresponds to which electrode. This toolbox will use the ANTs imaging framework to perform image registration, segmentation, and feature computation. In addition, parallel pipelines will allow for easy combination of electrophysiology data with imaging data. Other similar tools that have attempted this have been partly successful but do not use the latest computational imaging tools. In addition, these tools are too specific for use. We aim to make a tool that will be user-friendly and applicable in a wide range of neuroscience settings.

Project 2: Estimation of Resection Zone (aka Virtual Resection) using network features derived from ECoG in patients with drug-resistant ep

Mentor: Dr. Kate Davis and Dr. Brian Litt

Pre-requisites: Strong MATLAB or Python experience required. Interest in data or network science.

Drug resistant epilepsy (DRE) is characterized by seizures that cannot be controlled by medications. It affects more than 1/3 of the world's 60 million patients with epilepsy. Some of these patients may be amenable to surgical therapy or treatment with implantable devices, but this usually requires delineation of discrete structural or functional lesion(s), which is

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challenging in a large percentage of these patients. Currently, the gold standard for outlining lesions in DRE patients is through the identification of the epileptogenic zone, the region recruited to seize on scalp EEG or in conjunction with invasive intracranial monitoring utilizing subdural strips, grids, depth or stereo EEG electrodes.

This project is a new idea derived from the work from a recently-graduated PhD student and being led by a Neurology resident. This project attempts to validate network science features derived from the work in Dr. Bassett's lab in a retrospective patient cohort with intractable epilepsy. It would require computing multiple advanced "network" features derived from ECoG (EEG on the brain) and determining which nodes (or electrodes) would be estimated to be in the resection zone, i.e. the region of the brain that is cut out by a surgeon to cure a patient of their epilepsy. It requires tedious labor in retrieving the ECoG from the hospital, preprocess large amounts of ECoG data and well as the imaging (MRI/CT), and then running in-house code that computes network features on electrophysiology data obtain from ECoG.

Ethan Goldberg

Project 1: Large-scale imaging and manipulation of epileptic seizures

The laboratory studies the function of cerebral cortical circuits as well as circuit dysfunction in epilepsy, a common and debilitating neurological disease. Illuminating the logic of circuit function is a fundamental problem in neuroscience; understanding the basis of circuit dysfunction in epilepsy could lead to transformative therapies. We use electrophysiology, optogenetics, and two-photon calcium imaging in brain slices and in awake, behaving mice in vivo to investigate mechanisms of epilepsy in experimental model systems. The applicant will use these techniques to perform cellular-resolution imaging of seizures and attempt to manipulate seizure activity using optogenetics.

David Irwin

Project 1: Neuropathological staging of non-amnestic forms of Alzheimer's disease

Neuropathological staging of Alzheimer's disease neuropathology has been critical for biomarker studies to improve diagnosis. There are a significant number of patients with Alzheimer's disease neuropathology and non-amnestic symptoms but no efforts to stage the progression of pathology has been attempted in these atypical cases. The student will use digital image analysis of histology to measure tau burden in different cortical areas so we can construct a staging scheme for the progression of tau pathology in non-amnestic AD. The student will learn histology anatomy and manually segment regions of interest on a digital image of a histology slide using a computer program. The student will then apply validated algorithms to the regions of interest. With my supervision they will analyze regional pathology data (area occupied stain output).

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They are also welcome to shadow me in clinic. Basic computer skills, statistics and neuroscience background are needed.

Project 2: Endophenotypes of Frontotemporal dementia

Frontotemporal dementia has heterogeneous underlying neuropathology that cannot be clinically diagnosed during life. This project will examine clinical features from a large public database (NACC) in autopsy-confirmed samples. The student will organize spreadsheets and learn basic statistical analyses to compare the frequency and severity of reported symptoms in the database between groups. The student will also organize a chart review session for our group to review charts and categorize patient symptoms in the record to develop endophenotypes that predict pathology. The student will be an active participant in the consensus meetings and gain familiarity with many aspects of cognitive neurology and neuropathology. They are welcome to shadow me in clinic and review histology slides. Basic computer skills, statistics and neuroscience background are needed.

Project 3: Quantifying Neuron loss and gliosis in neurodegenerative disease

Digital image analysis of histology provides a high throughput method for studying neuropathology in neurodegnerative disease. The relationships between tau and TDP-43 inclusions, neuronal loss, gliosis and disease duration are not clear. This project will use a new digital image analysis method to measure neurons and activated glial cells using a computer algoroithm on digital images of histology slides. Students will manually segment images for analysis and help develop computer algorithms to detect neurons and glia. They are welcome to shadow me in clinic and review histology slides. Basic computer skills, statistics and neuroscience background are needed.

Daniel Licht

Project 1: Developing and optimizing patient interfaces for optical spectroscopy

The June and Steve Wolfson Laboratory for Clinical and Biomedical Optics in the Division of Neurology, Children's Hospital of Philadelphia focuses on detecting and preventing ischemic injury in the vulnerable pediatric brain. Much of our current work focuses on cerebral measurements in children with severe congenital heart defects utilizing fiber optic sensors. We currently have an opening for an undergraduate researcher with an interest in developing pediatric patient interfaces. The dramatic range in size from a neonate to a teenager brings with it a host of challenges for medical devices. In this project, you will work with a multi disciplinary team of clinicians, engineers, and physicists to improve these interfaces, test the interfaces in the lab, and translate these tools into clinical measurement. This project will offer the opportunity to engage in the full range of clinical translational research from concept to applying the devices to baby's skin.

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Project 2: Developing Optical Thermometry

The June and Steve Wolfson Laboratory for Clinical and Biomedical Optics in the Division of Neurology, Children's Hospital of Philadelphia focuses on detecting and preventing ischemic injury in the vulnerable pediatric brain. Much of our current work focuses on cerebral measurements in children with severe congenital heart defects utilizing fiber optic sensors. An ongoing project focuses on understanding and quantifying the benefits of neuroprotective hypothermia during open heart surgery. We currently have an opening for an undergraduate researcher to assess how current measures of clinical temperature (e.g., tympanic) relate to core temperature and to contribute to development of a non-invasive optical thermometer. In this project, you will work with a multi disciplinary team of clinicians, engineers, and physicists to develop tools, test them on the bench-top, translate into animal studies, and prepare for clinical translation. This project will offer the opportunity to engage in the full range of clinical translational research from concept to operating room.

Project 3: Intravascular Measurements of Lymph Flow

The June and Steve Wolfson Laboratory for Clinical and Biomedical Optics in the Division of Neurology, Children's Hospital of Philadelphia focuses on detecting and preventing ischemic injury in the vulnerable pediatric brain. Congestive heart failure is a common complication of single ventricle circulation. This failure is associated with pathologic drainage of lymph into the vascular system. We have recently begun work measuring lymphatic flow. We currently have an opening for an undergraduate researcher to take this project from proof of principle test to a robust instrument for animal trials. In this project, you will work with a multi disciplinary team of clinicians, engineers, and physicists to test tools on the benchtop, translate into animal studies, and prepare for clinical translation. This project will offer the opportunity to engage in the full range of clinical translational research from concept to operating room.

David Raizen

Project 1: Identifying mechanisms of sleep regulation ***Rising Sophomores only***

We spend one third of our life sleeping, and all animals sleep, from tiny round worms to humans. However, why we sleep and the basic molecular mechanisms regulate sleep and wake are poorly understood. We use the powerful laboratory animal C. elegans to discover new mechanisms of sleep regulation. The PURM student would be invited to assist in the identification of new sleep regulators. The approach would be to randomly mutagenize animals, then search for mutants with defective sleep. The gene mutated would then be identified by DNA sequencing. The student would be introduced to the (1) The use of model genetic organisms for modern biological research (2) Classical genetic analysis (3) Molecular DNA analysis (4) The science of sleep. The

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student would be mentored by Dr. Raizen and a post-doctoral fellow and would learn how to read the scientific literature and how to give scientific presentations. The Raizen lab has provided an introduction to science to over 10 undergraduate students, four of whom published papers. Nearly all have gone on to graduate school (3), medical school (3), or dental school (3). Students who wish to continue research during the academic year can, at the completion of their summer project, design a particular research project with Dr. Raizen.

Delia M. Talos

Project 1: The impact of altered immunity on synaptic development and behavior in a genetic mouse model of autism

Autism Spectrum Disorder (ASD) is characterized by core deficits in social interaction, language and communication, and restricted, repetitive patterns of behavior interests or activities. The incidence of autism appears to increase, yet there is no medication available that effectively targets the core disease symptoms. Our goal is to use established animal models of autism in order to design new strategies to effectively treat the disease, or limit its progression. As recent literature suggests altered immune responses in ASD, we would like to test whether suppressing brain inflammation during early postnatal period can rescue altered synaptic development and/or improve cognitive function and social behavior during adulthood.

This project will use a mouse model of Tuberous Sclerosis Complex (TSC), one of the most common monogenic causes of autism, accounting for about 4% of all diagnosed cases. The project will involve administration of drugs, as well as histological and biochemical brain tissue analysis. In addition, the student will have the opportunity to learn and perform various mouse behavioral tests, including sociability, repetitive behavior and anxiety-related assays, as well as several learning and memory tests. The student will be trained by current lab members and will be expected to perform experiments independently within the project. Candidates should have an interest in neurodevelopmental disorders. Some laboratory experience is preferred, but not required.

NEUROSCIENCE

Michael Platt

Project 1: Behavioral and Genetic Correlates of Alopecia in Free-ranging Monkeys (M. mulatta)

A growing and compelling body of research has linked alopecia, or hair-loss, to psychosocial stressors in captive, non-human primates. However, this relationship has been infrequently

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examined in an context outside of captivity where there is no medical intervention, contraception, nor sanctions placed on behavior. This is an invitation to two undergraduate students to join as research assistants on a comprehensive, on-going project studying the genetic correlates of behavior, cognition, and health in a population of rhesus monkeys (M. mulatta) living on Cayo Santiago island, Puerto Rico.

Students will be trained in an extant, easy to learn method for scoring hair-loss and apply it to the islands' ca. 1450 monkeys from a moderate distance and without live-trapping any animals. These monkeys are free-ranging, are habituated to human presence, and will provide an incredible opportunity to see these animals up close. Here we are interested in how social and genetic variation predict alopecia scores: Do socially subordinate and/or isolated individuals have greater alopecia? Do the genetic correlates of anxiety and depression predict alopecia? Is alopecia heritable?

This project is suitable for any biology, biological anthropology, or psychology major interested in primate field studies and behavioral ecology. Students can expect to be exposed to a multitude of research projects concurrently run on the island across these disciplines. Students will have access to affordable housing a minute walk from the beach and a 45-min drive from San Juan. If you have any logistical questions, please contact Sam Larson at larsonsa@sas.upenn.edu.

NEUROSURGERY

H. Isaac Chen

Project 1: Creating and transplanting frontal cortical neurons derived from human stem cells

The human brain has a limited capacity for repairing itself after injury. Especially after severe brain damage, the addition of new neurons and their associated processes and synaptic connections may be necessary to effectively restore neurological and cognitive function. Cortical neurons can be differentiated from human stem cell sources. Current differentiation protocols produce cortical neurons with an occipital or posterior cingulate cortex phenotype. While these neurons could help restore visual or default mode networks, they could not be used to reconstitute frontal cortex circuits (e.g., motor pathways). This project entails the development of new protocols for differentiating cortical neurons with a frontal cortex phenotype and the evaluation of their survival and network integration after transplantation into rodent brains. Participants in this project will learn principles of development and stem cell biology and a

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diverse set of skills, including culturing stem cells, differentiating neurons, live animal surgeries, and immunohistochemistry.

Project 2: Embedding electrodes within engineered neural tissues

Electrodes inserted into the brain for the purposes of stimulating and recording neuronal activity are often plagued by the development of scar tissue in the brain and micro-motion between the electrodes and the brain. These problems result in interface instability, which decreases the efficacy of the electrodes over the long-term and limits the clinical translation of technologies such as brain-computer interfaces. One potential solution is to build flexible electrodes into the structure of engineered neural tissues and subsequently to implant this hybrid device into the brain. Connections between the brain and the device would consist of biological synapses, and electrical activity would be conveyed to and from the electrodes of the device via the neuronal component of the device. This project involves developing techniques for growing neural tissues around flexible electrodes and assessing chronic neuronal survival and signal stability in vitro. Participants in this project will learn principles of neural tissue engineering and basic electrophysiology. Practical skills include neuronal cell culture, interrogation of electrode function, and in vitro electrophysiology.

Victoria E. Johnson

Project 1: The Chronic Neuropathological Consequences of Traumatic Brain Injury

Traumatic brain injury (TBI) is a substantial health problem with over 2.5M TBIs occurring in the US each year. Of further concern, TBI has been linked with an increased risk of the later development of epilepsy in some individuals - known as post-traumatic epilepsy (PTE). However, the mechanisms by which epilepsy develops after TBI are poorly understood. Emerging data describes the potential for on-going neuropathological changes that can persist for months and even years after severe TBI. Our lab is undertaking a series of studies to determine how these evolving brain changes may contribute to the development of PTE.

The student will have the opportunity to work on this project in a busy and collaborative laboratory environment. They will be able to learn a variety of techniques, including the preparation of tissue samples for neuropathological analysis. They will learn the principles of immunohistochemistry and perform this technique to explore post-traumatic brain changes at the cellular level. The student will also have the opportunity to further their understanding of brain structure and function in the context of traumatic injury. They will be encouraged to participate in our ongoing academic activities including scheduled talks and a bi-weekly journal club.

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OBSTETRICS & GYNECOLOGY

Ronny Drapkin

Project 1: Reprogramming of the PAX8 cistrome in ovarian cancer

A transcription factor which is unique to a particular cell type or tissue is known as a lineage defining transcription factor. The lineage defining transcription factor for the female reproductive (Müllerian) system is PAX8, which is expressed in both normal fallopian tube secretory epithelial cells (FTSECs) and their malignant counterpart, high grade serous ovarian cancers (HGSOCs). PAX8 is essential for the development of the Müllerian system. However, whether PAX8 acquires different functions after malignant transformation is unknown. Using chromatin immunoprecipitation and sequencing (ChIP-Seq), we show that FTSECs and HGSOCs are distinguished by marked reprogramming of the PAX8 cistrome, the genome-wide map of transcription factor binding sites. Whole transcriptome shotgun sequencing (RNA-seq) after PAX8 knockdown suggests that the transcription factor is not essential for gene expression under benign conditions, but may become essential in cancer. Moreover, comparison of the cistrome and transcriptome analyses reveals that genes which are significantly altered between benign and malignant cells are enriched near PAX8 binding sites, even if most of these genes are not directly PAX8-dependent. These changes may be related to altered expression in a transcriptional co-factor, TEAD3.

This PURM fellowship will address the networks that are controlled by PAX8 to define potential therapeutic vulnerabilities in HGSOC. RNA interference and CRISPR-based approaches will be used to functionally interrogate the interplay between PAX8 and TEAD3. Students will also have the opportunity to round with the gynecologic oncology fellows at the hospital and observe surgeries to treat ovarian cancer. Prior research experience is preferred.

Project 2: Cyclin E as a therapeutic target in ovarian cancer

The vast majority of ovarian cancer deaths are from high-grade serous ovarian carcinoma (HGSOC), which lags behind other solid cancers where molecularly targeted therapies are now in clinical use. HGSOC is a disease marked by profound copy number (CN) alterations rather than recurrent driver somatic mutations. In fact, aside from the ubiquitous presence of TP53 mutations, the frequency of other recurrent point mutations is less than 4%. Hence, amplification events offer the most likely tractable molecular targets in HGSOC. Amplification of the cell cycle regulator CCNE1 (cyclin E1) has emerged as an important therapeutic target in HGSOC. CCNE1 amplified tumors are characterized by predominately intact homologous recombination repair and relative chemo-resistance. CCNE1 belongs to the highly conserved cyclin family, whose members are characterized by a dramatic periodicity in protein abundance through the cell cycle. Cyclins function as regulators of cyclin-dependent kinases (CDKs). Cyclin E1 forms a

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complex with CDK2 to regulate cell cycle G1/S transition. Deregulation of cell cycle control is a pre-requisite for tumor development. We previously showed that deregulation of CCNE1 is an early event in HGSOC. Cyclin E1 amplification drives unscheduled entry into S phase which results in replication fork stress and DNA damage. To tolerate this stress, CCNE1-amplified cancer cells up-regulate proteins involved in DNA repair and fork protection. PURM fellows will use cell culture and analysis of DNA fiber length, immunofluorescence, proximity ligation assay, and western blot analyses to address the dependencies and vulnerabilities of CCNE1 amplified tumors. Opportunities to observe ovarian cancer surgeries will also be available.

ORTHOPAEDIC SURGERY

Atul Kamath

Project 1: Risk stratification in Orthopedic Surgery - Implications for Health Policy

Optimizing patients for surgery remains an important part of successful outcomes in orthopedic surgery. More study is needed to define risk factors for poor outcomes after orthopedic surgery interventions. The mentee will join on projects related to understanding and evaluating the role of risk stratification related to orthopedic surgery, from sports medicine/ hip preservation to total joint arthroplasty care. Ongoing work in retrospective and prospective topics will be included, and the student's motivations and interests will guide this mentorship experience. It is anticipated that the student will produce a peer-review publication under the close guidance of the mentor.

The student will also get an in-depth exposure to orthopedic surgery, including potential to shadow in clinic and the OR. The mentor has worked with a number of students of varying levels, including current Penn Med students and residents. There are no specific prerequisites, but interest in clinical/ patient outcomes important; statistical background is a plus.

Project 2: Patient Attitudes and Perceptions in Orthopedic Surgery

The patient experience, including perioperative expectations and perceptions, play an important role in outcomes after non-surgical and surgical treatments. The mentee will join on projects related to understanding and evaluating the attitudes and perceptions related to orthopedic surgery, from sports medicine/ hip preservation to total joint arthroplasty care. Ongoing work in retrospective and prospective topics will be included, and the student's motivations and interests will guide this mentorship experience. It is anticipated that the student will produce a peer-review publication under the close guidance of the mentor.

The student will also get an in-depth exposure to orthopedic surgery, including potential to shadow in clinic and the OR. The mentor has worked with a number of students of varying

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levels, including current Penn Med students and residents. There are no specific prerequisites, but interest in clinical/ patient outcomes important; statistical background is a plus.

Project 3: Readmissions in Orthopedics - Causes and Consequences

Readmissions for medical/ surgical complications in orthopedic surgery is an important topic. Readmissions have both medical and health economic implications. The mentee will join on projects related to understanding and evaluating the causes and consequences of readmissions related to orthopedic surgery, from sports medicine/ hip preservation to total joint arthroplasty care. Ongoing work in retrospective and prospective topics will be included, and the student's motivations and interests will guide this mentorship experience. It is anticipated that the student will produce a peer-review publication under the close guidance of the mentor.

The student will also get an in-depth exposure to orthopedic surgery, including potential to shadow in clinic and the OR. The mentor has worked with a number of students of varying levels, including current Penn Med students and residents. There are no specific prerequisites, but interest in clinical/ patient outcomes important; statistical background is a plus.

Louis Soslowsky

Project 1: Orthopaedic Bioenginering

Various projects in tendon and ligament injury, repair, and regeneration

OTORHINOLARYNGOLOGY

Richard L. Doty

Project 1: Olfactory Dysfunction and Mortality

Smell loss is one of the strongest risk factors for impending death in otherwise healthy older persons. It is a stronger predictor than cancer, stroke, lung disease, or hypertension, even when controlling for age, sex, race, education, socioeconomic status, smoking behavior, alcohol use, and diabetes. The reasons for this association are unknown.

This project addresses critical gaps in knowledge regarding the association between smell loss and future mortality and will determine whether taste dysfunction contributes to the prediction of mortality in healthy cohorts. It has the potential to identify individuals with chemosensory dysfunction who are most at risk for earlier death and who, in some cases, may be amenable to interventions that decrease such dysfunction and the likelihood of premature demise. The relationship between the causes of smell loss and the causes of mortality of persons from a

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unique and well-defined population of ~ 5,200 patients tested at the University of Pennsylvania Smell and Taste Center over the course of the last 35 years will be assessed, along with data from the National Death Index (NDI) and other sources.

If chosen for this project, you will be working closely with Professor Richard L. Doty, Director of the Smell and Taste Center. He is a pioneer in developing and validating practical quantitative tests of olfaction, including the olfactory tests to be used in this study. Some of the tests he has developed and helped to commercialize have led to significant advances in a number of fields, most notably neurology and epidemiology.

PATHOLOGY & LABORATORY MEDICINE

Ahmad Abou Tayoun

Project 1: Clinical sequencing of human highly homologous genes *Rising Juniors only*

Genomic sequencing, mainly large gene panels, whole exome and whole genome sequencing, is gradually becoming a routine clinical practice, and has significantly improved diagnostic yields in several clinical scenarios. Nonetheless, several challenges still stand in the way of widespread adoption of clinical genomics. Many such challenges are technical in nature and are inherent in our genomic structure and the commonly used sequencing methodology, namely next-generation sequencing or NGS. Specifically, our genome has accumulated several regions that are highly homologous to genes known to cause disease. Such regions, also called pseudogenes (non-functional genes), pose a major challenge to obtaining unique sequences from the true, functional genes. For example, using current technology, a disease causing sequence change (variant) in a disease gene is very likely to be mistakenly assigned (and thus missed) to its highly homologous pseudogene. To avoid missing such variants and to achieve the highest clinical sensitivity, clinical laboratories currently resort to other strategies to obtain unique sequences from disease genes known to have highly identical pseudogenes. Although have been shown to be useful (Mandelker et al 2014), these approaches tackle only one gene at a time, and are thus not scalable to the estimated ~200 pseudogenes found in the “medical” exome. The goal of this project is to optimize a “novel” molecular approach that will allow simultaneous sequencing of several disease genes with high homology regions. The student will be learn a few molecular wet bench protocols, and will be supervised to run optimization experiments to achieve the above goal.

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Project 2: Defining disease sensitive regions ***Rising Juniors only***

Genomic sequencing, mainly large gene panels, whole exome and whole genome sequencing, is gradually becoming a routine clinical practice, and has significantly improved diagnostic yields in several clinical scenarios. Nonetheless, several challenges still stand in the way of widespread adoption of clinical genomics. Massively parallel sequencing, also called next-generation sequencing, allowed the generation of large amount of sequence data in an unprecedented manner. Although bioinformatics approaches have been able to significantly reduce the number of sequence changes (variants) obtained, diagnostics laboratories are still left with a large number of such variants to interpret and determine their clinical significance in the context of patient phenotype. The goal of this project to use sequence data from controls and affected individuals to determine regions within genes that are more likely to be disease relevant (mutation hot spots) than others. The student will work with the mentor to determine the distribution of control and disease variants across all domains of relevant genes. Basic and advance statistical approaches will be used to quantify domain-disease associations. This information will be very helpful in prioritizing variant interpretation in a gene of interest. Students with interest in genetic diseases and with computational skills, or interest in self-acquiring such skills, are highly encouraged to apply.

Laurence Eisenlohr

Project 1: Mechanisms underlying the rapid killing of virus-infected cells by CD8+ (cytolytic) T cells

CD8+ "cytolytic" T cells play a key role in host responses to viral infections by killing infected cells before new virions can be assembled and released. This can require extremely rapid degradation of newly synthesized viral proteins and display of the resultant peptides at the surface of the infected cell in combination with Major Histocompatibility Complex Class I molecules. We continue to explore the forces that drive rapid "processing" of viral proteins, and how these forces might differ depending upon the nature of the processing substrate. Indeed, we have demonstrated that processing of antigen targeted to the endoplasmic reticulum is both qualitatively and kinetically distinct from antigen targeted to the cytosol. In addition, we have proposed a model in which the almost instantaneous processing of cytosolic antigens is not due to defectiveness on the part of the antigen but, rather, unchaperoned nascent peptide. Currently, we are testing various aspects of this model. Our efforts could significantly enhance the rational design of vaccines that are intended to target the CD8+ T cell compartment.

Project 2: Recognition of endogenous antigen by CD4+ T cells

A generally accepted paradigm in immunology is that CD4+ T cells recognize peptides derived from exogenous (internalized) sources of antigen while CD8+ recognize peptides derived from

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endogenous (intracellular) sources of antigen (generally, proteins synthesized within the antigen-presenting cell). It had been known for over two decades that exceptions to this rule exist – that endogenous sources of antigen can contribute to CD4+ T cell activation. However, the cases were considered so rare that the field has not paid much attention to this alternative. Recently, we have assessed the prevalence of alternative, endogenous MHC class II-restricted antigen processing. In work that that was recently published, we found that a network of endogenous processing pathways are, by a wide margin, the major drivers of the primary CD4+ T cell response to influenza and also rabies. These findings should fundamentally alter a cornerstone principle of basic immunology and, consequently, rational vaccine design. It should also expand the potential scenarios for the development of autoimmune disease and the potential targets for cancer immunotherapy. Efforts in the lab are currently aimed at mapping the intracellular pathways that contribute to endogenous MHC class II restricted processing, investigating the processing of other viruses and also bacteria, and extending the work to autoimmunity and cancer immunotherapy.

Project 3: Immune recognition of papillary thyroid cancer

For several years we have applied our experience in viral immunity to the very challenging area of cancer immunotherapy. In my view, infectious diseases have put far greater evolutionary pressure on the immune system than cancers. Thus, the key is to make cancerous cells look like infected cells to the immune system. In the case of virus-induced cancers such as cervical cancers, this arrangement is already in place and the vaccine is exceedingly effective. The situation appears to be similar with papillary thyroid cancers caused by the RET/PTC3 (RP3) fusion protein. Despite not having a viral etiology, RP3 causes neoantigen formation via aberrant phosphorylation, resulting in the presentation of tumor-specific phosphopeptides. RP3 also activates NFκB, resulting in the release of proinflammatory cytokines from tumor cells. These two signals (foreignness and inflammation) signal presence of an infection to the immune system. We have been pursuing the hypothesis that RP3-induced papillary thyroid cancer is relatively benign because it induces a robust, effective T cell response to the cancer-specific phosphopeptides and this keeps the cancer in check. We have published evidence to this effect and demonstrated that the transforming and inflammation-inducing signals emanating from RP3 can be functionally dissociated. The work provides an important counterbalance to the notion that inflammation enhances cancer progression. Current efforts are aimed at defining the cancer-specific phosphopeptides produced by RP3-expressing cells and in elucidating the inflammatory environment established by this cancer.

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Zissimos Mourelatos

Project 1: The secret life of messenger RNAs (mRNAs)

Messenger RNAs (mRNAs) convey, from DNA, the genetic information that will generate all proteins. The textbook view of mRNA lifecycle dictates that translating ribosomes protect mRNAs in order to make full-length protein, while mRNA degradation occurs mostly on mRNAs not undergoing translation, to prevent the formation of truncated polypeptides that would be detrimental to cells. We find that the exact opposite occurs in vivo. Our findings open up a novel area of gene expression regulation. We investigate how this novel pathway of mRNA lifecycle is tied to translation, cell proliferation and differentiation by using biochemical, cell biological and high throughput approaches. The student that undertakes this project will be guided by very experienced and collegial postdoctoral fellows and will participate in generation of libraries for next-generation sequencing, cellular fractionations and purification of ribonucleoproteins (RNPs) for characterization of their associated RNAs, from human and mouse cells lines, including embryonic stem cells and differentiated cells.

Project 2: Biogenesis and function of piRNAs

Germ cells carry the “essence” of most forms of multicellular life by storing, shaping (via meiosis), and transmitting the genetic information that propagates a species. They express Piwi family proteins that bind to small RNAs known as piwi-interacting RNAs (piRNAs) to form pi-RiboNucleoProteins (piRNPs) that silence retrotransposons, a function critical for preserving genome integrity.We have identified multiple factors that are required for processing piRNAs from longer RNA precursors and we now investigate precise molecular functions of these proteins in piRNA biogenesis using biochemical, cell biological and genetic approaches. The student that undertakes this project will be guided by very experienced and collegial postdoctoral fellows and will participate in protein and RNA biochemical experiments, including RNA and protein purifications, immunoprecipitations and cell biological experiments in cells using transfections and and RNAi technologies for gene knockdowns and knockouts.

Warren Pear

Project 1: The regulation of immune cell function by Trib1

Members of the Tribbles protein family are implicated in a multitude of biological processes including cancer, metabolism, development, and immunity where they regulate important cellular signals. Although implicated in both normal physiology and disease, the mechanisms by which Tribbles regulates these events are poorly understood. The Pear lab is particularly interested in the function of the immune system and cancer. To investigate how Tribbles functions in these processes, we conducted a screen to identify proteins that interact with

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Tribbles. The project in the Pear lab will focus on validating these proteins and showing their functional relevance to Tribbles pathophysiology. Techniques that are likely to be used include tools of biochemistry and molecular biology, such as immunoprecipitation and CRISPR, as well as functional studies in cell lines to assess immune function and transformation. These studies will be conducted in close association with predoctoral and postdoctoral trainees in the Pear lab.

Project 2: Identification of T cell specific factors that enhance Myc expression in normal and malignant T cells

Activating Notch1 mutations are common in T cell acute lymphoblastic leukemia (T-ALL), where they lead to dysregulated transcription. An important transcriptional target of Notch in cancer is the oncogene Myc. Myc plays a central role in regulating transcription, metabolism, proliferation, and survival in a diverse group of cancers. The Pear lab and other groups identified an important regulatory element ("enhancer") that regulates Myc transcription specifically in T cells. In addition to Notch1, several other T cell specific transcription factors bind to the Myc enhancer in malignant T cells. However, it is unclear what role these factors play in activating the Myc enhancer and if these factors are sufficient for the T cell specific usage of the Myc enhancer.

This project will investigate how the T cell specificity of this important enhancer is achieved. The project will identify the T cell specific factors that enhance Myc expression and determine whether these factors can provide activity in non-T cells. This project will provide important insights into the mechanisms of regulating Myc and may identify novel targets for treating leukemia. This project will be conducted in close association with Pear lab members. Techniques that will be utilized include DNA cloning, reporter assays, cell culture, cell transfection, luciferase assays, gene mutation using CRISPR/Cas9.

Erica Stone

Project 1: Tumor immunotherapy - novel targets

In this project the student will be involved in a project to identify novel targets for tumor immunotherapy.

The project will involve PCR, gel electrophoresis, mouse handing, cell culture, tissue preparation and flow cytometry.

Project 2: Tumor Immunotherapy - combinations therapies

In this project the student will be involved in a project investigating the potential efficacy of combination therapies for tumor immunotherapy.

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The project will involve PCR, gel electrophoresis, mouse handing, cell culture, tissue preparation and flow cytometry.

Mariusz Wasik

Project 1: Comprehensive genomic analysis as the basis for personalized diagnostics and therapy in cancer.

Both diagnosis and treatment of lymphoma, leukemia, and other kinds of cancer are changing dramatically due to the improved understanding of disease pathogenesis. Identification of genetic aberration in cancer cells by genome-wide methods should permit development of novel therapeutic agents designed to abrogate consequences of the aberrations and, as the result, elimination of the malignant cells.

The project focuses on the mutational and methylation analysis of the genome in malignant cells derived from patients with a type of lymphoma called mantle cell lymphoma and acute myeloid leukemia secondary to lymphoma. Both primary cells and cell lines we succeeded in developing from the patients will be evaluated for mutations and silencing of genes. The role of the student will be twofold:

1) to search the available gene databases and scientific literature to evaluate the mutated or aberrantly silenced genes as potential oncogenes or tumor suppressor genes

2) to perform functional studies using primarily the unique patient-derived cell lines to validate selected identified genes as therapeutic targets, either direct or indirect.

Participation in the project should permit the student to develop working knowledge of the mechanisms of carcinogenesis and the ability to find and critically evaluate the pertinent information. It should also teach him/her the principles of genomic scale evaluation of malignant cells and how this information can be used to develop highly specific and individualized therapies for cancer patients. Finally, it may lead to co-authorship of the resulting research publication.

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PEDIATRICS

Kristina Cole

Project 1: Targeting Replicative Stress in Pediatric High Grade Gliomas

Our laboratory is studying a class of anti-cancer drugs that could allow traditional chemotherapy to be more effective in treating patients with pediatric cancers, particularly pediatric brain tumors with elevated replicative stress. The replicative stress could arise from demands by oncogenes, alternative telomere maintenance mechanisms and/or defects in DNA damage and repair. The student will perform supervised experiments testing the anti-tumor activity and downstream signaling of the agent alone, and in combination with chemotherapy in several different pediatric cancer cell line models. The student will also have the opportunity to learn about pediatric cancers in general, how they are generally treated and the clinical trial process.

Matthew Hocking

Project 1: Family Functioning and Neurodevelopmental Outcomes of Pediatric Brain Tumor Survivors

Pediatric brain tumor survivors experience a wide array of medical and psychosocial repercussions that significantly impact functioning, including declines in neurocognitive functioning and psychosocial health-related quality of life. The immediate period after the conclusion of treatment is a critical time when neurocognitive declines emerge and psychosocial factors, such as family functioning and family management, could exert significant influence on the trajectory of these declines. Research with other pediatric illness populations (e.g., traumatic brain injury) illustrates that neurocognitive functioning and family functioning can affect each other.

This study examines the prospective associations between family functioning and neurocognitive functioning and health-related quality of life in 50 youth (age 6-16) who recently completed treatment of brain tumor. Data on survivor processing speed, working memory and executive function as well as data on family functioning and survivor health-related quality of life were collected within 6 months of the completion of tumor-directed treatment and again approximately 9-12 months later. Data collection on this project is almost complete. A student working on this project would gain experience in scoring and interpreting neuropsychological test data, data management and data analysis. The student also could potentially contribute to dissemination of study findings.

Project 2: Social Outcomes of Childhood Cancer Survivors

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Pediatric brain tumor survivors experience social adjustment difficulties (e.g. fewer friendships, poorer acceptance) compared to peers and other groups, yet little research has examined predictors of their social adjustment, particularly longitudinally. Two ongoing projects study the various factors that contribute to social adjustment outcomes in pediatric brain tumor survivors.

The first project is a longitudinal study that aims to 1) prospectively compare components of social information processing between pediatric brain tumor and non-central nervous system solid tumor survivors over time; 2) examine the associations between components of social information processing and social adjustment over time for both groups; and 3) examine the influence of risk and resilience factors (treatment intensity, family functioning, parent-survivor relationship quality) on aspects of survivor social information processing and social adjustment among both groups over time.

The second project is a collaboration with the Center for Autism Research at the Children's Hospital of Philadelphia and focuses on the roles of social attention and facial expression recognition in social adjustment outcomes in pediatric brain tumor survivors, youth with autism spectrum disorder (ASD) and typically developing (TD) youth. The aims of the project are 1) to compare social attention across youth treated for either an infratentorial (namely cerebellar) or supratentorial tumor, youth with ASD, and TD youth by measuring gaze patterns to social stimuli in eye-tracking paradigms and 2) to examine the associations between visual social attention, facial expression recognition abilities, and parent- and teacher-reports of social adjustment among groups. A student working on these projects would gain experience with participant recruitment, data collection, and data management and analysis.

Project 3: Parent Perspectives on Social Outcomes of Pediatric Brain Tumor Survivors

Pediatric brain tumor survivors experience a multitude of late effects that significantly impact psychosocial adjustment. Survivors experience increased social adjustment difficulties1, including greater social isolation2, when compared to other survivors. Qualitative approaches to studying social adjustment may provide rich information on families' understanding of the factors that contribute to survivor social adjustment. Member checks of previously obtained data are known to further enhance the validity and credibility of qualitative findings and can help to elucidate common perspectives of pediatric BT survivor psychosocial adjustment. This study uses qualitative interviews with parents of long-term pediatric brain tumor survivors to examine their perspectives on survivor social adjustment with pre-identified themes concerning factors affecting survivor social adjustment outcomes. A student working on this project would gain experience with data analysis of qualitative data, including coding interview transcripts using specialized software programs and identifying themes from the data. The student also would contribute to the dissemination of study findings.

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Elizabeth Lowenthal

Project 1: Exploring the relationship between stigma and adolescent HIV treatment adherence

The student will utilize data from a Botswana-based study of HIV treatment adherence to evaluate the relationship between the HIV-related stigma that adolescent patients perceive and how reliably they take their life-saving medications. The student will learn how to utilize a REDCap database and to do simple epidemiologic analyses using Stata. The project is based in Philadelphia and involves close collaborations with international collaborators. No prior experience is needed. The selected student will have strong organizational and analytical skills and will be excited about the research area.

Project 2: Missed Opportunities: Uncovering challenges in the HIV cascade of care among adolescents hospitalized with HIV in Swaziland

While HIV-related deaths are declining worldwide, they continue to increase dramatically among adolescents in areas with high HIV prevalence. This study seeks to uncover reasons why adolescents present to referral hospitals late in the course of their illness, often when it is too late to restore their health with antiretroviral medications. This is a mixed-methods study which will teach the student both simple quantitative analysis skills and qualitative analysis skills. The student will learn to utilize Stata software to analyze quantitative data and will learn some simple epidemiologic analysis skills. The student will also use NVivo software to code and organize qualitative data from interviews done with hospitalized adolescents and their caregivers in Swaziland. The work will be done in Philadelphia in close collaboration with colleagues in Swaziland. The selected student will have strong organizational and analytical acumen, but no prior experience is needed.

Project 3: Testing Motivators: Empowering HIV-infected Youth in Zimbabwe to Motivate the Testing of Older Children and Adolescents

While HIV-related deaths are declining in every other age group, they continue to rise among young adolescents. The increasing death rates in adolescents are largely due to delayed diagnosis of perinatal infections. This study aims to motivate earlier testing of untested children and adolescents in a high HIV-prevalence setting. The student working on this project will help to support a Zimbabwe-based study team by assisting with REDCap database construction, data quality assessments using Stata software, and drafting of Standard Operating Procedure Manuals.

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Lisa Schwartz

Project 1: Mobile Health Interventions with Adolescent and Young Adult Cancer Survivors ***Rising Juniors only***

Survivors of childhood cancer are at risk for long term late effects of their toxic treatment. Such late effects can impact any organ system and can emerge long after the cancer is cured. As such, survivors are required to receive follow-up care for life. Adolescents and young adult survivors (AYA) are especially likely to disengage from follow-up care and avoid health promoting behaviors. In order to keep AYA engaged and knowledgeable about their continued health risks, I have led a program of research using mobile health (Mhealth) interventions with AYA. Specifically, I am working with an external vendor to adapt a disease management app for AYA and have two ongoing clinical trials.

A summer student would play a critical role in helping to shape the content of the interventions (features and text messages) and to collect data with patients. The student would work with me, the research team, and the vendor to collect data with patients about the intervention and make modifications accordingly. Specific tasks would include contacting and scheduling participants, collecting qualitative feedback and summarizing it via notes, and making recommendations for modifications. There is also a related randomized clinical trial starting and the student would help identify eligible patients and work on administrative tasks related to the trial. The student must be able to work well in teams and to have comfort speaking with cancer survivors. Experience working in a research or hospital setting is preferred but not necessary. The student would be able to attend didactics in psychology and oncology and lab research meetings.

Deanne Taylor

Project 1: Building an informatics resource for the study of pediatric cancer ***Rising Juniors only***

This project is focused on building a computational resource for the study of pediatric cancer. Pediatric cancers are complex genetic diseases, in which the genome can be littered with mutations, genetic lesions, and abnormalities. Data from these cancers are equally complex as they try to capture the relationships between genes, pathways, molecular functions, survival, and drug response. Common database structures, such as typical relational databases, do not allow for efficient capture of complicated relationships that exist in the data. An alternative are “graph databases”, which are more flexible and perform faster on more complex queries allow informatics researchers to better capture the complicated relationships that exist in this data.

Our goal is to begin to bring graph database technology to the bioinformatics study of pediatric cancers by integrating multiple levels of neuroblastoma data. Specifically, we want to capture

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neuroblastoma cell line data in a Neo4J database and use this infrastructure and other open-source tools to develop novel findings. There are many opportunities in this project depending on the student skills and interests, from programming and database work, to building discovery queries to help in pediatric cancer research.

The ideal candidates will be interested in "big data", graph algorithms, and pediatric cancer research. They will have experience in basic computer programming and database basics. Some background in biology preferred but not necessary.

Project 2: Comparing pediatric cancer to rare disease variation. ***Rising Juniors only***

Germline, in-born variants found in human genomes can predispose children to developing cancer early in life. Also, at least half of all known rare genetic diseases first present in children. The effects of rare variants in genetic diseases may inform us as to the biological behavior of childhood cancers when these cancers share variants with rare disease conditions, and vice versa. We are interested in building a knowledge base combining observed pediatric cancer variants and how these variants correlate to variants found in rare diseases. This information can be used for hypothesis testing of cancer biology, some projects that can be done by the student. There are many sources of information on genetic diseases and pediatric cancers, but they are all disparate and do not include integrative information. We expect many interesting questions can be built from an integrative application and database. For example, for a particular category of rare disease, are there cancers that share variants or genes with the disease and can we use preexisting knowledge to consider treatments either for the disease or the cancer based on this comparison?

For this project, the student will be assisting researchers at CHOP in creating an integrated platform of rare diseases and pediatric cancers, and genes associated with those diseases, and those genes that interact with the disease genes. We will then be using different statistical tools to mine this "big data" for information. The project has many facets, so the student can choose which part of the project s/he would like to work on.

Desired skills include ANY of the following: statistics, R programming, Python, Perl, or Ruby programming, web development.

Project 3: Gene set enrichment analysis in pediatric cancer with multivariate logistic regression ***Rising Juniors* only**

Gene set enrichment analysis (GSEA) summarizes gene-level statistics at the level of predefined gene sets, such as metabolic/signaling pathways. We are interested in applying this method to the study of neuroblastoma.

GSEA has two common strategies. The first uses the gene-level statistics to select a gene subset and applies hypergeometric-like tests for the over-representation of each gene set in this subset.

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The second strategy uses the gene-level statistics to rank all genes and applies Kolmogorov–Smirnov or similar tests for the skewness of a gene set in the overall ranking. Neither of these strategies considers possible confounding variables that bring systematic bias into gene-level statistics. For example, longer genes generally obtained more sequencing reads from RNA-seq experiments, which gives them the advantage of higher stati stical sensitivity to be ranked higher.

We propose a more sophisticated strategy of GSEA using logistic regression models. In each model, the outcome variable is whether a gene is a member of a predefined gene set and the predictive variables include one or multiple gene-level statistics, such as differential gene expression, as well as zero to any number of confounding variables. Any of the predictive variables could be binomial, categorical, or continuous. Each model will report the accuracy of using the gene-level statistics, while controlling for the confounders, to predict whether a gene is a member of one gene set. This method will have broader applications in genomic studies, especially those involving integrative analysis of multiple data sets.

Requirement: familiar with regression modeling and statistical software, preferably R.

Flaura Winston

Project 1: Diagnosing Driving: Detecting and Reducing Risk BEFORE the crash

Motor vehicle crashes are a leading cause of mortality and morbidity in the US with annual deaths exceeding 30,000 and injuries exceeding 2.2 million. Safe driving and crash avoidance rely on driver physical and emotional health, judgment, attention, perception, cognition, memory, skill and response time. Clinical tests, fitness to drive protocols and on-road tests are used to determine license issuance, renewal and revocation yet these tests have little or no scientific foundation or validation regarding crash risk; none can define level and nature of safe driving risk to inform remedial management plans, and as most are specific to conditions, none can assess safe driving among adolescent drivers, the age group with the highest crash risk. There is no evidence that passing a state licensing exam is related to safer driving. The need is great for a valid, widely available method for assessing driver performance as it relates to ability to avoid crashes. The objective of this project is to advance the technical and analytical tools of our validated Simulated Driving Assessment (which is deployed via our high fidelity driving simulator or via our new mobile platform) as functional measure of driving performance and match them to high value, effective coaching for deployment in state Department of Motor Vehicle offices, clinical settings, corporate settings and schools. For more info: http://bit.ly/1UZijzX

Student duties will match their interests across a wide range. Examples: Mechanical engineers - metrics and simulator testing; Computer scientists - Unity programming, big data, predictive analytics; BBB, neuroscience, psychology - linking measured driving behavior to deficits in

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perception, integrated cognitive functioning, developing/testing interventions; Nursing, Public Health - developing/testing interventions, scaling and deployment of interventions, Physics, Statistics, Math - Modeling, Metrics, Analytics; Business - developing business models and pricing structures for corporations recognize that crashes affect their bottom line. Be part of saving lives.

PHARMACOLOGY

Steven Thomas

Project 1: Novel molecular mechanisms in the establishment of memory

The lab utilizes genetic, pharmacologic and biochemical approaches in mice to unravel the molecular mechanisms that underlie learning and memory. Recently we discovered a novel signaling mechanism that dissociates the formation of short- and long-term memory. We are currently trying to understand where in the brain and in what cells this signaling acts to facilitate memory formation. To achieve this, we have flanked the gene for the relevant receptor with loxP sites that permit cell type- and brain region-specific deletion of the receptor. We also have an antagonist that is highly selective for this receptor that can be infused into specific brain regions. We would also like to determine the nature of the downstream signaling mechanisms activated by this receptor that are relevant to memory formation. Toward that goal, pharmacologic rescue of memory will be performed in receptor knockout mice.

Project 2: Neurotransmitter signaling in health and disease

The adrenergic nervous system is an arousal system that contributes to the "fight or flight" response. In the periphery this is mediated by the release of norepinephrine from the sympathetic nervous system and epinephrine from the adrenal gland. In the brain, this is mediated by the release of norepinephrine from the brainstem adrenergic nuclei. To better understand the physiologic roles of this system in health and disease, the lab has recently created a genetic system in mice that permits the inducible loss of norepinephrine and epinephrine. This mimics some disease states in which the adrenergic neurons degenerate, including Alzheimer's, Parkinson's and Down syndrome. To better understand what symptoms may underlie the loss of adrenergic signaling, the lab is poised to study this novel genetic model. Because one focus of the lab has been to better understand the molecular mechanisms that underlie learning and memory, one set of experiments will be to utilize these mice in behavioral studies that assess learning and memory. Various paradigms will be used to assess different types of learning and memory, including declarative memory, implicit memory, and motor learning.

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PSYCHIATRY

Anu Asnaani

Project 1: Treatment Outcomes in OCD, PTSD and Anxiety Disorders ***Rising Juniors only***

This is a study that started in January of 2015 looking at how patients improve during cognitive behavioral treatment for their OCD, PTSD, and anxiety disorder symptoms using an online data capture system (REDCap). Our center sees approximately 25 new patients a month and we want to improve our monitoring of how their symptoms change during 12-20 weeks of treatment by the clinicians in our clinic. Student responsibilities include reaching out to patients to remind them about their assessments, troubleshooting and assisting with data management for the project, and helping researchers analyze the data collected so far. Students are also encouraged to think of their own ideas for research from this data, and to work with supervisors to consider a poster submission of their work at a national conference, although this is not required.

Project 2: Mindfulness Sleep Smartphone Study ***Rising Juniors only***

This is an exciting new study slated to begin in February 2016 that uses a novel smartphone application developed by researchers at UPenn, and tests its usefulness in a group of patients with anxiety disorders in improving their sleep. All patients use the smartphone application over four weeks while they are receiving cognitive behavioral therapy for their anxiety disorder symptoms (including OCD and PTSD), for us to test whether we can improve their sleep, and therefore their anxiety symptoms, via an at-home mobile application. Student responsibilities would include assisting patients with use of the application, checking in via phone with patients about their adherence to the application at home, helping to manage the data, and assist on all other aspects of the study deemed appropriate by the PI. Students interested in possible careers in clinical psychology and good interpersonal skills to deal with patients preferred.

Project 3: Modifying interpretation bias in OCD ***Rising Juniors* only**

This study is intended to begin in June of 2016, and examines a unique and previously untested way to improve how well patients with OCD do in exposure therapy. Patients basically complete a two-week computer intervention designed to modify the tendency to interpret situations as being threatening via an at-home brief cognitive training program, and then do 8 weeks of cognitive behavioral (exposure) therapy, after which they are assessed again to see if the training had any effect. This study takes a randomized controlled approach, with three groups: active training, control training, and wait list. Student responsibilities include teaching patients how to use the cognitive training tool, scheduling/reminding patients of upcoming assessments, helping with data management and recruitment for the study, and assisting on all other aspects of the study deemed appropriate by the PI. Students interested in possible careers in clinical psychology and good interpersonal skills to deal with patients preferred.

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Gazi Azad

Project 1: Partners in School: A Program for Parents and Teachers of Children with Autism

Communication between parents and teachers is a cornerstone of providing effective services to children with autism spectrum disorder (ASD). Conjoint behavioral consultation (CBC) is a problem-solving model by which parents and teachers work collaboratively with a consultant to address students' needs. While CBC has been linked to improved outcomes for typically developing children, there are few studies of CBC for children with ASD, or children from low-income families. The goal of this research project is to develop and test a program that will improve parent-teacher communication about evidenced-based interventions for socio-culturally diverse students with ASD in urban public schools. During years 1 and 2 of the project, interview, observational, and survey data were used to adapt CBC for use with parents and teachers of children with ASD. Currently, the preliminary effectiveness and feasibility of the adapted consultation model are being rested in urban public schools.

An undergraduate research assistant (RA) would receive academic and professional skills, experiences, and benefits from involvement in this project. First, the student will gain valuable research skills through exposure to literature reviews, data collection, entry, and analysis, and management of participants' records. Second, the student will have clinical experiences through exposure to parents and teachers of children with ASD and evidence-based interventions in the community. Third, the student will derive professional benefits by participation on manuscripts leading to authorship on posters and/or papers at professional conferences or scientific journals. Note that the PIs are postdoctoral fellow, Gazi Azad, PhD, and associate professor, David Mandell, ScD.

Rinad Beidas

Project 1: Policy to implementation: Evidence-based practice in community mental health

Background: Evidence-based treatments (EBTs), treatments that have been evaluated scientifically and show evidence of efficacy, are not widely available in community settings. In response to the call for EBT implementation, states and counties have mandated behavioral health reform. In Philadelphia, the Department of Behavioral Health has created a new center to support the implementation of EBTs, the Evidence Based Practices Innovation Center (EPIC), 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 and potentially enhanced payment rate for providing EBTs. The formation of EPIC offers a rare and important opportunity to prospectively study implementation in response to a policy mandate.

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Methods/Design: This mixed-methods study is prospective, longitudinal, and observational. We will investigate the response of 30 community mental health centers to EPIC. Study participants will be 210 therapists and 30 executive directors. Data will be collected prior to the policy, and then 3 and 5 years following its implementation of the policy. Quantitative data will include clinician-level measures of intervention implementation and potential moderators of implementation.. Qualitative data will include semi-structured interviews with a subset of the sample.

Discussion: Findings from this 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.

Project 2: Philadelphia Alliance for Child Trauma Services (PACTS)

Background: The Philadelphia Department of Behavioral Health and Intellectual Disability Services (DBHIDS) was awarded a Substance Abuse and Mental Health Services (SAMHSA), grant to develop a trauma-informed and trauma-focused system for young people and their families in Philadelphia. 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 implementing trauma-focused evidence-based practices (EBP) and for increasing screening and assessment of children in a variety of health care settings. The impact of PACTS will be evaluated 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) in community mental health centers. The study will include community therapists who provide TF-CBT to children and families in Philadelphia, as well as the children and families receiving these services. Quantitative data will include measures of general child functioning and symptoms. We will also gather information about clinician attitudes and knowledge towards EBPs. Qualitative data will include semi-structured interviews with a subset of the children and families 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 EBPs improves youth outcomes in the community.

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Project 3: Increasing accuracy and cost-effectiveness of fidelity measurement in cognitive behavioral therapy

Background: Research to improve client outcomes in community mental health has been hindered by an inability to accurately and inexpensively measure fidelity, or the type and quality of treatment provided. Measuring fidelity accurately is critically important, because it mediates the effect of evidence-based practices on client outcomes. Fidelity is also an indicator of quality of care. There is a critical need to identify and evaluate methods of fidelity measurement that are accurate (i.e., measure what they intend) and cost-effective.

Methods/Design: Our objective is to compare the accuracy and cost-effectiveness of therapists' self-report (fidelity measurement-as-usual) and 2 innovative methods (chart-stimulated recall and behavioral rehearsal) in assessing fidelity to cognitive-behavioral therapy for children and families, an established evidence-based practice. Chart-stimulated recall is a brief interview with a clinician about the care provided to a client, during which the clinician reviews the client's file to aid recall. Behavioral rehearsal, also known as standardized patient methodology, is a role-play between a clinician and a trained actor. We will randomize 135 therapists to 1 of 3 conditions: self-report (n = 45), chart-stimulated recall (n = 45), and behavioral rehearsal (n = 45). We will compare the fidelity measurement method in each arm to direct observation using a coding system.

Discussion: Our goal is to strengthen the public health impact of psychosocial interventions by identifying fidelity measurement methods that can be used for both research and practice. Successful completion of this project will identify accurate and cost-effective innovative fidelity measurement methods and identify factors that can increase their use.

Edward ("Ted") Brodkin

Project 1: The role of Pcdh10, an autism candidate gene, in brain and behavior development

Protocadherin 10 (Pcdh10) is a gene encoding a neural cell adhesion molecule that has been implicated in autism. Pcdh10 plays a role in prenatal brain development (axon guidance), and pruning of synapses. The Brodkin lab has found that mice lacking one copy of Pcdh10 show lower levels of social approach and investigation behavior, and alterations in the synaptic structure and glutamate receptor expression in the amygdala, as well as alternations in the function of amygdala circuits. In this project, the student will play an active role in ongoing studies of this mouse model relevant to autism to try to better understand the role of Pcdh10 in amygdala function and social behaviors, and to use this model system to identify novel treatment approaches for the social deficits of autism. Specifically, we will test the hypothesis that NMDA receptor / glycine agonist drugs can improve social approach behaviors and alter the structure

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and function of amygdala circuits in this model system. Students will learn mouse behavioral analysis, methods of structural analysis of amygdala dendritic spines, and electrophysiological methods for studying amygdala synapse functioning. This is a good fit for students interested in autism, medicine, psychology, neuroscience, and genetics.

Project 2: Testing a novel treatment to improve social functioning in adults with autism

Autism spectrum disorder (ASD) is being diagnosed at a higher rate, and large numbers of children with ASD are growing into adulthood, but little research has been done on developing and testing treatments to improve social functioning in adults with ASD. The Brodkin lab has developed a novel behavioral treatment program for adults with ASD that aims to reduce social anxiety and increase/improve social motivation, social cognition, social skills, and generalization of those skills. The student will help to carry out aspects of the behavioral intervention that is being tested; will assist in the assessment procedures to measure social anxiety, social motivation, social cognition, and social skills (including self-report measures, measures of eye tracking, and measures social skills during interactions); and will assist in data analysis. Students will learn methods involved in clinical treatments, clinical research, and psychological assessment, including quantitative measures of physiological processes. This is a good fit for students interested in autism, psychology, psychotherapy, and psychiatry.

Cynthia Neill Epperson

Project 1: Maternal Stress Effects On Pregnancy Outcomes

Early life stress adversely impacts human health across the lifespan. This project focuses specifically on the reproductive time point of pregnancy when a mother's way of responding to stressors may impact the health of the pregnancy as well as that of her offspring. Students will be taught how to administer standardized questionnaires and interviews to assess severity of depression and anxiety symptoms and to rule-out the presence of psychiatric conditions. Summer interns participate in the Center's Summer Research Intensive which includes up to 5 students. In addition to didactics and seminars for the Research Intensive, students participate in the Center's research meeting and journal club.

Project 2: Impact Of Estradiol and Serotonin on Cognitive Aging

Students will be taught how to administer standardized questionnaires and interviews to assess severity of PMDD symptoms and to rule-out the presence of other psychiatric conditions. Summer interns participate in the Center's Summer Research Intensive which includes up to 5 students. In addition to didactics and seminars for the Research Intensive, students participate in the Center's research meeting and journal club.

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Project 3: Stress Response In Premenstrual Dysphoric Disorder

Premenstrual dysphoric disorder (PMDD) occurs in up to 5% of menstruating women and is associated with significant emotional/psychological distress and impairment in daily functioning. This study utilizes the acoustic startle paradigm to examine the impact of an acute stressor on psychophysiologic responsivity among women with PMDD and healthy controls. Interns are involved in participant recruitment, screening and data acquisition. Students will be taught how to administer standardized questionnaires and interviews to assess severity of PMDD symptoms and to rule-out the presence of other psychiatric conditions. Summer interns participate in the Center's Summer Research Intensive which includes up to 5 students. In addition to didactics and seminars for the Research Intensive, students participate in the Center's research meeting and journal club.

David Mandell

Project 1: Evaluation of Public Mental Health Programs

The Center for Mental Health Policy and Services Research (CMHPSR) consists of a multidisciplinary group of faculty and staff devoted to studying and improving the organization, financing, management and delivery of care to people with psychiatric and developmental disabilities. Center faculty and staff also provide consultation and technical support to state and local governments, as well as mental health agencies implementing system change. Our goal is to link the best research and evaluation findings to policy decisions and the delivery of care.

The CMHPSR is part of a public-academic partnership with the City of Philadelphia’s Department of Behavioral Health. Through this partnership, we carry out research and evaluation activities for the City of Philadelphia’s behavioral system and support the Department of Behavioral Health in setting data-driven policy priorities.

We seek a student intern who will help the CMHPSR carry out evaluation projects by conducting systematic literature reviews, writing summary papers, and creating analysis reports. The student will participate in the monthly meetings with the city and gain real-world experience in working with government administrators and policy makers, health care professionals and researchers in planning and conducting community-based research.

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Steven Siegel

Project 1: Mouse models of schizophrenia

The Translational Neuroscience Program is also dedicated to understanding the neural basis for brain abnormalities in schizophrenia in an effort to improve future treatments. One approach to achieve this goal is through the use of animal models. People with schizophrenia are thought to have abnormal brain responses following auditory stimuli (sound). Although it is not known how this abnormal brain activity is related to symptoms, it provides a method to study neuronal abnormalities in people with the illness. Although the complex symptoms of schizophrenia cannot be modeled in animals, abnormal neural activity following auditory stimuli can be recreated in mice in order to study the underlying biology of this phenomenon. These patterns of neural activity in response to noise are called sensory processing. In order to examine the neural basis of abnormal sensory processing in schizophrenia, we are studying the genetics and cellular biology of sensory processing in mice that share schizophrenia-like patterns of neural activity following auditory stimuli.

PULMONARY, ALLERGY, AND CRITICAL CARE MEDICINE

Nuala Meyer

Project 1: Factors associated with mortality from severe sepsis in the Medical Intensive Care Unit

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

The student will collect this information for patients enrolled in the Molecular Epidemiology of Severe Sepsis in the ICU (MESSI) cohort study. The student may also learn to assess muscle mass by ultrasound in order to assess whether muscle stores influence functional recovery. Students will be taught to extract infection related to the patient's infection, medical history, physiologic state, and response to treatment while in the ICU from the medical record and to record this information in a computerized database. Students will also: assist with chest X-ray reading and collecting of data and attend lab meetings to discuss ongoing projects, analyses, and

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manuscripts in progress. Prerequisites: Students should be enthusiastic about working with critically ill patients and their families; professional and adherent to patient privacy standards, and interested in clinical/translational research.

Project 2: Molecular risk factors for Sepsis-Associated Acute Respiratory Distress Syndrome (ARDS)

This project provides the opportunity for a focused translational research experience, meaning that the student will be applying molecular techniques to human biosamples from our sepsis cohort MESSI (see above). Our group has previously identified plasma proteins that are highly associated with ARDS, a condition of severe respiratory failure. This project will test whether ARDS-associated plasma proteins are being secreted in small exosomes from the vasculature, or whether the proteins are independent of vascular secretion vesicles. The skills obtained from this experience will include: ultracentrifugation of plasma and cell culture media to isolate the exosome fraction; ELISA for protein quantification, and potentially Western blotting for qualitative protein identification. As the project progresses, there may be additional opportunities to learn techniques like real time PCR for mRNA quantification or for immunohistochemistry. Prerequisites: Students should be interested in translational research and should have completed college-level chemistry. Prior laboratory experience is preferred but not required. Students will need to adhere to standards for handling of biologic fluids and for maintenance of patient privacy.

RADIATION ONCOLOGY

Jarod Finlay

Project 1: Spatial Frequency Domain Imaging for Dosimetry and Response Monitoring

Spatial Frequency Domain Imaging (SFDI) is a technology that allows an image of tissue to be broken into absorption and scattering components. The physiological processes that affect absorption and scattering differ, so the ability to differentiate them will give insight into the responses to therapy. This project aims to develop a short working distance SFDI system for use in assessment of response to treatment such as photodynamic therapy (PDT).

The student should have a basic understanding of coding in MATLAB, as this will be used for data analysis. Knowledge of basic geometrical optics is helpful but not required. Student should be comfortable with math through calculus.

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Student duties will include programming, data analysis, and experiments to validate the function of the imaging system and gather preliminary data in animal models.

RADIOLOGY

David Cormode

Project 1: Gold-silver alloy nanoparticles for breast cancer screening

Early detection of breast cancer with mammography screening reduces mortality from this disease; however mammography is not effective for women with dense breasts. Improved screening techniques such as contrast-enhanced dual energy mammography (DEM) could overcome this issue. Silver nanoparticles provide excellent DEM contrast, however, release of silver ions from these nanoparticles is a safety concern. We hypothesized that gold-silver alloy nanoparticles (GSAN) would have improved biocompatibility, while maintaining the DEM contrast properties of silver. The student involved in this project will synthesize gold-silver alloy nanoparticles and characterize them with various techniques such as electron microscopy. The silver ion release of the nanoparticles and biocompatibility will be assessed with cell lines in vitro. Contrast production will be assessed using clinical equipment and Matlab-based analysis. In vivo performance for tumor detection will be performed.

Joel Karp

Project 1: Investigation of Methods for PET Image Reconstruction

Positron emission tomography (PET) is an imaging technique that works by detecting photons from a radioactive contrast agent administered to the patient. The result is an image showing the spatial distribution of that contrast agent. A conventional reconstruction algorithm assumes that the photons propagate along straight lines, and scattered photons that depart from these straight lines are discarded in order to achieve a quantitative image, which also requires knowledge of attenuation of photons in the body. Our group is working on a novel approach to attenuation correction by using, instead of discarding, these scattered photons to reconstruct information about the patient's body composition (analogous to an X-ray CT image). Check http://dx.doi.org/10.1118/1.4894818 for details on this topic and http://dx.doi.org/10.1118/1.4938264 for a more general review of attenuation correction in PET.

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Depending on skills and interests of the student, this project may assist in various ways, ranging from data collection on a prototype time-of-flight PET scanner, data processing, and analysis of the performance of different image-reconstruction algorithms. Experience in computer programming is preferred; experience with data analysis and programs such as MATLAB/Octave/Scilab is also desired.

The student will gain exposure to the methods used in medical imaging with applications in both research and the study of clinical disease. Our research group includes 5 faculty and several post-doctoral researchers, graduate students, and medical physicists. The student will work under the supervision of a post-doctoral researcher, and will have the opportunity to participate in lab seminars and discussions on a wide range of topics.

Sharyn Katz

Project 1: Serial [18F]Thymidine (FLT)PET/CT as a Biomarker of Response in Pemetrexed Therapy for Non-Small Cell Lung Cancer

In this project we will study an imaging biomarker for treatment response in non-small cell lung cancer (NSCLC), responsible for 85% of all lung cancers. Most NSCLC are unresectable at diagnosis (mean survival 10 months)leaving little time to choose the most effective therapy. We hypothesize that positron emission tomography (PET)imaging with 18F-thymidine (FLT) can assess treatment response in NSCLC within days of starting therapy by monitoring changes in tumor metabolism, rather than waiting months for tumor growth or shrinkage with the conventional approach of computed tomography (CT). Before FLT can be successfully integrated into clinical management, validation with each therapeutic is required since tumor metabolism varies by therapy. FLT is incompletely studied for the widely used cancer therapeutic pemetrexed (PEM). We propose a proof-of-concept study of FLT as a marker of cell growth, to determine whether PEM has produced a measureable decrease in tumor growth within 2 weeks of starting therapy. Since 70% of patients fail PEM-based therapy, reliable detection of PEM efficacy in days rather than months would save valuable time and allow for switch to effective therapy. This work will serve as foundation for a multi-center trial, similar to others currently underway for FLT-PET in other malignancies.

Despina Kontos

Project 1: Image Analysis for Breast Cancer Diagnostics

The student will work under the guidance of postdoctoral fellows and the PI, and will learn how to apply computerized image analysis software methods in breast cancer imaging research projects. The project will involve computer programming tasks for implementing computerized algorithms for multi-modality breast image analysis (i.e., digital mammography, breast MRI

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etc.), including image segmentation, feature extraction, and classification, to quantify breast tissue properties and tumor characteristics that may have value as prognostic/predictive biomarkers for breast cancer. The student will join a vibrant research environment and will gain a first-hand experience of our clinical breast imaging program. Contributions to our on-going research projects will be credited also with co-authorship in any resulting research publications.

Chamith Rajapakse

Project 1: 3D printing of Orthopaedic Implants using MRI

We are investigating the feasibility of personalized 3D printing of bone using images obtained from high-resolution MRI in human subjects and mesenchymal stem cell (hMSC) engraftment onto the same 3D-printed surfaces as a mean to further improve post-implant outcomes. Responsibilities include MRI scanning, image analysis, fabrication, and biological/mechanical testing of printed models. Training will be provided. Ideal for students interested in medical school and/or academic career. Continuation after summer could be discussed if interested.

Project 2: Musculoskeletal MRI and Biomechanics

We are developing methods to non-invasively predict bone fracture risk in patients using high-resolution MRI-based personalized biomechanical simulations. This project involves imaging of human subjects as well as validation studies in cadaveric bone. Responsibilities include MRI scanning, image analysis, mechanical testing of bone samples in the orthopaedic lab. Training will be provided. Ideal for students interested in medical school and/or academic career. Continuation after summer could be discussed if interested.

Project 3: Response to Vibration Therapy of Bone, Muscle, and Cardiovascular Disease Assessment in Radiology

This project involves assessment of response to mechanical stimulation in human subjects using state-of-the art imaging (MRI) and image processing. Responsibilities include analysis of images obtained using MRI, generation of 3D computer models of the anatomy, and simulation of various real-life mechanical loading conditions. Training will be provided. Ideal for students interested in medical school and/or academic career. Continuation after summer could be discussed if interested. Basic knowledge of computer programming is helpful.

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Ronnie Sebro

Project 1: The genetics of pediatric rhabdomyosacromas and osteosarcomas.

Sarcomas are cancers that can arise in bone, muscle or connective tissue throughout the body, and account for approximately 10% of pediatric/young adult cancers. Approximately 50% of bone sarcomas and 20% of soft tissue sarcomas are diagnosed in people under the age of 35.

The goal of this project is to advance our understanding of how genetic variation influences the risk of development of pediatric rhabdomyosarcomas and osteosarcomas. Together we will analyze data available on several hundred patients from large consortiums available to researchers through the NIH. Finding novel genetic variants associated with these sarcomas will help us identify novel drug targets and therapies geared towards curing these diseases.

Students will learn genetic and statistical analysis, and be introduced to machine learning algorithms. Data analysis will involve DNA and RNA gene expression analysis. This will be a great summer experience for pre-medical students (including those interested in pediatrics, oncology and pediatric research), for students interested in cancer biology, genetics and computer science. Weekly didactic sessions will be held to encourage students to stay interested in cancer research.

Project 2: Quantitative analysis of musculoskeletal diseases

Smart and motivated undergraduate student interested in working on an integrative research project on the genetic basis of musculoskeletal systems. Student will work closely on long-term research project in an exciting new topical area of analysis with MD/PhD principal investigator and musculoskeletal radiologist in the medical school. Some background in biology (especially genetics and morphology) and statistics preferred, but not necessary. Ability with Excel is a must. Freshman through juniors are welcome to apply. This research is ideal for biology, biological anthropology, statistics and pre-med students. The student will learn important statistical techniques and knowledge of functional anatomy as a result of this project, and the student will be able to contribute substantially to this research.

Project 3: MRI imaging of bone and soft tissue sarcomas

Phenomenal project involving the use of statistics to understand how the imaging features of bone and soft tissue sarcomas from MRI studies predict tumor grade, prognosis and overall survival. Responsibilities include data collection. The student will learn applied statistics, epidemiology and study design, some radiology and oncology. Perfect for premedical students and students interested in healthcare.

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Paul Yushkevich

Project 1: Mapping the Human Medial Temporal Lobe in Aging and Dementia

The medial temporal lobe (MTL) is the part of the brain that is of great importance in a wide variety of neurological and psychiatric diseases, including depression and Alzheimer disease. The MTL is organized into anatomically and functionally distinct subregions, and the ability to measure these subregions accurately is crucial to research on these diseases.

With the help of magnetic resonance imaging (MRI), we are able to generate brain images at the resolution of less than a millimeter - allowing many of the interesting MTL subregions to be visualized in the brains of living human subjects. Currently, to measure these subregions in MRI scans requires manual outlining, also called segmentation. Our lab is at the forefront of developing software tools that can extract these measurements automatically. To do so, we must develop comprehensive atlases of MTL subregions through combined use of in vivo MRI scans, postmortem MRI scans, and histological imaging.

In this summer student project, you will learn and perform the segmentation of one or more MTL regions on one of the aforementioned modalities. By doing so, you will assist the lab in developing MTL atlases, and thereby contribute to computational MRI analysis techniques that will be used in the future to analyze thousands of MRI images from major research studies.

We are looking for students who have excellent ability to focus on complex problems, can problem-solve effectively and independently, and enjoy working in a team. Although prior knowledge of brain anatomy is preferred, it is not necessary.

REHABILITATION MEDICINE

Michelle Johnson

Project 1: Evaluation of Infants at risk for development delays using Smart Sensors ***Rising Juniors only***

Successful early detection of delay or impairment in infants at-risk depends on the effectiveness of standard clinical scales, many of which are not sufficiently sensitive to screen infants younger than 6 months. We have developed a smart play gym that is instrumented with sensorized mat, and toys to capture infant interaction. A low-cost motion capture system also collects kinematic data. We are looking for an undergraduate student interested in supporting data collection and analysis of infants tested in this system.

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Project 2: Biometric assessment during functional movements of the upper limbs ***Rising Juniors only***

Monitoring heart rate, muscle activity and arm kinematics is becoming important for assessing functional outcomes after neurological injury. We have developed procedures for capturing this data during functional movements of the arms such as during drinking tasks. The undergraduate student will support the data collection and analysis of stroke and cerebral palsy patients on this system.

RHEUMATOLOGY

Laura Su

Project 1: Understanding how gut microbes impact T cell response to influenza infection ***Rising Sophomores only***

We are interested in how exposures to microbes in the gut change people's response to infections. We are testing this using the mouse model of influenza infection. The student will learn how to take care of mice, dissect mice, and perform cellular assays to identify T cells that specifically recognize flu and bacterial antigens.

Project 2: Determine why CD4+ T cells age prematurely in patients with rheumatoid arthritis ***Rising Sophomores only***

CD4+ T cells acquire the ability to kill other cells in about 1/3 of patients with an autoimmune disease called rheumatoid arthritis (RA). These cytotoxic CD4+ T cells have shortened telomeres and are thought to have aged prematurely due to chronic stimulation by self-antigens. However, no one knows what are the antigens that stimulate cellular aging. The student will be involved in identifying the target of cytotoxic CD4+ T cells in RA patients. The student will learn to clone and express the T cell receptor expressed by these cells and test for binding ligands on a yeast display library.

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SURGERY

Pavan Atluri

Project 1: Tracking intramyocardial delivery of Bioengineered shear-thinning gels laden with EPCs using in vivo imaging

Ischemic heart disease is a leading cause of death, and current therapies fail to address the microvascular deficiencies that patients face. We have previously demonstrated the efficacy of endothelial progenitor cells in revascularizing ischemic myocardium, and thereby improving heart function. However, the translatability of cell based therapy for ischemic heart disease has been limited due to low cell retention and poor targeting to ischemic myocardium. We have developed a novel injectable shear-thinning hyaluronic acid hydrogel (STG) and endothelial progenitor cell construct (STG-EPC) to overcome these barriers. This directed therapy to the ischemic myocardial borderzone enables direct cell suspension delivery and stabilization of infarcted myocardium to minimize adverse ventricular remodeling. We hypothesize that this system provides a clinically translatable therapy for robust vasculogenesis and myocardial stabilization.

The project will entail harvesting primary cells, making the tissue-engineered construct, and using a rat model of ischemic cardiomyopathy to test the efficacy of the cell-delivery platform. Additionally, the cells will be labeled with a near-IR tag to allow for longitudinal tracking. The student will actively participate in all stages of the research, including methods formulation, experimentation, and data interpretation and reporting. Specifically, the student will gain experience in small animal cardiac surgery, isolating and culturing primary cells, and acquiring and analyzing in vivo bioluminescent imaging data.

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Project 2: Chimeric model of bone marrow reconstitution with eGFP+ EPCs to quantify engraftment of endogenous EPCs in rat myocardium

Following a myocardial infarction (MI), the ischemic myocardium has a very poor capacity for regeneration. Subsequently, an upregulation of SDF, a natively found chemotactic agent, recruits endogenous endothelial progenitor cells (EPCs) from the bone marrow to the area of ischemia, where they have the potential to enhance microrevascularization and limit the progression towards heart failure. We hypothesize that delivering EPCs cells by way of a hydrogel construct will enhance the number of eGFP+ EPCs which are engrafted in the myocardium, improve functional outcomes, and ultimately limit ventricular remodeling.

The project will entail isolating and characterizing EPCs in rats, making the hydrogel construct, carrying out the bone marrow ablation and reconstitution model, and ultimately using a rat model of ischemic cardiomyopathy to test the efficacy of the cell-delivery platform. The student will actively participate in all stages of the research, including methods formulation, experimentation, and data interpretation and reporting. Specifically, the student will gain experience in small animal cardiac surgery, bone marrow ablation and reconstitution, sectioning and staining of post-surgical tissues, isolating and culturing primary cells, performing flow cytometry, and acquiring and analyzing hemodynamic data.

Project 3: Direct myocardial delivery of exosomes in injectable shear-thinning hydrogels improve functional outcomes

Recently, exosomes have attracted significant interest as a result of their important role in paracrine signaling and chemotactic potential. Following a myocardial infarction, the ischemic myocardium has a very poor capacity for regeneration, and specifically there is a large microvascular deficit. Endogenous endothelial progenitor cells have the potential to micro-revascularize myocardium in the region surrounding the infarct. Our preliminary work has shown that EPCs secrete exosomes in vitro, and these exosomes could have a similar therapeutic potential as do EPCs themselves. We hypothesize that delivering these exosomes in a sustained release hydrogel construct will limit upregulate paracrine signaling and stimulate angiogenesis in vivo.

The project will entail isolating and characterizing exosomes, making the hydrogel construct, using a rat model of ischemic cardiomyopathy to test the efficacy of the delivery platform. The student will actively participate in all stages of the research, including methods formulation, experimentation, and data interpretation and reporting. Specifically, the student will gain experience in small animal cardiac surgery, sectioning and staining of post-surgical tissues, isolating and culturing primary cells and exosomes, performing flow cytometry, and acquiring and analyzing hemodynamic data.

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Stephanie Fuller

Project 1: Outcomes of patients after intervention for pulmonary atresia and intact ventricular septum ***Rising Juniors only***

The aims of the retrospective study are to examine the survivors of all patients with pulmonary atresia with intact ventricular septum who underwent surgical repair between 1/1/84 and 12/31/10. The morbidity and mortality and risk factors for each will be identified and examined as well as the long term mortality among four discrete eras of critical care management and treatment planning. Secondarily we will compare quality of life outcomes as well as functional status scores to determine the effects of evolving treatment.

Marina Guvakova

Project 1: The Analytics of Biomarkers for Early Stage Breast Cancer. ***Rising Juniors only***

Cancer that is diagnosed at an early stage, before it is had the chance to get too big or spread is more likely to be treated successfully. We believe that we can do our bit to help spot cancer early by discovering biomarkers of aggressive disease. Towards this goal, we advance molecular screening of diagnostic biopsies through collaboration with surgeons, pathologists, R&D industry leaders and statisticians. We analyze the gene's mRNA expression in the breast tissue from healthy women, patients diagnosed with stage 0 breast cancers called DCIS (Ductal Carcinoma In Situ) and advanced cancer. We when compare these multiplex gene profiles in order to identify the molecular changes related exclusively to cancer progression. In summer, we will continue to discover meaningful patterns in the uniquely derived clinical data.

By participating in this project the student will gain knowledge of translational cancer research and obtain expertise in automated molecular assays, including multiplex mRNA profiling, automated IHC, quantitative image analysis and analytics of large data. Strong analytical and mathematical skills are required for this multidimensional project. There will be plenty of opportunities for the student to apply his/her skills in statistics. Knowledge of numerical analysis software (like MATLAB) and technical computing (like R) is a huge plus. Desire to work semi-independently is encouraged. If the research results in the publication, the student will be part of the team working on this publication. This project will be ideal for an engineering student with interest in applied biology, computer science, and digital microscopy.

Project 2: Deciphering Complex Molecular Interactions of the Vav2 Oncoprotein. ***Rising Juniors only***

The goal is to expose students to the reality of discovery novel protein-protein interactions. We have developed and characterized genetically modified breast cancer cells with altered growth and migration – both are key features of cancer progression. The summer project will continue

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to explore our previous discovery on how the oncoprotein called Vav2 regulates the cytoskeleton dynamics to play the essential role in the cell growth cycle, cell adhesion and cell migration. We plan to determine which structural features, protein-protein associations, and signaling mechanisms may account for the dramatic differences in cancer cell behavior.

Using unique breast cancer cell model developed in our laboratory, we will determine whether interactions of Vav2 with other partners are modified when the protein is mutated in the critical structural domains. Multiple mutants of the Vav2 protein are available for testing. The methods involved will include cell culture, plasmid DNA transfection, fluorescent microscopy, and protein purifications including immunoprecipitation, western blotting and mass spectrometry. This information will help to identify the proteins and pathways regulated by the Vav2 oncoprotein. The student is expected to have completed cell biology and biochemistry classes and have strong quantitative skills. By participating in this project the student will learn a number of innovative molecular biology techniques, build experience in experimental design, and gain deeper knowledge in biochemistry, cell biology, and cancer research. It is hoped that research relationships between the student and our lab will continue through independent study during the academic year 2016-2017.

Julia Tchou

Project 1: Effects of exercise on anti-tumor immune functions

This interactive pilot study investigates the effect of exercise on overall immune function in healthy young adults and will serve to establish feasibility for a future study to evaluate the impact of exercise on anti-tumor immune functions in breast cancer patients. The study will begin with a feasibility study that enrolls up to ten healthy volunteer participants who, at baseline, do not engage in routine exercise activity (<1 hour per week), in a group exercise class through the University of Pennsylvania's recreational facilities. We will determine if frequent exercise stimulates the overall function and anti-tumor activity of their immune system. The primary analysis will be to determine if it is feasible to compare the anti-tumor activity of immune cells before and after a finite duration of exercise program in healthy patients to merit the conduct of similar studies in other populations such as breast cancer patients.

Student involvement will include recruiting study participants, organizing the logistics of the exercise class, coordinating pre-study laboratory testing, and seeing the study through its completion. After the study's completion, the student will be responsible for conducting analysis on the feasibility data in order to prepare grant submissions for future investigative studies. The student should have strong organizational skills, experience with biomedical research writing, and pervasive interest in immunology, oncology, and translational research. It is also expected that the student will continue to play a role in future studies following grant receipt. The research

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assistant will gain leadership skills, clinical knowledge, and the opportunity to participate in the writing of several exciting manuscripts.

TRANSLATIONAL MEDICINE & HUMAN GENETICS

David Fajgenbaum

Project 1: Assist with launch and data collection for international patient registry study

Idiopathic multicentric Castleman disease (iMCD) is a deadly inflammatory disorder that is as common as ALS and more deadly than lymphoma, because it is so poorly-understood. One of the greatest barriers to successfully treating iMCD has been the lack of a database to track treatments and patient care, leaving physicians to make care decisions with limited data. I have secured a large grant to solve this problem by creating a global natural history registry of iMCD and other subytpes of Castleman disease called "ACCELERATE." It will collect real-world demographic, clinical, laboratory, patient-reported outcomes, and treatment data on patients with CD. Such a registry could help to guide physicians in making more informed, evidence-based decisions when treating patients with CD.

I have begun to build the database for the registry and submit IRB applications. Before the registry is ready to go live with first patient enrolling by the end of the summer, we will need to test out the system by importing de-identified data from a recent systematic literature review and other de-identified datasets. This project will be interesting to students, because they will be able to work with a variety of stakeholders (physicians, pharmaceutical companies, patient advocates) involved in the registry and the pre-launch work over the summer will be essential for the success of this important project. Successful data entry and curation over the course of the summer could lead to co-authoring a manuscript in a peer-reviewed journal about registry data collection methods. As Principal Investigator of this study, I will ensure that the student is exposed to a variety of aspects of this complex project.

Project 2: Assist with interpretation and integration of datasets from genomics to proteomics

Idiopathic multicentric Castleman disease (iMCD) is a deadly inflammatory disorder that is as common as ALS and more deadly than lymphoma, because it is so poorly-understood. The cause of the immune activation, pathological immune cell type, and pathways are unknown. I am conducting and collaborating on several "-omics" research projects around the world. By the

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beginning of this summer, I will have results back on whole genome sequencing , RNA sequencing of mammalian transcripts, RNA sequencing of non-mammalian RNA, flow cytometry , and proteomics. I will also have clinical data to correlate with the research data. The next steps will be to interpret the data. I am looking for an undergraduate student to assist with data interpretation and presentation of results through powerpoint presentatioms. I will provide close mentorship and instructions for all analyses. This project will be interesting to students, because they will be on the cutting edge of medical research and assist with turning big data into important insights to help patients. The student will complete their data presentation by the end of the summer. If the student has extra time, the student will be asked to assist with subject recruitment of ongoing and new research studies.

Project 3: Assess the state of rare disease research

Historically, rare diseases have been neglected by biomedical researchers and underfunded. Furthermore, the limited numbers of rare disease researchers often work in silos and rarely collaborate. As a result, 95% of the 7,000 rare diseases do not have a single FDA-approved therapy. More recently, there has been increased attention and focus into drug development for rare diseases. But major hurdles still exist, including limited collaboration and inefficient use of funding and tissue samples. The Penn Orphan Disease Center was founded in 2012 to accelerate research and treatment development for rare diseases.

I conducted interviews and asked a set of questions about the current state of research and opportunities for advance research to 40 rare disease experts in 2012. I am interested in engaging an undergraduate student to create and deliver a follow up survey to the same 40 rare disease experts to assess how things have changed over the last four years. The student will be encouraged to scan the rare disease field to identify examples of collaborative initiatives making major progress. This project will be interesting to students, because it will lead to findings that may speed up research for many rare diseases and it will give students exposure to top experts from a variety of medical fields. By the end of the summer, we should have data back, complete analyses of the data, and begin working on a manuscript to submit for publication in a medical journal. As current Associate Director, Patient Impact, of the Penn Orphan Disease Center, I will work closely with the student to try to turn our data into new ideas for helping advance treatments for rare diseases.

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Nursing

BIOBEHAVIORAL HEALTH SCIENCES

Bart De Jonghe

Project 1: Neurobiology of Nausea and Starvation

This laboratory and animal model based research is centered on discovering how the brain integrates signals of energy balance and nausea which contribute to behaviors of starvation (i.e., lack of hunger) and feelings of general malaise and "sickness" following drug treatments for chronic diseases such as cancer. The student will engage in behavioral neuroscience research from the single cell to the whole organism in an effort to unlock the neural circuits of nausea and energy dysregulation stemming from chemotherapy. The work will be performed in a small laboratory setting with direct mentorship by senior students/lab members and the Principal Investigator. No undergraduate research experience is necessary, however a strong interest in cancer and/or behavioral neuroscience is a plus. The student will benefit from a setting where all lab members are encouraged to participate in all aspects of research. The student will also engage in scholarship and participate in regular lab meeting to understanding the field and nature of the research beyond the experiments at hand.

Lea Ann Matura

Project 1: Mechanisms of a Symptom Cluster: Dyspnea, Fatigue and Sleep Disturbance in Chronic Illness

Symptom clusters are the co-occurrence of two or more symptoms that are related. The symptom cluster dyspnea, fatigue and sleep disturbance is common and negatively affects health-related quality of life in people with pulmonary arterial hypertension (PAH). Determining underlying biological mechanisms is essential to develop and test biobehavioral interventions to target these mechanisms and alleviate symptoms. The pathobiology involved in PAH includes activation of the sympathetic nervous system (SNS) and inflammatory pathways which may prove to impact the symptom cluster in PAH. Inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-alpha) have been associated with symptoms (dyspnea, fatigue and sleep disturbance) in other disorders. We will determine if activation of the SNS and inflammatory biomarker levels are associated with symptom cluster severity (dyspnea, fatigue, sleep disturbance). We will enroll 60 women with PAH. Our overall hypothesis is increased levels of plasma norepinephrine, IL-6 and TNF-alpha levels will be associated with symptom

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cluster severity in women with PAH. Students will need to know basic library research skills and knowledge of working with Microsoft office.

Therese Richmond

Project 1: Emotional Responses & Recovery from Injury in Urban Black Men

This NIH funded study focuses on injury as a flashpoint from which interventions can be introduced to improve health and reduce disparity in urban black men. This study innovatively assesses the lifetime accumulation of risk and protective factors at the personal and institutional levels, incorporates environmental data using geographic information systems, and links link these rich data to acute peri-traumatic subjective experiences. Doing so will enable more accurate identification of black men who will develop post-injury depression or post-traumatic stress, and thereby capitalize on injury as a point of intervention to mitigate negative health outcomes. We are enrolling a consecutive cohort of 600 urban black men who are hospitalized for injury and followed for 3 months post-discharge to measure the primary outcomes: depression and post-traumatic stress.

RA Duties:

We are looking for a PURM student to join our interdisciplinary research team and work with a stellar staff. Job responsibilities include transcribing qualitative interview audiotapes and initial analysis, data entry in REDcap, possibly working with geospatial data, conducting library research, possibly interviewing participants in-hospital, accompanying staff for f/u interviews. We are looking for a mature and inquisitive student with excellent people skills and abilities to interact with a diverse population with high levels of respect, and savvy with computer programs.

FAMILY & COMMUNITY HEALTH

Jianghong Liu

Project 1: Environmental exposure, neurocognition, and adolescents' mental health outcomes

As part of NIH funded study, the purpose of this project is to investigate how Environmental toxicants exposure (e.g. lead exposure) affect neurocognition, psychophysiology and emotional

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and behavioral outcomes in children/adolescents. The student will conduct extensive literature searches, read and analyze published literature to establish a solid background on the topic. The student will build experience in literature search, synthesis, and interpreted data results. The student should have good organizational skills and be comfortable working independently and in a group setting. Training will be provided. Understanding data analysis is plus but is not required.

Project 2: Early health factors on adolescents' positive psychology

We know vey little about what are the early health factors associated with adolescents emotional well-being (e.g. happiness, and grit, and what are the mechanism of action. These protective health factors could be nutrition, sleep and maternal emotional status during pregnancy. The student will build experience in literature search, synthesis, and interpreted data results. The student should have good organizational skills and be comfortable working independently and in a group setting. Training will be provided. Understanding data analysis is plus but is not required.

Project 3: Prenatal and postnatal 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) and postnatal factors (e.g. lead exposure) affect childhood sleep patterns and their subsequent effect on neurocognition and behavior in children/adolescents. The student will conduct extensive literature searches, read and analyze published literature to establish a solid background on the topic. The student will build experience in literature search, synthesis, and interpreted data results. The student should have good organizational skills and be comfortable working independently and in a group setting. Training will be provided. Understanding data analysis is plus but is not required.

Catherine McDonald

Project 1: Testing a Web-based intervention for Risky Driving with Cell Phone Monitoring

Motor vehicle crashes are the leading cause of death in teens. Passengers, texting, phone calls and mobile phone apps can take a teen's attention away from the roadway. Our research team is testing a web-based intervention for distracted driving by using in-vehicle monitoring of cell phone use while teens drive on the road. We seek a well organized and self-directed student to assist in our recruitment, enrollment, data collection and analysis. Training will be provided and the candidate will gain skills in human subjects research, web-based intervention delivery, cell-phone monitoring, interdisciplinary communication, and scholarly presentation. We are excited

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to welcome a student to our team that combines nursing, medicine, engineering and public health. You will interface with study staff at CHOP and PENN, and will need to complete all required back ground checks.

Project 2: Analysis of eye tracking data for attention to the roadway during driving simulation

Lack of attention to the roadway is a major contributor to crashes among teen drivers. Our research team has collected eye tracking and driving simulation data with newly licensed teen drivers. These data need to be analyzed for measurement of attention to the roadway, relationship with other driving metrics, and self-reported driving behaviors. We seek a well organized and self-directed student to assist in data management and analysis. Training will be provided and the candidate will gain skills in human subjects research, eye tracking and driving simulation, interdisciplinary communication, and scholarly presentation. We are excited to welcome a student to our team that combines nursing, medicine, engineering and public health. You will interface with study staff at CHOP and PENN, and will need to complete all required back ground checks.

NURSING

Salimah Meghani

Project 1: Mixed-methods Research to Elucidate Mechanisms of Clinical Disparities in Cancer Pain and Symptom Outcomes

This study provides an important opportunity for a student interested clinical research, generating interventions, and reducing health disparities. Disparities in clinical pain management and cancer symptom outcomes are well-documented, although the sources of these disparities are not fully elucidated. The goal of this summer study is to advance research on this important topic using a mixed-methods research design. This design integrates useful methods from cognitive anthropology combined with 12 separate focus groups with African American and White cancer patients and their family caregivers. Generating intervention ideas from patients and families themselves is an approach emphasized in the recent patient-centered initiatives to produce "ground-up evidence" and workable interventions.

This study will explicate what is important to patients and family caregivers in the context of patients' illness and illness management and to determine if the salient concerns and considerations differ for patients vs. families or between racial subgroups; and 2) Elicit patients-family generated concerns and ideas to improve cancer pain management and to convert ideas to actionable interventions specific to decreasing disparities. The study leverages technology to prevent systematic exclusion of those with the greatest symptom burden from participating in the

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study. Due to the translation gap (i.e., gaps in documenting issues through research and doing something about them), we propose a systematic plan as part of this study to convert findings into interventions.

The PURM fellow will learn the following skills: 1) completing training in human subjects research and learning to navigate Institutional Review Board; 2) conducting clinical research; 3) assisting with in-person and virtual synchronous focus groups; 4) analyzing and coding qualitative data; 5) Learning to use data analysis software (specifically SPSS) to generate and interpret data outputs from the statistical analysis of he quantitative data. 6) learning to triangulate mixed-methods data. The mentee(s) will have opportunities of co-authorship on scientific posters and papers.

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Social Policy and Practice

SOCIAL POLICY & PRACTICE

Femida Handy

Project 1: Intergeneration transfer of environmental values

This research project involves all levels of learning, from writing, research and analysis of findings

Environmental Habitus: The Intergenerational Transmission of Environmental Behaviors in Cross-National Comparison

Recent scholarly attention finds that individuals' pro-environmental orientation is related to their parents' pro-environmental values, attitudes, and behaviors, and that family socialization exerts a significant influence on young people's pro-environmental orientations and behaviors. This research takes environmental behavior into the family domain, and proposes to investigate the links between environmental behaviors of three generations to measure the impact of cultural and economic contexts on intergenerational transmission of environmental behaviors. Our main theoretical heuristic is the notion of environmental habitus, arguing that a pro-environmental stance may run in the family, not necessarily because individuals follow the imperatives of the environmental movement or because they hold an environmental ideology, but because their families hold values and behavioral dispositions of frugality, modesty, or conservation that have consequences for everyday pro-environmental behavior. Furthermore, we examine environmental habitus comparatively, asking if it takes different forms in three different national contexts – Israel, the United States, and South Korea. These countries are characterized by different cultural and economic contexts, different framings of environmental issues, and different historical trajectories starting from pre-World War II and continuing up to today. We will conduct surveys in the three countries through online panels. We will interview parents and their children, and ask the parents questions about their own parents. An additional source of data will be focus groups aimed at better contextualizing and interpreting the results of the surveys. Our research will contribute to the understanding of the determinants of environmental behavior, the cross-national differences in environmental behavior, and the influence of intergenerational social reproduction on environmental issues.

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Project 2: Ethics for Social Impact

I am writing a book on this topic and there will be student engagement at all levels of the project-research, writing and editing

Nonprofit charitable organizations, in general, are considered trustworthier than their counterparts in the public or for-profit sector. This is true in surveys conducted in Canada and USA, and is often given as the raison d'etre for the comparative advantage they enjoy when they compete for consumers (and donors). Indeed in a nationwide survey more than 25 percent of Americans reported "a lot" of confidence in nonprofits as compared to 9 percent for government and 7 percent for for-profit organizations. At the same time the press and media outlets have reported, with some regularity, scandals among nonprofits. And, in addition there are many wrongdoings that go unnoticed, as they are either not reported or happen at small organizations that the media ignore.

Nonprofit board members and employees are often placed in difficult situations, with no single stakeholder and an allegiance to ambiguously written mission statement. It is difficult to ascertain whose rights to prioritize when facing complex situations. When do donor rights trump the mission or employee rights? Does good governance always mean transparency? What rights do volunteers have in the organization? Do monetary donations trump donations of time? Is there a triple bottom line? Is financial solvency paramount in the face of changing needs? When is mission drift acceptable? Does serving the public good always mean forfeiting the private benefits? These questions are faced in the day-to-day running of many nonprofits and must be dealt with in ethical ways. The question arises, what is the ethical way?

This book outlines frameworks for dealing with complex cases by outlining various ways leaders of nonprofits can view the dilemmas facing them. By providing various ethical frameworks, and using a case study approach, this book will illuminate the various elements involved in ethical decision making for nonprofit decision makers.

Susan B. Sorenson

Project 1: Multiple roles of social media and technologies

Social media and related communication technologies can be beneficial or harmful, depending upon their source and intent. This duality is an important issue in the field of intimate partner violence: media may be engaged to stalk and control an intimate partner, or used to reduce the danger of physical harm and the fearsome effect of being stalked. Technology and intimate partner violence has not been written about to the extent it deserves, and the Center Director and a Graduate Student Fellow would like to engage an undergraduate to explore this dual role in depth. (This project will be conducted under the auspices of the Evelyn Jacobs Ortner Center on Family Violence, a cross-School center at Penn.) The result will be communicated in one or

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more forms depending upon the findings and the intended audience; possibilities of the latter include academicians, community organizations, government agencies, and lay persons. The project, ideal for students interested in society and technology, will provide the opportunity to learn how to assemble, synthesize, and analyze information, and how to write for publication matched to the intended audience. On-going involvement with the Center is a possibility.

Project 2: Giving knowledge away: Communicating research and researchers

The faculty, graduate students, and undergraduates who are part of the Evelyn Jacobs Ortner Center on Family Violence, a cross-School center at Penn, conduct and report on a wide range of research from the perspectives of many academic disciplines. The Center wants to make these research findings accessible to members of the general public. This project will create information sheets summarizing this research to be posted on the Center's website and printed for hard copy distribution. This compilation will be coupled with interviews of faculty and students about their work and those interviews will be converted to text suitable for publication in the Center's newsletter and its website. These projects provide an opportunity for a student to develop and practice these skills throughout the summer and will give the student experience in identifying focal points of research articles, in conducting interviews, and in writing for a lay audience. This is a good fit for students whose future will include synthesizing and communicating information. On-going involvement with the Center is a possibility.

Yin Ling Irene Wong

Project 1: Community In-Alliance for Recovery: Challenging Stigma of Mental Illness in Rural China

Stigma is pervasive in Chinese society, resulting in the under-utilization of treatment among persons with mental illness (MI), as well as social rejection and social isolation among families affected by MI. The goal of this project is to design, evaluate, and disseminate an innovative family-based health messaging intervention using graphic vignettes and mobile phones to reduce stigma of MI.

The PURM student will participate in an interdisciplinary research team consisting of faculty, students and mental health professionals of Penn, the University of Hong Kong, and Sichuan University. Along with team members whose academic backgrounds span the disciplines of communication, psychiatry, public health, social administration, and social welfare, the PURM student will participate in the following activities: 1) compiling a comprehensive literature review regarding stigma of MI in Chinese society; 2) planning a one-day workshop on the prevalence and treatment of MI to be held at the Penn Wharton China Center in Beijing, China; 3) designing and implementing a research protocol on Photo Elicitation Interviewing (PEI), a

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qualitative research method using photographs taken by persons with MI and their family caregivers to explore the impacts of stigma on their lives.

The PURM student will learn the following academic and professional skills: 1) conducting interdisciplinary research in a cross-cultural setting; 2) designing a qualitative research project using the media of photography and graphic vignettes; 3) developing research protocols and data collection instruments; 4) writing up reports and manuscripts for dissemination and publication. The student will gain an understanding of the cultural meaning of MI in rural China.

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Veterinary Medicine

BIOMEDICAL SCIENCES

Leszek Kubin

Project 1: Connections between noradrenergic neurons and motor neurons in transgenic rats

The project represents a component of a larger research program supported by the National Institute of Health whose goal is to determine how sleep affects breathing. In this study, we use as models transgenic rats which carry a gene for "Cre" protein in those central neurons that contain tyrosine hydroxylase and, as such, belong to the class of catecholaminergic (noradrenergic, adrenergic and dopaminergic) neurons. When appropriately designed adeno-associated viral vector carrying genes for green fluorescent protein (GFP) and channelrhodopsin (ChR) is injected into selected brain regions of our transgenic rats, catecholaminergic neurons, and only those, will produce GFP and ChR. GFP is then synthesized in the target neurons and transported along the axons to their synaptic terminals. Concurrently, ChR is synthesized in the target neurons and forms channels in their membrane that open when neurons are illuminated by blue laser light pulses. Hence, the injected rats can be used to trace anatomical connections in the brain between selected groups of catecholaminergic neurons and central neurons with which they make synaptic connections. The goal of this project is to explore the detailed neuroanatomy of connections between different groups of central noradrenergic neurons and motor neurons that control muscles of the upper airway that protect the upper airway from collapse during sleep in patients with the Obstructive Sleep Apnea Syndrome.

The projects offers an undergraduate student an opportunity to gain practical experience with histological and immunohistochemical techniques and light and fluorescent microscopy. The student will also become familiar with stereotaxic techniques, neuroanatomy and neurochemistry of the brainstem, and the basic brain circuits that generate sleep-wake states and central respiratory rhythm. This summer project may extend into an independent study project to be continued during the fall semester.

Project 2: Activation of motor neurons by noradrenergic neurons in transgenic rats

The project represents a component of a larger research program supported by the National Institute of Health whose goal is to determine how sleep affects breathing. In this study, we use as models transgenic rats which carry a gene for "Cre" protein in those central neurons that contain tyrosine hydroxylase and, as such, belong to the class of catecholaminergic (noradrenergic, adrenergic and dopaminergic) neurons. When appropriately designed adeno-associated viral vector carrying genes for green fluorescent protein (GFP) and channelrhodopsin

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(ChR) is injected into selected brain regions of our transgenic rats, catecholaminergic neurons, and only those, will produce GFP and ChR. GFP is then synthesized in the target neurons and can be visualized to verify that successful transfection occurred. Concurrently, ChR is synthesized in the target neurons and forms channels in their membrane that open when neurons are illuminated by blue laser light pulses. Hence, the injected rats can be used to selectively stimulate different groups of noradrenergic neurons across sleep-wake states and assess the effect of such stimulation on the states of vigilance and central respiratory activity. The goal of this project is to determine whether laser stimulation of selected groups of brainstem noradrenergic neurons can activate upper airway muscles during sleep without disrupting sleep continuity. As such, the project seeks to test whether one can protect upper airway from collapse during sleep by activating certain noradrenergic neurons. If feasible, this could open new means of treating the sleep disorder known as the Obstructive Sleep Apnea Syndrome.

The projects offers an undergraduate student an opportunity to gain practical experience with analysis of electroencephalographic (EEG) and electromyographic (EMG) signals with the goal to recognize different sleep-wake states and quantify the effects of central stimulation of noradrenergic neurons with laser light. The student will also become familiar with stereotaxic techniques, neurochemistry of the brainstem, and the basic brain circuits that generate sleep-wake states and central respiratory rhythm. This summer project may extend into an independent study project to be continued during the fall semester.

CLINICAL STUDIES - NEW BOLTON (VET)

Thomas Parsons

Project 1: Assessing affective in sows via cognitive bias testing

Swine producers are being asked to transition their sows out of individual gestation stalls to group housing. In group housing, the sow faces greater freedom of movement and a more complex social environment. Research on the welfare of group-housed sows tends to focus on traditional metrics of physiological ailments, such as skin lesions, lameness, body condition and productivity. The cognitive bias test can be used to infer an animal's subjective experience or affective state. The theory of this psychological experiment is that an animal will appraise a certain ambiguous stimulus as predicting either positive or negative outcome depending on their affective state. For example, research on human and non-human animals indicates that negative mental states, such as anxiety or depression, can induce negative, or pessimistic, judgments of ambiguous stimuli. Cognitive bias assessments are carried out via go/no-go tests as they have the advantage of allowing for active choice responses by the animals. Operant conditioning methods will be used to train the sows to distinguish between two stimuli that lie at the ends of a continuous stimulus range. One stimulus will be associated with a highly valued reward while

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the other will be associated with a lower valued reward or punishment. The conditioned behavioral response will be a snout-press to a touchscreen. This position would be ideal for undergraduates seeking to pursue a career in animal science or veterinary fields. Students will gain skills in handling and movement of large animals, operant conditioning techniques, and behavioral metrics to assess animal welfare.

CLINICAL STUDIES PHILA (VET)

Cynthia Otto

Project 1: Ovarian Cancer Detection by trained dogs

In this project 3 trained detection dogs will be used to characterize the odor associated with blood samples from patients with ovarian cancer. Overall goals will be to determine if the dogs are able to detect early stage ovarian cancer, identify samples that have the proposed chemicals associated with the odor of ovarian cancer and determine if the odor is unique to ovarian cancer. During the summer the focus may be on only one of these goals. The student would be involved in the set up of scent detection wheel, processing of the samples and data collection. The student must be comfortable around dogs, be reliable and pay attention to detail.

Project 2: Can dogs diagnose an infection?

In this project 3 trained detection dogs will be used to characterize the odor associated with biological samples from animals or people with infections associated with medical implants. Overall goals will be to determine if the dogs are able to detect which patients have an infection and how early after the infection it can be detected. In addition, we will determine if the odor is unique to a specific type of bacteria or the presence of a biofilm. During the summer the focus may be on only one of these goals. The student would be involved in the set up of scent detection wheel, processing of the samples and data collection. The student must be comfortable around dogs, be reliable and pay attention to detail.

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Wharton

BUSINESS ECONOMICS & PUBLIC POLICY

Mike Abito

Project 1: Technological Choice in Response to Environmental Regulation: Electricity Markets and the Clean Power Plan

In August 2015, the EPA announced the final version of its Clean Power Plan (CPP), which aims to cut carbon pollution from the power sector by 32\% below its 2005 levels. In this paper, we assess the long-run implications of that rule on electricity markets, taking into account that profit maximizing firms make optimal investment and generation decisions. We set up a dynamic model of the power sector. Crucially, the model allows for rich heterogeneity in the generation portfolio, both within and across firms. We then estimate the model using the methodology in Bajari, Benkard, and Levin (2007) and using data from the Pennsylvania-New Jersey-Maryland (PJM) Interconnection. Our policy simulations focus on mass-based emission restrictions and compare the market and environmental outcomes under different scenarios: (i) PJM or state-by-state carbon trading; (ii) increase in the renewables portfolio and (iii) with demand management policies.

Judd Kessler

Project 1: Organ Donor Registration Decisions

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 —- is less than 50% even though 95% of people say they support organ donation. This research project aims to better understanding what motivates individuals to register as organ donors by running a series of randomized controlled trials with partner organizations, varying the way people are asked to register and observing subsequent registration rates. The student will be involved in overseeing a database of research topics, identifying partner organizations, and participating in the design and analysis of experiments done as part of the research.

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

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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.

LEGAL STUDIES AND BUSINESS ETHICS

Peter Conti-Brown

Project 1: History of the Federal Reserve

Students participating in this project would help me digest the very large amount of primary sources on the Federal Reserve by doing archival research and writing research memoranda on key moments in the Fed's history, including: the Fed in the shadow of Watergate, the Fed in the Cold War, the Fed and the deregulation of the financial sector in the 1980s and 1990s, and the Fed and 9/11. Students should have an interest in history and politics and feel comfortable reading and summarizing primary sources. Some travel may be required, but this is negotiable.

Project 2: Do Crises Cause Legislation?

A co-author and I are working on a large-scale empirical project to determine how and whether financial crises cause legislative responses in Congress. We have collected the primary statutes and will begin a long process of coding these documents for easier empirical research. Students should be interested in law, politics, and finance.

Project 3: The Supreme Court and the Federal Reserve

How does the Federal Reserve function as a political institution? Is it as a board of experts, or more like a court? In this project, I will explore how the Fed's functions sometimes look more like law-making than economics. Students will assist me in doing historical work around key

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episodes in Fed and Supreme Court history. Undergraduates interested in law school are urged to apply, as are any who are interested in finance, politics, and law generally.

Sarah Light

Project 1: Precautionary Federalism and the Sharing Economy

The student will assist me with research on one or more law review articles relating to the environmental impacts of transportation network companies like Uber and Lyft. The articles explore the implications of these impacts for public policy/regulation and private environmental governance. The research may be about impacts in the US and in Europe. The work may also address theoretical questions. My research methodology is normative and qualitative, rather than empirical. Some background in legal studies and/or environmental management and policy is preferred, though not required.

MANAGEMENT

David Hsu

Project 1: Scientific Discovery and Commercialization Strategy

This research project studies the commercialization strategy of high-technology startups. Exploiting simultaneous scientific discoveries, we explore what drives their successful commercialization. This approach helps rule out differences in entrepreneurial ideas, allowing us to understand how differences in startup development strategy and external business environment explain startup success. Aside from commercialization, we will also examine intermediate startup development goals such as attaining venture capital financing. The main task for the RA will involve updating and improving a MIT-developed algorithm that identifies simultaneous scientific discoveries. The algorithm matches scientific articles based on date, authors and citations. It identifies pairs of research articles having no author in common, written no more than one calendar year apart, being frequently cited by the same papers, and being consistently cited adjacent to each other. We plan to develop the algorithm further and use it on a large sample of data.

We are recruiting for 1-2 research assistants. The project requires part-time commitment (20 hours per week) through the summer. Diligence, curiosity, and interest in technology and entrepreneurship are required. Experience with programming on one of the common languages (i.e. one among Python, C++, Java, etc) will be an asset.

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Laura Huang

Project 1: Entrepreneurs, Investors, and Impression Management

This project looks at how entrepreneurs manage the impressions of angel investors and venture capitalists. Prior research has shown that there are fundamental criteria that drive evaluations and investment decisions, such as market and financial data. However, there are also other factors that are likely to be less explicit. There are a variety of signals and cues that influence the way that potential resource providers (e.g. investors) subsequently evaluate entrepreneurs and their new ventures. Students interested in research at the intersection of entrepreneurship and social psychology are encouraged to apply. You will gain experience working with multiple types of archival data, and will learn about the entrepreneurial investment process and financial decision making. The project entails working with business plans, resumes, and investor feedback forms, as well as watching a large set of pitch presentations. Students may also be asked to participate in the design and administration of surveys, as well as the analysis of the resulting data. Strong organizational skills and attention to detail are critical.

Anoop Menon

Project 1: Big Data, Innovation, and Business Strategy

Innovation is a key force behind economic growth. While we have studied it for many decades, many of the intricate mechanisms that foment, direct and suppress innovation still remain a mystery. This project will use machine learning and big data techniques to create and integrate multiple large datasets in a fashion that would enable us to answer a set of basic, yet crucially important questions about the relationship between firm strategy, intellectual property rights, and innovation. What are the major strategic approaches that firms take toward innovation? How does competition impact innovation? How does firm performance impact innovation and vice versa?

To answer these questions, we will combine public databases of international patents, patent lawsuits and patent acquisitions with firm regulatory filings, reports, mergers, acquisitions and stock market performance. Students will be responsible for creating programming routines that extract and clean large amounts of data from various public databases, and for integrating information across these different datasets. They will be using advanced machine learning and data processing tools to achieve this, and would have the opportunity to develop new techniques to perform certain domain specific tasks (for example, disambiguating company names). Through this, they will be able to develop valuable data-science skills.

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Prerequisites include prior programming experience, preferably in data scraping and big-data handling techniques, proficiency in Python, and in one or more of the following languages: R, Stata, SQL.

Luis Rios

Project 1: Organizational Hysteresis: A Lab Study

We seek to test a novel theoretical perspective on the role of non-linear dynamics ("NLD") in maintaining path dependent equilibrium in organizations. While orthodox views on NLD argue that they reduce stability, we suggest a type of NLD model (Presisach hysteresis) which has recently gained wide acceptance in the natural sciences, and which might resolve long-standing paradoxes in current theories of firm evolution.

Project one will seek to establish a "proof of concept" using a lab experiment. We will investigate whether individual actors exhibit hysteretic behavior. We will use a non-ideal relay composed of two human subjects. Where there is a threshold function (eg input is compensation incentive and output is task/labor). We vary the inputs and measure outputs. Evidence of a non-ideal Preisach relay dynamic would be to find that a hysteretic effect is amplified if the workers are acting as a team vs. individually.

Because this project straddles the domains of pure mathematics, natural sciences, and organizational theory, it would be a great opportunity to expose talented but narrowly-trained students to the world of inter-disciplinary research. The students' role will be to collect and organize data, contribute to the literature survey, and participate in the administration of the experiment. Ideal students will have some background in lab experiments with human subjects (e.g. psychology) and an interest in mathematics and/or organizations.

Project 2: Incompetence or Foreclosure: Why do Firms Fail to Exploit Technology?

There is evidence that technological acquisitions often fail to yield value for the acquirer. This is often attributed to the difficulty in integrating the acquired knowledge that resides within human capital. However, an alternative explanation might be that some acquisitions are made by firms that seek to foreclose on the opportunities of future competitors. In other words, they may purposely buy in order to "shelf" new rival technologies.

This project exploits a novel database which matches patents to FDA medical device categories, allowing us to see firms' experience at the product level, as well as the strategies they pursue post-acquisition in terms of exploiting or sitting on acquired technology.

This phase of the project will use undergraduate research assistants to collect data to supplement our database. Specifically, they will be trained in methods to access deal databases like SDC and Zephyr, and to read analysts coverage of the deals. This will develop their skills in generating

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qualitative data to compliment quantitative data. They will also be involved in statistical analysis and the writing of the appendix for a journal article.

Natalya Vinokurova

Project 1: Improving Heart Surgery Outcomes

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 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: Where did Robo-signing come from?

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: How to make oil companies safer?

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.

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MARKETING

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). 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, for which my coauthor is Derek Gilman, former Director of the Barnes Museum and current Vice Chair of Impressionism at Christie's. 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 has 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.

OPERATIONS AND INFORMATION MANAGEMENT

Maurice Schweitzer

Project 1: Humor and Power

How does power influence the experience of humor? In this project, we explore different types of humor and the interplay between humor and power. For example, do people laugh louder and

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longer when high power tell jokes than when lower power people tell jokes? Do people find edgy humor to be more appropriate when high power people tell them than when lower power people tell them?

Students would join my research team and work collaboratively with Ph.D. students, post-docs, and research assistants. Responsibilities would include supporting laboratory studies, conducting surveys, analyzing data, and presenting early stage results.

Project 2: The Magnitude of Emotions

Though early research broadly categorized emotions as either positive or negative, more recent work distinguished between individual emotions (e.g., anger, fear, sadness). This recent work, however, has failed to appreciate an important nuance: the magnitude of the emotion. At different levels, emotions can have very different effects. For example, mild anger can have very different effects than rage. In this project, we explore the different effects of feeling emotion, emotion regulation, and emotion expression at different magnitudes.

Students would join my research team and work collaboratively with Ph.D. students, post-docs, and research assistants. Responsibilities would include supporting laboratory studies, conducting surveys, analyzing data, and presenting early stage results.

Project 3: Fear and Motivation

Motivation is a cornerstone of management. How can we effectively manage other people? Some managers employ fear. In this project, we explore how fear works and the beneficial and harmful effects of using fear to motivate others.

Students would join my research team and work collaboratively with Ph.D. students, post-docs, and research assistants. Responsibilities would include supporting laboratory studies, conducting surveys, analyzing data, and presenting early stage results.

Lynn Wu

Project 1: Big Data and Firm Performance

Despite the rapid increase in the spending of new technologies, most firms could not quantify the return to investing these new technologies. Thus, understanding how new technologies such as internet of things, social/mobile media, and advanced AI can have a productivity impact on firms has become an increasingly important question.The research assistant will be assisting with data analysis on two related projects. We plan to track how big data capabilities affect firm performance and earnings. We will be examining corporate earnings and use machine learning techniques such as deep learning on letter to stockholders, skill composition of the C-level execs and the general workforce, as well as call transcripts to analysts. We aim to extract these

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variables that can help predict long term firm performance. Ultimately, we seek to understand why some firms can reap greater return to investing in technologies while others are not. With the rapid changes in information technologies that are currently disrupting many industries, we hope to identify key characteristics that helps firm leverage these technologies to the best of their abilities. Students must know how to program in Python or Java or similar languages, and know the basics about how to extract text from unstructured data. Students must be willing to learn machine learning techniques and statistical techniques. Ideally, Students should have taken CS 110 and CS 120 or equivalent courses and experience. Rising Junior preferred.

Project 2: Surveys of Emerging Tech

This project aims to survey important technology developments in the recent years in the high tech industry (Internet of Things, MOOC, Big Data, crowdsourcing, deep learning, peer-to-peer economy etc.). We seek to understand the fundamental differences these technologies are bringing and how they are disrupting or have the potential to disrupt any industries. Students are expected to survey the fundamentals behind the technology, what makes it disruptive, what industry the technology has the most impact on and how individuals, firms and the society could take advantage of these new technologies. Through the exercise, we will also be exploring the dark side these technologies could bring such as income inequality. If you are an avid reader of Techcrunch, Hacker News, or various technology related blogs and have a strong interests in firm strategy, venture capital and start-ups, this is an ideal position for you.