Penn Undergraduate Research Mentoring Program
Project Descriptions

Summer 2018.

Please read this before proceeding to project listings!

Application and instructions are here: ***http://www.upenn.edu/curf/research/grants/purm***

Unless otherwise noted, current 1st year students and sophomores may apply for any listed project.

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

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

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

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Arts and Sciences

ANTHROPOLOGY

Morgan Hoke

Project 1: Cohort Follow-Up Field Work: Economic Activities, Early Environments, and Child Growth in Nuñoa, Peru

The goal of the research project is to follow-up a cohort of Peruvian children enrolled in an investigation during infancy in order to examine the process through which social, economic, and health inequalities come into being and are maintained.

Undergraduate students may travel to the field site in highland Peru and assist in data collection (June-July 2018). Student researchers will be provided training in responsible research conduct with human subjects, anthropometric methods, biomarker collection methods, and survey administration. Their responsibilities in the field will include: interacting with study participants, assisting in the administration of surveys, conducting anthropometric measures, assisting in biomarker collection, and facilitating data storage. Students interested in going to the study site should have some knowledge of Spanish. Students will gain important skills including survey administration, data collection management, and experience in engaging in research in an international setting.

In addition to working closely with me, undergraduate students will work with Clare Super, a graduate student in the Anthropology Department who will also be attending the field site to assist in data collection. Students will also receive mentorship from Professor Thomas Leatherman of the University of Massachusetts Amherst who conducts research at the same field site. While Dr. Leatherman will not be directly involved in the research project the students will be working on, he has many years of experience working in Peru and at the field site and can provide invaluable insight to the students.

Project 2: Cohort Follow-Up Lab Work & Write Up: Economic Activities, Early Environments, and Child Growth in Nuñoa, Peru

The goal of the proposed research project is the processing, analysis, and write up of the data collected in the field in the course of the first research project.

This research project takes place at UPenn in the Biocultural Anthropology Methods Laboratory (BAMLab) located in the Penn Museum. Opportunities at BAMLab include, data entry, data management, data analysis, laboratory methods training, biomarker sample analysis, and statistical analysis. I will provide training for students to familiarize them with laboratory and

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statistical analysis methods. This laboratory-based research and analysis will take place from July through August of 2018 and may continue into the academic year if students are interested. This work will help students understand the process through which field collected data is transformed into academic publications. Students assisting in data analysis and write up will have the opportunity to participate in the academic publishing process. Students will also gain experience working in a scientific laboratory conducting ELISA assays, and in the management and processing of scientific data.

Undergraduate students will work with closely with myself and Clare Super, a graduate student in the Anthropology Department who will also be working with data analysis and management in the BAMLab.

Megan Kassabaum

Project 1: Smith Creek Archaeology Project (SCAP)

SCAP is an ongoing archaeological research project focused on a precontact Native American mound site. The site, Smith Creek, is located in far southwest Mississippi and was occupied most heavily about 1000 years ago. Students who join the SCAP team through PURM will be involved in every aspect of anthropological fieldwork through daily, hands-on experience in the field (5 weeks in Mississippi) and lab (5 weeks in the Penn Museum). Students will learn the methods of archaeological survey, excavation, and site mapping, as well as lab skills including artifact processing and basic ceramic analysis. For students interested in careers in archaeology, this project provides all of the field training necessary to take part in future excavations worldwide. For students who are not necessarily planning to pursue further study in archaeology, the project provides the opportunity to engage broadly with anthropological questions about early technology, monument construction, food production and consumption, and American Indian history, culture, and identity. While the 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. Past SCAP students have gone on to conduct Honors Thesis research, win prestigious museum fellowships and internships, present at professional conferences, co-author articles, and enter Masters and PhD programs in Anthropology and related fields. No prior experience is expected.

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Deborah Thomas

Project 1: Human Rights and Sexuality in Jamaica

During the summer of 2018, I will need two students to serve as researchers on a project having to do with human rights and sexuality in Jamaica. Students will conduct ethnographic participant-observation fieldwork, interviews, and other forms of qualitative research on how queer Jamaicans have attempted to create secure spaces within the context of a homophobia that is generalized through both political and popular culture. They will work within the organizational structures of Jamaicans for Justice (JFJ), Jamaican Forum for Lesbians, All-Sexuals and Gays (J-FLAG), Pride in Action (an LGBT Center on the campus of the University of the West Indies), and the University of the West Indies (UWI) Rights Advocacy Project (U-RAP). The latter organization is a project of the UWI faculty of law established in 2009 to promote human rights and social justice in the Caribbean by undertaking and participating in strategic litigation, socio-legal research and legal education regarding sexual orientation and gender diversity in collaboration with Caribbean lawyers and Caribbean civil society organizations and by working with students of the Faculties of Law. The students will focus on how class and social location influence the extent to which and the ways in which queer Jamaicans are able to secure their own safety. In doing so, they will work with individuals to think through issues related to the divisions that structure Jamaican society: public/private, uptown/downtown, church/popular culture.

BIOLOGICAL BASIS OF BEHAVIOR

Marc Schmidt

Project 1: Neurobiology of courtship behavior in songbirds

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

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

BIOLOGY

J Nicholas Betley

Project 1: Monitoring how nutrients influence neural activity in hunger circuits.

Hunger is a complex physiological state that is regulated by interactions between available nutrients and neural signals that control hunger. In this project, a student researcher will have the opportunity to explore both homeostatic and hedonic neural circuits that increase food intake. Both circuits are important to maintaining appropriate body weight, and dysfunction in these circuits can lead to maladaptive conditions associated with overconsumption of food. Undertaking this project will involve recording the activity of distinct neural populations in the awake and behaving animal, while it is consuming food or receiving nutrients infused directly into the stomach. After participating in this project, the student will have the ability to perform in vivo neural activity monitoring and will be well versed in designing a proper counterbalanced study to monitor neural activity. Additionally, students will have the opportunity to learn basic neural anatomy and immunohistochemistry skills.

Project 2: Investigating how the brain prioritizes basic survival needs.

When faced with two conflicting needs, how does an individual prioritize the most important need and perform actions to address that need? In this project, a student researcher will have the opportunity to perform neural manipulations in combination with behavioral assays in rodents to address how the brain influences the behavioral response to basic survival needs such as hunger, thirst, fear and pain. This project will lead to a firm understanding of how to design and implement complex animal behavioral assays as well as learning neuroanatomy and basic immunohistochemistry skills.

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Dustin Brisson

Project 1: Selective Whole Genome Amplification to Enable Microbial Population Genomics

Microbial population genetic research has been crucial for understanding many important topics such as pathogen dynamics, virulence, and host specificity. Although conventional population genetic analyses are limited by the quantity of sequence data from each sample, population genomics offers vast quantities of sequence information that can be used to infer evolutionary and ecological processes on very fine spatial and temporal scales. Inferences on these scales are critical to understanding and eventually controlling many infectious diseases. The promise of population genomics is tempered, however, by difficulties in isolating and preparing microbes for next-generation sequencing. We have developed the selective whole genome amplification (SWGA) technology that allows researchers to sequence microbial genomes from complex biological samples (i.e. host tissues, soil samples, gut contents) without relying on laboratory culture methods even when the focal microbial genome constitutes only a miniscule fraction of the sample. The primary hindrance to popular adoption of SWGA is not its effectiveness in producing samples suitable for next-generation sequencing but in the upfront investment needed to develop an effective protocol to amplify the genome of a specific microbial species. The student involved in this project will assist the post-doc currently on the project to identify the factors that result in optimal SWG amplification by generating amplification products and preparing these products for next-generation sequencing. The ultimate goal is to develop an efficient swga development pipeline that will allow researchers (including the student) to address medically- and biologically-important questions using population genomic data from any microbial species. Students with molecular and computational skills are encouraged to apply.

Project 2: Phylogeographic dynamics of ticks and tick-borne pathogens

Vector-borne diseases are one of the most prevalent types of emerging infectious diseases worldwide. In collaboration with the NY Health Department, we have collected >80,000 ticks and their associated pathogens from 515 locations across NY State. Collections were conducted over a 17-year period when these ticks and the pathogens they carry were expanding across the region. The current project aims to identify the environmental factors (landscape, climate, and human population) that govern the emergence of the tick and its pathogens – including the Lyme disease-causing bacterium and a malaria-like protozoan – by analyzing genome sequences in advanced analytical frameworks. The student involved in this project will assist the post-doc and graduate student currently on the project in genome sequencing, bioinformatic analyses, or statistical analyses that will ultimately result in mechanistic models that describe how environmental factors in real ecosystems determine migration and population growth patterns of this infectious disease system. These mechanistic models will be used to estimate future disease spread into novel environments and to predict future human disease risk. Results from these analyses can also produce critical insights into the factors driving disease risk from important human pathogens, and may identify processes that can be targeted to reduce disease risk. From a

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global disease perspective, this type of work is imperative as the geographic ranges of many infectious diseases are rapidly increasing and encroaching upon human communities. Students with molecular and computational skills and that have a keen interest evolution are encouraged to apply.

Junhyong Kim

Project 1: Machine Learning Approaches to Sparse Biological Data

Biology is becoming increasing driven by large-scale data such as from genomic measurements, mobile health devices, and biological imaging. However, compared to other kinds of data, the data is still relatively sparse (10's to 100's of measurement rather than 100,000's to millions in other fields), noisy, and high-dimensional (thousands of distinct variables). Our lab is developing novel approaches to learn biological information from these kinds of sparse, noisy, and high-dimensional data. The data sources include single cell transcriptome measurements, image data, and real-time measurements from microfluidics devices.

In this project the summer student will help collate collections of datasets from public databases, program new analysis algorithms, and participate in the development of novel approaches. The participating student should have strong programming skills in Python or Matlab--or, other language skills such as JAVA, C++, Julia. Coursework in algorithms, machine learning, as well as basic biology is desirable. The student will work in a team of senior scientists, postdoctoral fellows, and technicians.

Michael Lampson

Project 1: Mechanisms of nucleosome stability and epigenetic inheritance

Chromosome inheritance depends on an element within each chromosome known as the centromere. The location and function of the centromere are determined epigenetically by a DNA-binding protein known as CENP-A, which is a histone H3 variant. CENP-A propagation from one cell to its progeny is crucial to maintain centromere identity, and a key element of this process is the remarkable stability of CENP-A within a protein complex bound to DNA, the nucleosome. We have identified key structural features of CENP-A and designed mutations to disrupt this stability. The goal of this project is to test the effects of the mutations on CENP-A nucleosome stability and function. Using an established cell lines expressing a CENP-A mutant, the student will measure protein stability using quantitative fluorescence microscopy. The

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student will also create new cell lines with targeted mutations, using CRISPR-Cas9 technology, to determine how interactions with other proteins affect CENP-A stability. We anticipate that the initial summer project will lead to a long-term commitment and ultimately authorship on a publication. Some background in biology and chemistry, at least at the introductory level, is desirable.

Project 2: Genomics and cell biology of centromere evolution

The rapid evolution of some genes involved in essential cellular processes is paradoxical because these genes are expected to be highly conserved by natural selection. To understand this paradox, we are combining genomic and cell biological approaches, focusing on genes coding for centromere proteins. We are sequencing the genomes of eight rodent species, setting up an opportunity for the student to determine which genes have evolved rapidly, using established approaches for comparative sequence analysis. This analysis allows us to address the fascinating question of why these genes are rapidly evolving (i.e., what evolutionary force is acting on them). Using mouse (Mus musculus) as a model system, we are substituting genes from another species in the genus Mus to test hypotheses for why essential genes have diversified between species. The student will use live and fixed cell fluorescence microscopy to analyze the effects of such gene swaps. We anticipate that the initial summer project will lead to a long-term commitment and ultimately authorship on a publication. Some background in biology, at least at the introductory level, is desirable.

Mia Levine

Project 1: Telomere integrity on a treadmill

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 encoded by 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 breaks 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 so-called selfish DNA elements embedded in the ends of chromosomes. We will

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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 another species. We will assay this "Frankenstein fly" for various phenotypes related to telomere function. This project offers the opportunity for two undergraduates (each working on a different telomere protein) to learn classical Drosophila genetics, evolutionary genetics, cell biology (including confocal microscopy), and molecular biology including cloning and quantitative PCR. Students with a keen interest cell biology or evolution are encouraged to apply.

Timothy Linksvayer

Project 1: How do symbiotic bacteria affect ant behavior, aging, and fecundity?

The endosymbioitic bacteria Wolbachia is very widespread in arthropods and has diverse effects on lifespan, fecundity, as well as behavior. It is also widespread in social insects such as ants, but it's effects are unknown. Using the model ant Monomorium pharaonis, which is amenable to controlled laboratory experiments, we will quantify how Wolbachia affects ant fecundity, aging, and behavior. The lead mentor on this project will be Rohini Singh, a fourth year PhD student in the Linksvayer lab.

Project 2: What is the genetic basis of social behavior in ants?

The traits of highly social organisms such as humans and ants have a particularly complex genetic basis because an individual's traits (e.g., behavior, lifespan) depend on its own genes as well as the genes of its social partners. This project will use our study system, the pharaoh ant Monomorium pharaonis, which is amenable to controlled breeding and other laboratory experiments to quantify the genetic basis of social behavior. The lead mentor on this project will be Justin Walsh, a fourth year PhD student in the Linksvayer lab.

R. Scott Poethig

Project 1: Using CRISPR-Cas9 mutagenesis to produce new alleles of SPL genes in Arabidopsis

CRISPR-Cas9 is a new technology that provides the unprecedented ability to create genetic changes in precisely-defined regions of the genome. We are using this technology to generate new alleles of genes (SPL genes) that regulate the juvenile-to-adult transition in the plant, Arabidopsis. We are particularly interested in deleting two related genes that are part of a tandem duplication, as these genes cannot be simultaneously mutated by any other method. The student

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involved in this project will use PCR to screen the progeny of transgenic plants expressing CRISPR-Cas9 in order to identify individuals that are deleted for these genes. In addition he/she will screen F2 families by PCR to identify plants carrying mutations in multiple SPL genes. The phenotype of these plants will allow the student to determine the extent to which these SPL gene have related, or different, functions. The student will work closely with a post-doctoral fellow, Dr. Jianfei Zhu.

Mechthild Pohlschroder

Project 1: The Great Neglected: Post-Translational Protein Modifications in Prokaryotes

During the last century, molecular biologists determined that long double-helical strands of DNA serve as a kind of genetic template that encodes all the information necessary to generate the proteins required to build a living cell. Or so it was thought. Although the amino acid sequences of proteins are indeed encoded in these DNA strands, or genomes, generating a properly functioning protein often requires more than merely translating code into an amino acid sequence. In fact, a variety of post-translational modifications (PTMs) vastly increase the complexity of a cell's protein profile, or proteome, and PTMs, such as glycosylation, can play pivotal roles in regulating cellular processes. When something goes awry in a PTM process, it can profoundly affect the manifestation of a multitude of diseases in human beings. Unfortunately, the roles PTMs play in prokaryotes have been largely neglected. However, we have now determined that glycosylation is vital to regulating the formation of biofilms - multicellular microbial communities embedded in a polymeric matrix that are associated with a variety of debilitating diseases, including cardiovascular disease. and that appear to affect the virulence of several important bacterial pathogens. Recent advances in computational processing of data generated by mass spectroscopic analyses now allows us to perform large-scale, proteome-wide analyses of PTMs during biofilm formation in the haloarchaeon Haloferax volcanii and the bacterial pathogen Pseudomonas aeruginosa. In this interdisciplinary project, students will use the tools of molecular biology to generate and characterize mutants that lack proteins that they identify using a cutting-edge computational approach.

Project 2: Some like it sweet: Agl15-dependent N-glycosylation during stress

While biofilms - complex polymeric structures that protect embedded microbial communities from a diverse variety stress - adversely affect the health of millions of human beings, diminish crop production, and cause of economically significant corrosion, they also play beneficial roles in such applications as bioremediation, biocatalysis, and wastewater treatment. In many prokaryotic species, crucial processes during the initial stages of biofilm formation, such as surface adhesion and cell aggregation require the presence of functional type IV pili, cell surface

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structures that are evolutionarily conserved between the bacteria and the archaea. Recent studies in the Pohlschroder lab indicate that the differential changes in the expression and N-glycosylation, of a subset of the type IV pilins, the constitutive subunits of the type IV pili, play important and novel roles in regulating and facilitating these initial steps in biofilm formation in the salt-loving haloarchaeon Haloferax volcanii. Using a multidisciplinary strategy that combines approaches commonly used by molecular biologists, biochemists, and geneticists, respectively, the research proposed in this project will specifically lead to the characterization of the roles played by the Agl15-dependent N-glycosylation pathway, which appears to be induced by stress, in pilus biosynthesis and function as well as biofilm formation. Since key aspects of archaeal and bacterial biology are shared, the results of this project will not only promote a more comprehensive understanding of the mechanisms underlying the processes involved in archaeal biofilm formation, they will also provide important insights for researchers studying bacterial biofilms.

Project 3: Sticking around: identifying genes required for surface adhesion

While biofilms are used as tools to facilitate bioremediation, wastewater treatment, and the commercial production of certain chemicals, they can also cause significant harm, through biofilm-based infections, deleterious effects on crop production, clogging pipes in potable water systems, and economically significant corrosion. Surface adhesion is the initial step in biofilm formation, a fundamental developmental stage in many microorganisms. Thus, identifying and characterizing the mechanisms underpinning this process will help elucidate how this strategy has become a key to allowing prokaryotic species to survive and colonize a diverse array of environments. We recently created a transposon insertion library in the haloarchaeon Haloferax volcanii. Moreover, we have adapted the Air-liquid interface (Ali) assay, which can be used to quantify cell adhesion to an abiotic surface, the first step in biofilm formation, to allow rapid screening of the transposon insertion library for mutants that exhibit defective adhesion phenotypes. Using this approach, we already identified proteins that play important roles in surface adhesion that had not previously been known to play any role in this process. Identifying additional mutants using this assay, combined with genome sequencing, and genetic and biochemical characterization, will advance our understanding of the mechanisms underlying archaeal biofilm formation, and may lead to methods that improve the effectiveness of bioremediation. Furthermore, since bacterial and archaeal biofilm formation share core principles, our work with this non-pathogenic prokaryote may improve our understanding of bacterial pathogenesis.

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Doris Wagner

Project 1: Dissecting the biological role of liquid-liquid phase separation in epigenetic control of transcription

Intrinsically disordered (ID) regions are found in proteins linked to neurodegenerative disease, in RNA-binding proteins and in proteins that regulate transcription (1). Understanding the functions of intrinsically disordered proteins and protein domains is an exciting area of modern cell biology and biochemistry. Many proteins with ID domains can undergo liquid-liquid phase transitions to reversibly form mobile nuclear or cytoplasmic puncta or droplets (2-4). Functionally, the high protein concentrations found in the condensed phase may sequester important biomolecules in times of stress or enhance the kinetics of biochemical reactions (4, 5). While the number of proteins containing ID regions identified as capable of undergoing phase separation is steadily increasing, the biological role of liquid droplets remains poorly understood. We have identified several plant transcriptional and epigenetic regulators with ID domains that undergo liquid-liquid phase separation in response to their cellular environment to fine-tune growth and development. We hypothesize that the ability to form droplets is regulated and therefore propose to define the functional domains, critical amino acids, post-transcriptional modifications (PTMs) that promote or prevent the liquid phase transition of these proteins in vitro and in plant cells using biochemical and cell biological tools. In parallel, we will probe the transcriptional activity and the biological function of the variant proteins in vivo on transcription and chromatin compaction using molecular and genomic approaches. The research team includes myself, a graduate student and postdoc in the Wagner lab, and a senior lecturer who is currently addressing part of this project in collaboration with us in a laboratory class. Over the summer, as part of this team, you will explore how ID proteins interface with the chromatin regulatory machinery by investigating protein-protein interactions and by developing and testing mechanistic models for how these interactions lead to gene regulation.

1. Bergeron-Sandoval LP, Safaee N, & Michnick SW (2016) Mechanisms and Consequences of Macromolecular Phase Separation. Cell 165(5):1067-1079.
2. Kato M & McKnight SL (2017) Cross-beta Polymerization of Low Complexity Sequence Domains. Cold Spring Harb Perspect Biol 9(3).
3. Wei MT, et al. (2017) Phase behaviour of disordered proteins underlying low density and high permeability of liquid organelles. Nat Chem 9(11):1118-1125.
4. Shin Y & Brangwynne CP (2017) Liquid phase condensation in cell physiology and disease. Science 357(6357).

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Michael Weisberg

Project 1: Community Science in the Galápagos Archipleago

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

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

Besides the Penn team, you will work together with local leaders and community members in a series of projects that address pressing issues where ecology, climate change, poverty, and educational inequality intersect.

CHEMISTRY

Barry Cooperman

Project 1: Mechanism of Action of Nonsense Suppressors

Premature termination codon (PTC) diseases afflict millions of people worldwide. Treatment of PTC disorders involves the use of therapeutic agents called nonsense suppressors (NonSups) which stimulate the selective binding to the ribosome of a near cognate tRNA at the PTC position, thereby restoring the production of full length functional proteins. Even small extents of readthrough, leading to limited synthesis of a missing essential protein, can provide dramatic clinical improvement, making this approach highly valuable. However, at present there is only

one NonSup, ataluren, approved for clinical use and even this approval is quite limited in scope. The experiments we propose focus on elucidating the detailed mechanisms and sites of action by which NonSups promote PTC readthough and misreading, based on the premise that understanding these mechanisms will facilitate the development of safer, more effective therapeutics for the treatment of PTC diseases. To study NonSup mechanisms we have designed and implemented a system for eukaryotic polypeptide translation composed entirely of separately purified components, termed PURE-LITE. NonSup-induced readthrough (NSIRT) can arise from direct effects of NonSup binding to specific components of the protein synthesis apparatus and from less direct effects that include escape from nonsense-mediated mRNA decay (NMD), and alterations in cellular activity levels of the protein synthesis machinery. The use of PURE-LITE allows partial resolution of the complexity of Total-NSIRT by measuring only effects on readthrough resulting from direct NonSup binding to one or more of the PURE-LITE components. Using PURE-LITE we determine the efficacy of each NonSup in promoting both read-through translation and misreading, the latter giving rise to toxic side effects for some NonSups. In this project the student will learn how to carry out the PURE-LITE assay and participate in ensemble and single molecule reaction kinetic approaches to determine how the rates of specific substeps within the readthrough and misreading elongation cycles are modulated by NonSups. In participating in this project, the student will interact with my graduate student Martin Ng and my research specialist Hong Li.

Project 2: Monitoring cell state by tRNA Pair Quantification

We are implementing a novel new method, denoted tRNA Pair Quantification (TPQ), as a highly sensitive and specific approach for monitoring the cell state which will have commercial application for rapid, point-of-care diagnosis of disease. Changes in cell state are often accompanied by alterations in the distribution of dicodons (codon pairs) utilized in ongoing protein synthesis. We have demonstrated that such alterations can be detected by the Förster Resonance Energy Transfer (FRET) signal that is generated when, in response to a specific dicodon, a pair of fluorophore-labeled isoacceptor tRNAs (fl-tRNAs) are bound in adjacent sites on a ribosome actively engaged in protein synthesis. The multiplicity of isoacceptor tRNAs in human cells results in a total of 1035 discrete fl-tRNA pairs that can be monitored, different subsets of which can serve as biomarkers for a specific cell state. In our initial experiments, we are using TPQ to discriminate between cells infected with different influenza subtypes. This will serve as a proof of principle that TPQ can be used for disease diagnosis. Viral infections are attractive targets for this purpose, because differences in dicodon usage between a mammalian cell and an infective virus can be readily estimated from their known open reading frames. This allows us to proceed directly to the testing of infected cells using limited sets of fl-tRNAs. A successful outcome will open the way to more ambitious uses of TPQ, such as in cancer diagnosis. In this project the student will learn how to prepare fluorescent tRNAs, transfect such tRNAs into cells, and use flow cytometry to quantify FRET signals in control and virally-infected cells. In participating in this project, the student will interact with my graduate student

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Martin Ng, my research specialist Hong Li, and members of the Hensley virology laboratory in Penn's Microbiology Department.

Zahra Fakhraai

Project 1: Vertical Alignment of Nanorods in Polymer Nanocomposites

Vertically aligned anisotropic nanoparticles are important in providing directionality in material properties. For example, plasmonic rods oriented out-of-plane can transmit power horizontally and help improve the efficiency of luminescent solar cells, or they can improve thermal conductivity in the vertical direction.

In this project, we aim to use various strategies such as casting methods or solvent annealing to orient gold nanorods vertically in a polymer matrix. The student would perform experiments and optical simulations related to the calculation of the orientation order of the rods. Ideally, the student is familiar with electromagnetism (2nd-semester physics), but this is not a requirement.

Feng Gai

Project 1: Site-Specific Spectroscopic Probes for Protein Structure and Dynamics

Proteins are molecular machines that execute a wide range of functions. In order to do so, proteins must afford certain degree of plasticity in their structure and dynamics and also possess variability in local electrostatic environment, solvent accessibility, and stability. However, assessing any of these protein properties in a site-specific manner is not straightforward since native spectroscopic signals often lack the needed specificity. One strategy that we are exploring to overcome this limitation is to develop unnatural amino acid-based spectroscopic probes for studying various biological questions, such as amyloid formation and protein electrostatics. Students participating in this project will have the opportunity to learn a great deal of research skills, ranging from peptide synthesis to fluorescence spectroscopy and microscopy, as well as experiment design, data analysis, result summary and presentation.

Project 2: Super-resolution Imaging of Membrane-Antimicrobial Peptide Interactions

The innate immune system of many organisms uses antimicrobial peptides (AMPs) as a line of defense against invading bacteria. It has been proposed that AMPs function by forming various oligomeric structures and/or pores upon binding to bacterial membranes. However, experimental validation of this hypothesis is difficult. Currently, we are developing a supper-resolution

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imaging method to examine AMP-membrane interactions, aiming to 'watch' the underlying molecular processes. Students participating in this project will have the opportunity to learn principles of fluorescence microscopy and acquire experimental skills in super-resolution imaging and biophysical chemistry. In addition, students will learn how to process, analyze, summarize, and present data and results.

Madeleine Joullié

Project 1: Interdisciplinary approach for the development of novel latent fingerprint detection reagents

Although latent (hidden or invisible) fingerprint detection on paper is an integral component in forensic science, it remains as an uncharted territory for contemporary organic chemists. During the latter part of the 20th century, a wide variety of chemical reagents that react with amino acids present in natural skin secretions have been identified for this process. However, approximately over 50% of all fingerprints still escape detection due to limitations to sensitivity. Other formidable challenges include reproducibility of existing methods, probing complexity of the fingerprint residue, and development of cost-effective formulations. A robust method that utilizes a relatively simple reagent system is still in demand. As an ongoing collaboration project with Dr. Jisun Lee, this program is designed to address such challenges and is built on promising recent findings using 1,2-indanedione analogues for the detection of latent fingerprints. Students will be exposed to synthesis, purification, and characterization of small organic compounds. Most importantly, students will also gain experience detecting latent fingerprints on paper using the synthesized compounds. Additional unique benefits will include first-hand experience in being an integral part of a research project that is directly applicable to tangible societal issues. Students will be co-supervised by Dr. Lee. Successful completion of CHEM 241 and 242 is required. Completion of CHEM 245 is preferred.

Project 2: Integration of fermentation as a powerful tool in organic synthesis ***Rising Juniors only***

This interdisciplinary project focuses on utilizing fermentation as a means to produce complex natural products that are otherwise difficult to obtain via traditional synthetic methods. Isolation and subsequent conversion of such compounds using techniques generally involved in organic synthesis will facilitate and expedite the detection of biologically relevant compounds that may have an impact in the discovery of novel therapeutics. Students will be exposed to fermentation techniques in the beginning stages of the program and move onto organic synthesis, purification, and characterization of isolated and synthesized organic compounds. Students will be co-supervised by Dr. Jisun Lee. Successful completion of CHEM 241, 242, and 245 is required.

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Eric Schelter

Project 1: Synthesis of Metal Complexes for Rare Earth Element Separations

Rare earth elements are essential in modern life with applications from smartphones to wind turbines and electric vehicles. The primary mining of rare earths is extremely energy intensive and polluting. There is an interest in recovering rare earths from spent technological devices. However, recycling is currently cost prohibitive compared to imported materials obtained from mining. In this project, the student will work on synthetic organic and inorganic chemistry to develop new complexes of rare earth metal cations. The goal of the project will be to test the ability to separate the new rare earth metal complexes efficiently, based on molecular design principles. Working with a graduate or postdoctoral supervisor, the student will perform chemical synthesis and characterization with spectroscopy to prepare and test new compounds.

CLASSICAL STUDIES

James Ker

Project 1: Latin in the City of Philadelphia

In this project the student researcher would explore the presence of the Latin language in the Philadelphia cityscape, including (but not restricted to) the vicinity of the Penn campus. The main goal would be to document, both in writing and through photography, the various ways in which Latin is visible in the city -- whether in inscriptions, archives, public art, monuments, institutions, school programs, tattoos, ... or any other form. Given the likely quantity of total data, the researcher could be selective about the focus, according to her/his interests. For example, the project might focus on a specific Philadelphia personality, such as Benjamin Franklin, on a chosen community, such as a specific school or program, or on an institution, such as the Philadelphia Zoo or the Free Library. It might be more about Latin as used in the past or about Latin as it is being -- or could be -- revitalized. A combined focus on ancient Greek would be conceivable, though not required. The outcome of the project would be a presentation of this data in a stable digital format that would allow easy access and comprehension by a wide audience, perhaps also allowing for crowdsourcing of further content. Ideally it would then be usable for various purposes involving engagement with Latin, ranging from pedagogy to public outreach. The researcher should have studied Latin for at least 2 years and be willing to develop skills in the most useful computer applications, together with the linguistic study required to gain

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a confident understanding of the Latin material. She/he would be responsible for several weeks of self-directed exploration and development of the digital publication, combined with regular consultation and discussion with the faculty supervisor.

EARTH AND ENVIRONMENTAL SCIENCE

Irina Marinov

Project 1: Detection and attribution of climate change: optimal fingerprints analysis

The detection of climate change signals in rather short satellite or in-situ ocean datasets is a challenging task in climate research. Here we will use an optimal fingerprint technique to determine how much of the signals observed over the past 20 years in ocean properties (temperature, oxygen, phytoplankton biomass, chlorophyll) can be explained by forced (anthropogenically-driven) climate oscillations versus natural climate oscillation patterns. This "big data" signal detection technique is a type of generalized multivariate regression, and relies on data from observations and a large set of climate model simulations from the latest generation of global climate models. By the conclusion of the semester, the student will create an end-to-end processing pipeline – including data acquisition, pre-processing and cleansing, and analysis – for the application of the above methodologies to ocean-climate data.

The student is expected to read some primary oceanographic literature, independently read and follow basic matrix algebra and statistics, learn how to read and visualize satellite and in-situ ocean data imagery and climate model output (gridded data fields) in python and/or Matlab 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. Some mathematical and computational background and skills needed. Background or interest in natural sciences (physics, chemistry, biology) a plus.

Project 2: Ocean physics and biology in a warming climate: a satellite ocean color analysis

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 phytoplankton biodiversity 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

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will attempt to link changes in ocean biology to changes in oceanic physical properties (e.g. light, surface to deep mixing, sea surface temperature, turbulent mixing, sea-ice cover) that are known to influence phytoplankton growth. Depending on student interest, this project may focus on the ocean biological variables or on the basic ocean physics observed from satellite observations. 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. Some computational background and skills needed; basic statistical knowledge ideal.

Alain Plante

Project 1: The Santa Monica Mountains Landscape

This research project will combine remote sensing (through collaboration with Dr. Jane Dmochowski) and possible field work to further our understanding of the effects of climate change and urbanization on Southern California's Santa Monica Mountain coastal range. This mountain range can be divided into distinct microclimate regions—The Western Fog Zone, The Immediate Coast, The Upper Elevation Santa Monica Mountains, The Lower Elevation Inland Santa Monica Mountains (North Slope Urban Transition), The Inland Dry (Inland Urban Area), The Simi Hills Inland, and The Eastern Urban (Hollywood Hills)—all of which are home to various chaparral and coastal sage scrub ecosystems, each consisting of their own soils and plant communities. Understanding which regions are most sensitive to fire, changes in plant communities, as well as temperature and precipitation changes, can help to determine resilience, overall greening, and fire regime, which can give insight into managing the growing pressures on this region due to global climate change and urbanization. The student will be expected to work on campus over the summer. The ideal student will be comfortable analyzing large data sets, have excellent quantitative and computer skills, and be interested in and familiar with relevant aspects of earth science, environmental science, and/or ecology.

Project 2: Legacy of coal mining sediments in alluvial soils in central Pennsylvania

Pennsylvania has a long legacy of coal mining, which can be seen through the presence of high concentrations of coal in legacy sediments found in floodplain and riparian soils along the Susquehanna and Schuylkill rivers. This collaborative project seeks to determine the extent of these coal legacy deposits and the long-term environmental consequences of these materials. The summer research project would involve the chemical characterization of these soils to distinguish between neogenic soil organic carbon and coal-derived geogenic carbon. Additional experiments

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would test for potential microbial activity in coal-contaminated soils, and for concentrations of heavy metals. Though primarily laboratory-based work, there is a possibility for some fieldwork to observe and sample additional sites.

Project 3: Soil organic matter characterization in African 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.

Lauren Sallan

Project 1: Using Advanced 3D Printing to Test the Function of Fish Fins

3D printing is revolutionizing experimental science; it can allow the rapid production and objective testing of a huge variety of structures natural or theoretical. For the first time, we have the ability to objectively answer basic questions about the function and biomechanics of animal form independent of living animals. Countless studies have examined the swimming capabilities of living fishes in order to determine the adaptive value of their fin shapes. Different tails, dorsal fins, anal fins, and pectoral fins are all assumed to have different impacts on the abilities of fishes to move efficiently through the water, much as different engines and wings affect the performance of airplanes. However, results from living animals are confounded by too many variables: fishes are complex animals with multiple fins evolved in tandem. Here, the student will get at the true function of fin shapes through 3D printing of of basic fin forms (large, small, rounded, pointed) which will be attached to a printed, flexible fish body. The student will test the effects of the different arrangements of fins on fish movement through flowing water in a flume (which functions like a wind tunnel for airplanes) through digitization of high speed video. The student will learn skills in computer modeling, 3D printing, biomechanics testing and interpretation, as well as learn about fish diversity. No previous experience is needed, students will be trained by PhD students Aja Carter and Erynn Johnson, both of whom have extensive

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experience in 3D modeling and printing and biomechanics testing. Students will learn modeling, experimental practice, and quantitative and statistical analyses. Students will also attend lab meetings, speak with collaborators, and have to opportunity to pursue efforts after the summer towards authorship on one or more scientific papers.

Project 2: How Have Ice Ages Shaped Fish Biodiversity?

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

Project 3: How Did Jaws Take Over the World?

Over 99% of all living vertebrates have jaws; the sole exceptions are parasitic, eel-like hagfish and lamprey. This fact has been used to suggest jaws are a "key innovation," or critical trait allowing exceptional diversification. Yet, jaws showed up relatively late in the fossil record and do not seem to be associated with immediate success. The earliest jawed fishes lived in the shadows of armored jawless forms that resembled everything from crabs to angelfishes to sharks, and were restricted to a small area around South China. Yet, these same jawed vertebrate rose to sudden ecological dominance tens of millions of years, or even 100 million years after they evolved. The trigger for this abrupt take-over is unknown; did jawed fishes outcompete jawless forms, eat them to extinction or did some environmental factor enable their sudden, delayed rise? Were they the ultimate invasive species, released from their previously limited range with devastating effect on local jawless communities? This project will involve databasing traits for

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jawed and jawless fossil fishes, including size, environment, habitat and diet, in order to test for potential ecological interactions or factors that enabled the success of jawed fishes. Students will learn and apply important "Big data" approaches to paleontology and evolution, including databasing techniques, quantitative and statistical analyses, and programming in R and other languages. Students will also attend lab meetings, speak with collaborators, and have to opportunity to pursue efforts after the summer towards authorship on one or more scientific papers.

ECONOMICS

Holger Sieg

Project 1: Empirical Research in Urban Economics

Individuals, households, and firms operate in close proximity, creating densely populated cities and metropolitan areas. If we believe that cities are somehow useful and desirable, the economic rationale must be that cities make individuals, firms, and even governments more productive. If there were not significant efficiency gains that arose from proximity, citizens of the United States could spread out far more than they currently do. I am currently working a new book that focuses on different aspects of urban economics. I am looking for an RA who is excited about learning more about the role that large cities play in the modern economy.

The RA will need to access existing data sources and will learn how to analyze data using a statistical software called STATA . Basic knowledge in economics, calculus and statistics as well some good computational skills are helpful.

The RA will also summarize the research findings and help me draft a chapter for a book that I am currently working on. Students will gain some experience with LATEX which is a scientific word processing program.

We will have weekly meetings to discuss research assignments and findings.

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ENGLISH

Herman Beavers

Project 1: The Bluestone Road Cycle

I am currently working on a cycle of poems that are set in the years during Reconstruction till the first 20-25 years of the 20th Century, approx. 1873-1930. The student working with me on this project will be asked to do archival work with newspapers, pamphlets, magazines, and other forms of media from this time period. The student will also be involved in compiling research information on the history of Wilberforce University, which began as a school for training students to enter the ministry. Newspapers from the Xenia, OH area will need to be parsed to find stories on the school and its students (and faculty). The information collected by the student will be utilized in the creation of poetic personas based on characters from the novel _Beloved_. Students already familiar with the use of microfilm and research databases, as well as having a working knowledge of Morrison's fiction are preferred.

Project 2: The Turbulence of 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, after acquiring a working knowledge of chaotic, 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 3: African American Poetics *Rising Sophomores* only

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, modernist or postmodernist poetry and poetics) are preferred

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Michael Gamer

Project 1: The British Library Playbill Project

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 premiere 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. Around 1/2 of the internship will be mundane, spent in the world of data entry, helping to populate our database of playbills. At least 1/4 of it will be spent in learning Python and in attending the Python working group every Monday at 9:30 am. The rest of your time will be spent in learning about the insane world of 18th- and 19th-century theater. No prior experience with programming is necessary, but we do seek humanities students interested in theater history who also wish to learn how to code for their own future research projects.

Project 2: Novel Realisms

I am just turning back to a book project called *Novel Realisms*, which focuses on popular novel during what we call the Romantic Period (roughly 1770-1848). Most fundamental to the book's argument is the question of how novelists classify their own works. What happens if we imagine works of fiction to have "titles" in the same way that people do? -- complete with claimed genealogies, family trees, and looser affiliations? I am looking for an intern who would like to read a lot of fiction from this period, working in Penn's rare book room with its incredible collection of rare books. In particular, I'm looking for a student interested in the history of the novel who is good at taking notes, since my aim is for us to compile a collection of notes that we can both use in our research. In short, you should apply for this position if reading and transcribing in a rare book reading sounds like your idea of heaven, and if you could see yourself formulating your own research projects from this material.

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Project 3: The Collected Works of Ann Radcliffe

Ann Radcliffe is arguably the most famous Gothic novelist of the eighteenth century - the only novelist that Jane Austen took the time to single out by name and to parody lovingly. For Walter Scott, Ann Radcliffe was the ‘first poetess of romantic fiction’, while Thomas De Quincey dubbed her ‘The Great Enchantress’ and Nathan Drake ‘the Shakespeare of Romance Writers.' Then, with the publication of *The Italian* in 1797, she entirely disappeared from public view. The next news circulating occurred 20 years later with her death. Like the villains of her novels, she remains a shadowy figure. Students today find her readable and fascinating; her use of suspense, terror, the supernatural, music, and other atmospherics make her the most theatrical of novelists of the Romantic period.

With Angela Wright of the University of Sheffield, I have begun the project of editing Radcliffe's complete works for Cambridge University Press. This summer, therefore, presents a perfect opportunity for a student interested in reading Gothic fiction of the 1780s and 1790s, as well as taking notes on every bit of information available about her, her work, and her connections.

But this project is not for the faint of heart: you really, really need to want to spend a summer living around the turn of the 19th century. You have to want to read a lot of Radcliffe and her associates, as well as the considerable amount of writing published about her in the 19th century. Most of all, you need to want to learn how to do the kind of real research required by a project like this: a truly authoritative, consistent scholarly edition of the complete oeuvre of a single author.

If you love reading fiction and know how to take good notes, and if you like literary detective work and don't mind the more mundane work of note-taking -- and especially if you are interested in British Romanticism and this period -- please apply.

Suvir Kaul

Project 1: Literary anticipations of the Anthropocene

We live in a historical moment when climate change and the degradation of the environment globally has led stratigraphers to coin a new term, the Anthropocene, to mark a new geological epoch in which human lives and patterns of consumption now are a factor in ecological traumas across the globe. While literary writers and natural scientists from the seventeenth centuries onwards did not have a precise sense of the global impact of the new methods of land usage and the exploitation of natural resources initiated by the development of capitalism and colonialism,

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their work is sensitive to such historical developments, and thus a resource for those of us interested in the long history of contemporary ecological crisis.

This project will develop a bibliography of such writing, and tabulate the ways in which writers in earlier periods intuited or anticipated systemic changes. We will also note the combination of celebration and anxiety that accompanied all such anticipations. The student who signs on for this project will be responsible for developing such an annotated bibliography (and I will of course explain how this is best achieved).

Project 2: Mapping Captain Singleton's travels

Daniel Defoe's "The Life, Adventures, and Piracies of the Famous Captain Singleton" follows the Captain and his crews on voyages across the Atlantic, around the Cape of Good Hope, to Madagascar, then across the Indian Ocean to the Spice Islands, Australia, and Formosa, and includes a trek across north-central Africa. Defoe read travelogues that allowed him to render some details about places and oceanic routes accurately, but where such details were not available to him, he made up topographical features as well as encounters with people and animals. This project will use a web-based application to map these travels--including into parts of Africa or the Spice Islands that are products of Defoe's imagination--and to add layered details about time spent traveling, adventures en route, and other useful information for anyone who wishes to see how Captain Singleton traveled across the globe.

Students who have some knowledge of map-making software are encouraged to apply; appropriate training will be provided to others. The end product will be a useful resources for teachers and students of Defoe's novels, but also for others who wish to understand the main oceanic routes and destinations of merchants (and pirates) in the early eighteenth century.

David Kazanjian

Project 1: Tepoztlán Institute Conference

This application seeks funding for an undergraduate assistant affiliate with the Tepoztlán Institute for Transnational History of the Americas, on whose board I have served for 10 years and for which I am the co-director from 2017-19. Founded in 2004, the Institute's primary mission is to hold an annual, intensive, interdisciplinary, week-long conference (July 18-25) in the village of Tepoztlán, Mexico, devoted to the historical study of contemporary social and political dynamics that cut across national borders, transcend local contexts, and link multiple regions of the Americas. The theme of this year's conference is "Black Lives/Black Deaths: Dispossession, Disappearance, and Enclosure." The assistant would join me and two PhD students from the Penn English Department in a summer study group which would discuss the

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assigned conference theme readings once weekly for nine weeks leading up to the conference. The assistant would then attend the conference and participate in all the sessions, with faculty and graduate student attendees from throughout the Americas. The assistant would also assist me and my co-director in providing on-site logistical assistance during the conference, particularly Spanish-English interpretation during the sessions as required.

For more information on the Institute, see ***http://www.tepoztlaninstitute.org/home.html***. See also a special journal issue with reflections by the Institute's founders and articles from its first few years: *Social Text 92, Fall 2007*.

Jennifer Ponce de León

Project 1: Another Aesthetics is Possible: Radical Politics across the Arts of the Americas

What forms have experimental and politically-engaged art and literature taken in the past 20 years? How have artists participated in social movements in different places in the Americas? My research examines these questions, focusing, in particular, on artistic practices that combine and move between visual, literary, and performative forms, and that extend into areas of practice not usually associated with the arts, e.g. cartography, activism, finance, historiography, and gaming. I need a Research Assistant to work with me as I finish my book _Another Aesthetics is Possible: Radical Politics across the Arts of the Americas_, which focuses on work produced by U.S. Latinx & Latin American art collectives and writers since the late 1990s. I also need assistance doing research for a second book, which addresses similar themes.

A Research Assistant will work with a broad range of scholarly and journalistic writing, videos and images, and help me prepare and organize this material, and also work with interview material I have gathered in my own research. In the process, they will learn about some of the most exciting radical art practices from the past 20 years, as well as about contemporary social movements. They will learn about interdisciplinary scholarship and about research methodologies from the humanities and social sciences. They will also learn about working with audiovisual materials for research, publication, and presentation. Applicants do not need to have prior experience working in the arts. The ability to work with Spanish and/or Portuguese language texts is a plus, but absolutely not required.

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Whitney Trettien

Project 1: thresholds: creative/critical digital publishing

thresholds is a digital zine for creative/critical scholarship, co-edited by me and Fran McDonald (University of Louisville). Our goal is provoke new juxtapositions of idea and image -- an annotated scan from a book on media theory next to a video collaboration, for instance, or a critical essay on the aesthetics of the glitch next to the exposed code that underlies the essay. We make these juxtapositions literal through an innovative formal design: the site has a central threshold that splits content down the middle (imagine the two pages of an open book, or a split-screen film).

After working closely with each author to design her piece, we stitch an issue together as a patchwork tapestry. The reader navigates the zine horizontally by bumping left or right, one half-screen at a time. While each contribution can stand alone, then, the intentional design of thresholds makes them a part of something bigger: a tangle of text, image, and movement where the seams between each piece become as important as the pieces themselves.

Our third issue—a collaboration with University of Chicago's digital storytelling lab—will launch early this summer. Our fourth is slated for next Fall. Student involvement can take a number of forms, depending on interests and skills. Tasks could include: 1) site design; 2) communicating with contributors; 3) organizing launch events; 4) editing contributions. Fran and I will mentor students to gain the relevant technical skills, which are minimal, although a basic knowledge of Photoshop and/or CSS might be helpful.

http://openthresholds.org

Project 2: Cut/Copy/Paste: The Social Life of Books

How do fragments of books circulate through archives? This question motivates my current book project, Cut/Copy/Paste: Fragments of History. In this project, I scout out the fringe maker cultures of seventeenth-century England, where communities cut up, "hacked," and reassembled books. (Think zine cultures today -- but centuries ago!) Working across a century of upheaval, when England was reconsidering its religion and governance, each of these communities saved the frail, fragile, frangible bits of the past and made from them new constellations of meaning. These odd book objects do not fall into familiar literary categories, slipping between the cracks of disciplines; later institutions like the British Library did not know how to catalogue them. Yet, brought back together in this hybrid history, their scattered remains witness an emergent early modern poetics of care and curation, grounded in communities of practice

As part of this project, I have been working with a web developer and a book designer to develop new techniques and digital tools for visualizing the use, recycling, and circulation of books in archival collections. What new data models might make visible the movement of books and book

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parts through space, as they change hands (timelines, social networks)? Research tasks might include working with rare materials, writing posts for a companion website, and trips to special collections. Skills or interest in data visualization is encouraged by not necessary. Students will gain experience working with rare archival material and in designing a digital humanities project with a broad public audience in mind.

HISTORY

Julia Verkholantsev

Project 1: Digital Database: Myths of Origin in Medieval Chronicles

The project deals with the creation of a digital database to analyze a range of questions about the role of myths of origin in medieval and early modern chronicles and historiographic sources of Europe. “Myths of origin” are legendary stories that describe genealogies of ethnic groups, their social orders, names, and places that they inhabit. The goal of the project is to understand what motivated medieval authors to view myths as “historical material.” Many of these myths are built around etymological interpretations of names of people and objects because medieval historians believed that connections between similarly sounding words provided a mystical link to the otherwise unknowable reality of the distant past. For example, the 15th-century historian Pulkava was convinced of the divine origin of his native Bohemia because he believed its name derived from the Slavic word Boh, which means ‘God’, while his early 14th-century colleague from Poland (anonymous) believed that the unusual sexual attraction of the pagan princess Wanda was intrinsically related to her name, which is derived from the Polish word “hook.” I am particularly interested in the internal mechanism of etymologically motivated stories, in which etymologies function as an epistemological device and as the driving force of the narrative.

Skills needed: demonstrated interest in history and working with primary sources, strong analytical and writing skills, attention to detail. Advanced knowledge of a foreign language (e.g. French, German, Latin, Spanish, Italian, or other) is a plus. The student research assistant will work with customized interface developed at the Price Lab for Digital Humanities, analyze primary sources for data entrance, and assist with database development.

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Beth Wenger

Project 1: Jewish Counterculture Oral History Project

Beginning in the 1960s, a generation of young Jews set out to revolutionize and reinvigorate American Judaism. Coming of age in the aftermath of the Holocaust and the creation of the state of Israel, but also amid the revolutionary ferment of the 1960s Civil Rights campaigns, Black Power, and Women's and Gay Liberation movements, this new generation of well-educated, politically engaged young Jews gave voice and form to new, self-conscious modes of Jewish expression. They were part of a broader Jewish counterculture whose members rejected what they deemed stale forms of Jewish practice in favor of more democratic, egalitarian and spiritually meaningful religious experiences. They created a host of radical innovations in Jewish political, social and religious life that have left a lasting imprint.

This project focuses particularly on the havurah movement, which represents a signal effort to reinvent Jewish communal worship and social life outside the framework of traditional synagogue denominations and structures. The idea of a havurah, which translates roughly as "fellowship," began to evolve in the 1960s. Havurot (plural of Havurah) provided forums for study, worship and social interaction among progressive Jews looking for more intimate forms of Jewish community. The first such institution, Havurat Shalom, was established in Boston in 1968, in the wake of Israel's Six-Day War and at the height of America's cultural, social and political ferment. In his study of American Judaism, historian Jonathan Sarna emphasizes that havurah members consciously set out to "jettison the bourgeois middle-class values of suburbia and to re-imagine Judaism" as a liberating force capable of revolutionizing personal and religious relationships as well as politics and society. (Sarna, American Judaism, p. 319). Related efforts sprang up in other cities, such as Fabrangen in Washington, D.C., the New York Havurah, as well as havurot in the mid-West and California.

By the spring of 2018, this project will have recorded twenty-five interviews with key founding members of the havurah movement. We will have first drafts of transcriptions that need to be finalized by carefully reviewing the audio recording and putting the written transcripts in a uniform style. We seek a highly organized, detail-oriented student to perform these final tasks in the project. These oral histories—and the transcriptions—will ultimately be made available to the public on the Penn Libraries website as part of an open endeavor to gather and disseminate information and begin to interpret this important moment in American Jewish history.

We welcome those familiar with American Jewish history, but this is not a prerequisite for the position. Any student interested in learning about this fascinating religious social movement, the climate of the 1960s and 1970s, and/or American religion more broadly will find this position especially rewarding. Moreover, these interviews are a wonderful—and still unknown—primary source that would be a very fruitful research project for any student.

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HISTORY & SOCIOLOGY OF SCIENCE

Etienne Benson

Project 1: War, Science, and Empire: Remaking the Twentieth-Century Earth Sciences

Ralph Alger Bagnold (1896-1990) was a British army engineer, pioneer of motorized desert exploration, and expert in the physics of sand, water, and wind. While mostly forgotten today, he was a renowned war hero, explorer, and scientist in his time; NASA scientists recently named a Martian dune field in his honor. His eventful life spanned most of the twentieth century and was intimately shaped by two world wars and the collapse of the British empire, which had reached the pinnacle of its power just as he was entering adulthood. This project uses Bagnold's life as a way of exploring the emergence of a radically new understanding of the Earth — one based on mathematical models and quantitative measurements of the physical mechanisms shaping the surface of the planet. Because Bagnold made his scientific contributions while immersed in practical efforts to wage war and exploit natural resources, his life has much to tell us about how science relates to its social context. As a research assistant for this project, you will search for relevant documents in local and regional archives (such as the National Archives in College Park, Maryland) and will help to locate, organize, and synthesize information about Bagnold's life and work in newspapers, scientific journals, memoirs, and other published materials. This is an ideal position for anyone interested in gaining hands-on experience with historical research methods and an in-depth understanding of the origins and social contexts of the modern earth sciences. Prior research experience is not required.

LINGUISTICS

Julie Anne Legate

Project 1: What doing? How English children learn to pronounce subjects

An enduring topic in language acquisition is why children learning English drop subjects, What doing?, for an extended period of time, even though adult English requires subjects, What are you doing?. Researchers (e.g. Hyams 1986) have tried to identify this child English subject-drop stage with adult subject-drop languages like Spanish. In Spanish, subjects are optional, and missing subjects are identifiable by the morphology on the verb: Hablo `I speak' versus Hablas

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`you speak'. However, there are significant distinctions between child English and adult Spanish patterns that make such an equation impossible (e.g. Valian 1991, 1992). A more promising identification is with languages like Chinese in which subjects are optional, but missing subjects are identifiable by the topic of conversation (e.g. Hyams 1994, Yang 2002). The unanswered question, though, is how the English child learns not to omit discourse topics. In this project, we will consider whether the explanation lies in a probabalistic learning model (Yang 2002) combined with properties of the input -- the child slowly accumulates evidence from the language they hear that topics are pronounced in English. Primary data will come from the CHILDES database.

Project 2: The solution was discovered by us.

English shows a simple alternation between the active sentence "We discovered the solution" and the passive sentence "The solution was discovered by us.'' The object of the active becomes the subject of the passive, and the subject of the active becomes an optional ``by''-phrase in the passive. When we look at other languages, however, we find that these properties dissociate. In e.g. Hindi and (colloquial) Icelandic, the object of the active stays an object in the passive, yielding something closer to ``there was the solution discovered by us''. In e.g. Indonesian, the object of the active becomes the subject of the passive, but the subject also stays a subject, resulting in something closer to ``the solution was we discovered.'' In this project, we will meet to discuss what passive possibilities are known crosslinguistically, and then focus on analyzing the properties of the student's (favorite) language. The ideal student will speak or have familiarity with a less-studied language.

Project 3: You discover solutions when you try.

English shows an array of strategies for talking about people in general: generic/indefinite "you" as in "you can't park on street during a snow emergency", generic/indefinite "they" as in "they say it's going to rain", and formal "one" as in "one should always say thank you". In other languages, this type of meaning is expressed by a designated pronoun, e.g. German "Man", French "on", or by a form that looks a lot like a passive, e.g. Lithuanian and Turkish. In this project, we will meet to discuss what possibilities are known crosslinguistically, and then focus on analyzing the properties of the student's (favorite) language. The ideal student will speak or have familiarity with a less-studied language.

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Kathryn Schuler

Project 1: The acquisition of language variation in child learners

While learning a new language is a very difficult task for most adults, children are known to acquire language with remarkable ease. Our lab - the Child Language and Learning Lab - is interested in how children acquire language and why they are so much better than adults at doing it.

In this project, we will ask how children handle one particularly complex aspect of language acquisition: the acquisition of language variation. Acquiring variation is complex because sometimes variation in language is important and meaningful (like matching the dialect of your social group), and sometimes variation is just random noise (like when someone makes mistakes). We are interested in finding out how children know they should learn and match the important and meaningful variation, but ignore the variation that is just random noise. To address this, our lab has developed a computer game that teaches child participants a small, made-up language. The language contains these two types of variation and hidden within the game are tests on what the child has learned.

Students will be responsible for all aspects of the research study, from recruiting child subjects and collecting data from child participants to analyzing the collected data and interpreting the results. Students will be trained on conducting research with children as well as on some common experimental techniques and data analysis methods used in the lab. Students will be mentored by the Primary Investigator (Dr. Kathryn Schuler). No prerequisites are required, but experience working with children is strongly preferred.

Project 2: A cognitive bias for asymmetry and its role in language

Recent research (in both linguistics and cognitive science) has suggested that humans come to the language learning table with certain cognitive biases that influence what they are able to learn and, in turn, how languages come to be shaped. For example, things that are quite common across the languages of the world tend to be very easy to learn, while things that occur more rarely are much more difficult to acquire.

One tendency observed across many languages is that the underlying structure either branches to the right (e.g. Arabic) or branches to the left (e.g. Turkish). In this project, we will explore whether humans have a general cognitive bias for asymmetry that could explain why many languages are structured in this way. Do human learners have an easier time processing asymmetrical branching as compared to more symmetrical branching? When languages violate this tendency, do they contain any particular structures or markers that may be necessary to make these more uncommon patterns more learnable?

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Students will be responsible for all aspects of the research study, from recruiting adult subjects and collecting data to analyzing the collected data and interpreting the results. Students will be trained on conducting research with human subjects as well as on some common experimental techniques and data analysis methods used in the lab. Students will be mentored by the Primary Investigator (Dr. Kathryn Schuler). No prerequisites are required, but experience in linguistics and/or cognitive science is preferred.

Project 3: How children make generalizations in language and beyond

Research in our lab - the Child Language and Learning Lab - has provided experimental support for the Tolerance Principle, a model proposed by Dr. Charles Yang (Penn Linguistics), as a model of how children form productive rules. In his recent book on the Tolerance Principle, "The Price of Linguistic Productivity: How children learn and break rules of language", Dr. Yang suggests that his model could be applied more broadly to explain how children make all sorts of generalizations, both within and outside of the domain of language.

To investigate whether this is the case, this project (in collaboration with Dr. Yang) will test experimentally whether children's non-linguistic generalizations are well predicted by the Tolerance Principle model. Students will be responsible for all aspects of the research study, from recruiting child subjects and collecting data from child participants to analyzing the collected data and interpreting the results. Students will be trained on conducting research with children as well as on some common experimental techniques and data analysis methods used in the lab. Students will be mentored by the Primary Investigator (Dr. Kathryn Schuler). No prerequisites are required, but experience working with children is strongly preferred.

Meredith Tamminga

Project 1: Unlocking the secrets of consonants

Penn is home to one of the world's largest corpora of sociolinguistic interviews: the Philadelphia Neighborhood Corpus. The corpus contains over 400 conversations that have been transcribed and time-aligned. Thanks to this rich source of natural speech data, the Philadelphia English accent has a remarkably well-studied vowel system: Philly's vowels have been the testing ground for influential theories of both socially-meaningful speech variability and language change over time. But what about consonants? While the basic acoustic properties of consonants have been studied extensively in controlled laboratory settings, research on consonants "in the wild" has lagged behind considerably. We are now working to build up the layers of the Philadelphia Neighborhood Corpus that will be needed to bring the study of consonants to the forefront.

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You will be engaged in our implementation of the EMU Speech Database Management System (http://ips-lmu.github.io/EMU.html). Other tools you can expect to encounter are Praat (for acoustic analysis) and R (for statistical programming). Depending on the progress of the project and your own interests, your summer may involve: working with sound files and spectrograms to improve our annotation of fine-grained phonetic detail; applying an automated syllabification tool to build up a syllable-structure tier in the corpus; or writing scripts to extract linguistic features from audio. We will also address theoretical questions of how the mental categories of language relate to the continuous acoustic signal of speech, and the role of that relationship in language change.

Experience with programming or background in phonetics useful, but not required.

Charles Yang

Project 1: Learning to Count (with Signs)

Everyone learns to count, and learns that counting can go on forever. But clearly no one does so by literally counting forever, there must be a tipping point: once children count past that number, they have figured out the rules of counting for that language. For children learning English, the major transition appears to be around low seventies: in fact, if children can count to 72, they can always count to 100, and it's virtually impossible to find children who could count to, say, 80 and stop there. By contrast, Chinese-learning children only need to count to about 40 to learn the counting rules. As a result, every four-year-old Chinese-learning children can flawlessly count to 100, but English-learning children generally will have to wait until five and half.

It is widely acknowledged that it is the cross-linguistic differences that is responsible for the cross-cultural developmental differences. The base numbers (1-10) in all languages require rote memorization, but English number words have a lot of irregularities beyond those: many teen words such as "eleven" and "twelve" bear no resemblance to their numerical content whatsoever ("ten and one", "ten and two"), and words such as "fifteen", "twenty", "thirty", etc. involve unpredictable changes to the sounds of the base words ("two", "three" and "five"). In comparison, Chinese numbers past 10 are completely regular: "11" is literally "ten one" ("12" = "ten two"), and "30" is "three ten". To learn the rules of counting, children must overcome the rote-memorized words to discover the general rule of counting: that English has more exceptions than Chinese accounts for its developmental delay. Still, one wonders why the tipping points are exactly 70 and 40 for these languages.

Over the past few years, my research group has developed mathematical models of learning that correctly predict the values of these tipping points (see, for instance, a 60-sec lecture featuring this work (https://www.sas.upenn.edu/node/6946). The research has been thoroughly verified on

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English- and Chinese-learning children, and we are currently expanding this work to American Sign Language (ASL).

Specifically, we will study ASL-learning children's ability to count manually: How high can they count without making a mistake? What are the systemic errors in their count list? How does their counting compare to children learning spoken languages (e.g., English)? Can they count to, say 100, earlier or later than English-learning children? How do they perform on simple tasks involving natural numbers (e.g., number comparison, the Successor Function, that the next number is greater than the previous number by one)? The answer to these questions promise to reveal the precise connections between language and numbers as a case study of cognitive science, with important implications for early mathematical education.

This project will be a collaboration with Prof. Maria Coppola at the University of Connecticut, a world renowned expert on the cognitive science of ASL. The student MUST have some knowledge of ASL (e.g., having taken an ASL class). They will help to annotate and quantify the amount of experience ASL- learning children receive in parental input with respect to number words, counting routine, and activities involving number knowledge.

MUSIC

Glenda Goodman

Project 1: Music in Imperial Travelogues

The eighteenth century witnessed global travel at an unprecedented level, as European nations sought to expand and consolidate power through imperialism. Intercultural encounters resulted, and, recognizing the strategic value of knowing local customs, Europeans set about documenting the music they heard: they transcribed melodies and published them in travel accounts, which were intended to be inform future travelers. Thus, notated music advanced the agenda of empires.

More than 2000 travelogues were published before 1800, yet the presence of notated music has not received systematic attention from scholars. This project tasks a student researcher with identifying notated music in eighteenth-century travelogues, using two excellent bibliographies of possible primary sources as a guide ("The Hill Collection of Pacific Voyages at the University of California, San Diego" and Raymond Howgego's "Encyclopedia of Exploration to 1800"). The student will learn how to use online catalogues to zero in on likely sources, and will also work with physical and digital copies of the travelogues to confirm and document the presence of notated music. Such research will be rewarding for a student who is interested in gaining skills

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and experience with rare books and book history, bibliography, and digital sources, as well as students interested in the history of music and intercultural encounter (although music literacy is not necessary for doing this research). The student will also gain topical knowledge about the history of empires in the eighteenth century. Most of the sources are in English, French, and Spanish, but students will learn to identify music even if they cannot read the text.

NEAR EASTERN LANGUAGES AND CIVILIZATIONS

Heather Sharkey

Project 1: The Nile Valley between Mexico and India: Tracing Global Histories through Life Stories

I am writing a book that uses life stories to trace modern historical connections between the Nile Valley – especially Egypt, Sudan, South Sudan, and Ethiopia – and the world, circa 1850 to 1950. One aim is to challenge the tendency among historians to focus primarily on colonial and postcolonial relationships – for example, by examining Egypt and Sudan relative to Britain, which occupied the former in 1882 and the latter in 1898. By uncovering other connections, I hope to promote a more nuanced understanding of how the Nile Valley has fit in the weave of world history. I have written a few chapters already (on connections to France, China, and Turkey) and this summer will research two more, on links to Mexico and India (including, from 1947, Pakistan).

The first chapter involves an episode that occurred in the 1860s when a contingent of Sudanese soldiers went to Mexico, to provide back-up for Maximilian I during his ill-fated, three-year attempt to assert himself as emperor, with support from Napoleon III of France.

The second chapter investigates Bamba Müller, the daughter of a German merchant and Ethiopian concubine, who left Egypt in 1864 when she married the exiled Maharaja Dhuleep Singh of Punjab, settled with him in England, and entered the social circles of Queen Victoria.

I seek a PURM student who has a keen interest in modern world history; who can read and summarize Spanish scholarship for the Mexican side of the project; and who is eager to develop skills in historical research.

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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 and professional 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.

Requirements: prior knowledge in working with R (or related programs) as well as programming experience.

Project 2: Changing social norms: Combating open defecation in India with data. Stage 2.

Working with the Bill and Melinda Gates Foundation, we are conducting a massive three-year project designed to provide a clear understanding of the underlying social factors that support open defecation and barriers that prohibit latrine use in rural and urban India.

Open defecation (OD) is a serious public health issue in India, and over 300 million people practicing in the country alone. OD contributes to many serious health issues, with India reporting the highest number of diarrheal deaths in children under-five in the world. It is not simply an infrastructure limitation either, as many latrines that have been built in affected areas go unused.

Using an individual-level survey, we explore how beliefs, expectations, cultural factors, and group membership may contribute to OD’s persistence. Specifically, we will use a social norms framework to attempt to distinguish between different kinds of socially motivated behavior.

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Additionally, we measure and analyze the structure of target communities so as to better understand what sort of intervention would be most effective. Our measurements and analyses will ultimately be used to advise on and design an intervention to most effectively encourage OD abandonment.

This is an exciting project in terms of both its scope and importance. An interested student will have opportunities to research relevant aspects of Indian culture, help construct professional surveys to assess factual beliefs, social expectations, and community structure, and/or help analyze data. We are particularly interested to compare our findings with prior literature and survey data and explain any observed differences in terms of real improvements and differences in methodologies. As such, we would be interested in taking on students who have some training and interest in statistics or data science.

PHYSICS

Marija Drndic

Project 1: Two dimensional materials: science and applications

This project is within the field of nanoscience and nanotechnology and entails the growth of new two dimensional materials and related characterization and device fabrication to study the electrical and optical properties of these devices. In particular, the PURM students will help make single-atom thin membranes of new two-dimensional materials and will help characterize them with optical and electron microscope techniques. The student will work in close collaboration with Drndic lab graduate students and postdocs to improve the growth of materials to minimize and control the defects in these materials and to study how the structural properties (atomic content and arrangement) plays a role in the optical and electrical features of these new materials. If a student is particularly interested in the applications of these basic studies, we will offer them an opportunity to work on the application side, which includes applications in biomarker detection, DNA sequencing and efficient water desalination with two-dimensional membranes. Drndic lab has pioneered several device applications in this field and the PURM students will have the opportunity to work with a dynamic, internationally recognized team, at the frontiers of the latest nano science and applications. For ambitious students who are particularly hard working and successful, we offer opportunities for them to go with the lab to present at conferences during the academic year and other exciting opportunities when they join our team and show longer term commitment as well.

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The students will be trained by the Drndic lab and within the world class Singh nano fabrication facility. We expect the students to be self driven and motivated with good interpersonal and communication skills as team work and collaboration is required to pursue successful projects. Self-drive and persistence are the most important prerequisites.

No other particular prerequisites are required besides a strong interest in physics and related fields and a strong self-motivation and work discipline and persistence in research. Graduate students in Drndic lab, including Paul Masih Das, Priyanka Thiruraman, Francis Chen-Chi Chien and postdocs David Niedzwiecki and Jerome Mlack, will be assigned as mentors depending on the particular angle of the project including the specific materials, materials growth or device measurements, for example. We can accept up to three undergraduate students to work in our lab during the summer on the 2-3 aspects. Drndic lab has a strong record of mentoring high school and undergraduate students and keeping in touch with them after they move to graduate school or other successful career paths. please also visit our Webpage, Facebook page, Twitter page :).

Jonathan Heckman

Project 1: Number Theory and Stringy Vacua

Aim of the project: Understand some of the surprising number theoretic properties which appear in certain solutions of string theory. There is a fairly explicit list of examples for a particular class of theories known as 6D superconformal field theories, and these --quite surprisingly-- are related to a particular subset of rational numbers. What is currently lacking is an understanding of the kinds of patterns for these numbers which can arise. Student's duties will include understanding some of the mathematics of these solutions, and to develop methods to search statistical patterns in these models. Helpful prerequisites include some number theory and statistics, as well as experience with Mathematica. Student will also work with postdocs Falk Hassler and Fabio Apruzzi in Prof. Heckman's group.

Project 2: 1D Dynamical Systems and String Theory ***Rising Juniors only***

There is a class of solutions to the string theory equations of motion which can be understood in terms of a deceptively simple 1D discrete dynamical system. The aim of this project will be to understand some of the regular patterns which have been observed in previous work. Student's duties will include understanding some of the mathematics of these solutions, and to develop methods to search for statistical patterns in these solutions. Helpful prerequisites include some understanding of programming in a scripting language such as Mathematica, as well as some exposure to dynamical systems. Student will also work with postdocs Falk Hassler and Fabio Apruzzi in Prof. Heckman's group.

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Project 3: Popularize a topic in Particle Physics / String Theory

Student would help to build a website / fill it with review material on topics connected with the physics of quantum strings. Depending on interests of student, this include instructional videos with visuals and music. Student would work with postdocs Falk Hassler and Fabio Apruzzi in Prof. Heckman's group.

A. T. Charlie Johnson

Project 1: Electronic Nose System Based on Carbon Nanotubes

The work will involve collaboration with colleagues from the Ovarian Cancer Center and the Penn Vet Working Dog Center, among others. The student will be mentored by a postdoctoral fellow and/or a phd student.

We have developed technologies that duplicate and extend our ability to see, hear, and touch, but for odor detection and analysis, biological systems (e.g., dogs) remain the “gold standard”. The ultimate goal of this project is to develop an electronic nano sensor system capable of similar feats such as the detection of disease by the odor of human blood samples or monitoring of air pollution in real time. Our sensor concept is based on a carbon nanotube technology invented in our lab. Course work or experience in Physics or Chemistry is very desirable but not essential for participation in this project.

Project 2: Scalable Synthesis of Two-Dimensional Materials

The student will be mentored by a postdoctoral fellow and/or a phd student. The work will involve collaboration with colleagues in Chemistry and multiple SEAS departments.

Imagine a material as large as a sheet of paper but only 1/100,000 the thickness of a piece of hair. Examples include graphene (a single-atom thick layer of carbon) and a growing family of 3-atom thick materials known as metal dichalcogenides. These materials can exhibit a variety of remarkable electronic and mechanical properties, making them suitable for integration into new sensor concepts, wearable devices and systems, and many other applications. In this project we will explore the properties of devices based on two-dimensional materials with sizes as small as 20 nm to test their suitability for use in next generation computer chips as well as new types of biochemical sensors. Course work or experience in Physics or Chemistry, is very desirable but not essential for participation in this project.

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Project 3: Graphene-Aptamer Chemical Sensors to Detect Toxins in Water

The student will be mentored by a postdoctoral fellow and/or a phd student. The work will involve collaboration with colleagues in Chemistry and multiple SEAS departments.

Systems suitable for real-time monitoring of toxins in water would enable tremendous progress in environmental protection and research in environmental toxicology. However, development of freestanding biosensor tools that to monitor water toxins in the field with high sensitivity and selectivity remains a significant challenge. In this project we will develop a portable electronic system for detection and quantitation of water contaminants based on aptamer-graphene nanosensors. We are working towards a self-contained multiplexed sensing system with low-power wireless data transmission that can be used to monitor multiple toxins simultaneous and report the measurements to a base station. The proposed system will be a proof-of-concept prototype tool for water quality control and for projects looking to further scientific understanding of the human health impacts of toxin exposure. Course work or experience in Physics or Chemistry, is very desirable but not essential for participation in this project.

Elliot Lipeles

Project 1: Investigation of Boosted Jet using Center of Mass Clustering

Heavy particles decaying to light quarks produce jets of light hadronic particles. These particles are grouped together in to "jets" to model the properties of the originating quarks. When the initial heavy particle is very high energy ("boosted") the jet can appear to overlap and merge into one large jet. Various ad-hoc algorithms have been derived to separate the jets. This project is to attempt to separate them with a method based on using the underlying Lorentz symmetry to establish that they haven't actually merged at all.

Project 2: Custom ASIC (chip) Testing

The ATLAS project at the LHC will undergo a large upgrade. Penn is developing custom application specific integrated circuits (ASICs) for this. Prototype chips will be produced this spring and be tested in electronics labs over the summer. The project will entail developing software (and "firmware") to communicate with the ASICs and categorize the functionality and performance.

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Masao Sako

Project 1: Search for the Most Luminous Stellar Explosions

Penn is involved in an exciting cosmology experiment called the Dark Energy Survey (DES), which will make the most precision measurements of the expansion history of the Universe and help understand the mysterious nature of dark energy. Using a massive 520-Megapixel camera on the Blanco 4m telescope in Chile, this 5-year project will measure the detailed properties of over 300 million galaxies and discover thousands of supernova explosions billions of light years away. The PURM student will help identify the most luminous explosions called superluminous supernovae (SLSN) by developing the algorithm to search for these objects. SLSN are rare events and their properties are poorly understood. This project will help double the world sample of SLSN. More information about DES can be found here -- http://www.darkenergysurvey.org/

Project 2: The Search for Planet Nine

There is now mounting evidence that there is a yet-to-be-discovered massive planet in the outskirts of our Solar System. This planet called "Planet Nine" is expected to be ten times the mass of the Earth and well beyond the orbit of Pluto. We have imaging data from the Dark Energy Survey (DES), which has observed a large portion of the southern sky that overlaps with the most likely place where Planet Nine might exists. The PURM student will help analyze the data, search for candidates, and study the survey efficiency for discovering this object. More information about DES can be found here -- http://www.darkenergysurvey.org/

Evelyn Thomson

Project 1: Searching for new particles with ATLAS

The ATLAS experiment is searching for new particles in the highest energy proton-proton collisions ever detected. With a factor of 4 increase in data expected by the end of 2018, new searches become possible for the first time. Professor Thomson's group is exploring several new searches for particles in Minimal Supersymmetric Standard Model with an additional B-L symmetry. These searches involve computer programming to design selections to optimize signal over backgrounds from other processes, design of control regions to estimate backgrounds, and validation regions to test background estimates. Previous knowledge of computer programming in C or C++ or Python or Java or a similar language will be helpful. Additional mentors: Dr. Jeff Dandoy (postdoc in Professor Thomson's group), Ms. Leigh Schaefer, Mr. Christian Herwig (graduate students in the Penn ATLAS group).

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Project 2: Python programming and advanced electronics

Measuring the momentum of charged particles produced in proton-proton collisions is a key part of the ATLAS detector. Penn is designing advanced electronics to read out the next generation of silicon strip charged particle detectors. Responsibilities will be developing Python code to test the functionality of electronics in simulations, and participating in the development of software to analyze data from a future teststand for the actual electronics chips. Additional mentors: Dr. Jeff Dandoy (postdoc in Professor Thomson's group), Mr. Ben Rosser, Ms. Elodie Resseguie, Mr. Joey Reichert (graduate students in the Penn ATLAS group)

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, this biomedical research is oriented towards optical monitoring of deep tissue physiology, i.e., millimeters to centimeters below the tissue surface. The diffusion (random walk) model for light transport permits experimenters to quantitatively separate tissue scattering from tissue absorption, to accurately incorporate the influence of tissue boundaries and interfaces, and to use light at different wavelengths to carry out tissue spectroscopy and imaging. Further, dynamic diffuse optical methods monitor the speckle fluctuations of scattered light, which in turn are sensitive to blood flow. Collectively this work makes possible construction of novel instrumentation for non-invasive extraction of regional information about tissue blood flow, total hemoglobin concentration, and blood oxygenation, among other factors. The research in this project will measure and understand cerebral blood flow, oxygen dynamics, and oxygen metabolism during functional activation in healthy adults, during management of brain injury, especially stroke, and during surgical procedures. Students will use/develop state-of-the-art electro-optical instrumentation for these purposes; they will learn to analyze the optical signals, and opportunistically, they apply these tools in the clinic along with my graduate students and post-docs.

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

Undergraduate students will join on-going experimental projects that utilize optical microscopy, laser spectroscopy and micro-manipulation, wet chemistry and more, in order to understand the phases, dynamical properties, and mechanics of various soft materials. The exact project will depend on the latest developments in our lab. Briefly, one possible set of experiments seeks to understand how local structure drives assembly, rearrangement and deformation in disordered colloidal particle packings like glasses. This research utilizes novel particle systems with unique

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"knobs" for experimental control, including microgel particles whose diameter can be tuned with temperature. In disordered and partially ordered colloidal solids we will carry out experiments to elucidate the parameters which make a material "soft". Another (different) project will study liquids with exotic elasticity: liquid crystals (LCs). Chromonic liquid crystals are new. They exist in water, and compared to traditional LCs, used in displays, they twist extremely easily. This leads to formation of chiral (helical) structures. Our experiments will probe fundamental properties and self-assembly of these LCs confined in drops, capillaries, etc. We also have projects that investigate the behaviors of magnetic nanoparticles in LCs, and which study reconfiguration of thin films due to swelling.

Project 3: Non-invasive Optical Monitoring of Cancer

Undergraduate students will join on-going projects that utilize diffusing light to probe tissue physiology of cancer. The exact project will depend on the latest developments in our lab. riefly, this biomedical research is oriented towards optical monitoring of deep tissue physiology, i.e., millimeters to centimeters below the tissue surface. The diffusion (random walk) model for light transport permits experimenters to quantitatively separate tissue scattering from tissue absorption, to accurately incorporate the influence of tissue boundaries and interfaces, and to use light at different wavelengths to carry out tissue spectroscopy and imaging. Further, dynamic diffuse optical methods monitor the speckle fluctuations of scattered light, which in turn are sensitive to blood flow. Collectively this work makes possible construction of novel instrumentation for non-invasive optical imaging and monitoring breast cancer during chemotherapy, as well as other cancers during photodynamic therapy. One project will complete and utilize a multi-modal Optical-MRI clinical breast imager within a standard-of-care hospital MRI scanner at the Hospital of the University of Pennsylvania; a 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). Another 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. Animal model experiments in the latter vein are also an option, this time in the context of a new cancer therapy called photodynamic therapy.

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Bo Zhen

Project 1: Fractionalization of topological charges in polarization fields

The ideas of topology have found tremendous success in closed physical systems, including electronics, photonics, and photonics. So far, studies tend to focus on two types of topological invariants: those describe the property of bands (Chern numbers, etc) and those describe the property of defects (topological charges). In this project, we would like to explore if there is a fundamental connection between these two types of invariants. For example, is it possible certain band topological invariants necessarily lead to topological defects? Is it possible some band topological invariants can split an integer topological charge into fractional ones?

This project will start out as mostly a theoretical one, although it may involve some experimental components in the end. Student is expected to be have working knowledge in electromagnetism, quantum mechanics, and basic coding skills. Experiences with solid state physics is preferred.

POLITICAL SCIENCE

Ryan Brutger

Project 1: Threats, Promises, and Leader's Strategies in International Negotiations

Do you enjoy following current events and foreign policy? Are you interested in how people learn about politics and develop political opinions? If so, you may be interested in this PURM project. My research focuses on international negotiations, such as those involving the Iran-nuclear deal, the Syrian peace talks, and the Trans-Pacific Partnership. I am particularly interested in analyzing the strategies leaders use in negotiations and how members of the public react to the negotiations (or don't). I am looking for students to assist me in identifying interesting international negotiations, writing brief summaries on the negotiations, coding key components of the negotiations, and writing up case studies of negotiations of particular interest. This project will require students to be organized in their research process and is best suited to those who are excited to read and analyze news, government, and historical reports on a wide range of international negotiations. Coursework in political science or international studies is helpful, but not required.

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Julia Gray

Project 1: How Do International Organizations Work?

International organizations such as the European Union, the World Trade Organization, and NAFTA are all part of the landscape of global cooperation. But those organizations change throughout the years of their existence: some are better at achieving their goals; some are used more frequently; others even fall into disuse or die out altogether. What explains these patterns? Students will research around 80 different international organizations, using Lexis Nexis as well as academic journal articles and library resources to chart the performance of these organizations over time. Students will also compile this information into one broad dataset of the effectiveness and functioning of organizations around the world.

Project 2: Who Makes Up the Market? International Investment and Credible Commitments in Emerging Markets

How do countries convince investors that they are creditworthy? In other words, how do countries -- particularly developing countries or emerging markets -- establish reputations on financial markets? Countries jump through all sorts of hoops in an attempt to attract investment: they join international organizations, attempt to enact domestic economic and political reforms, and sign treaties. Which of these signals work, and how? In this project, students will analyze both the commitments that countries undertake, and also the audience (specifically, the composition of investors in a country) to see what signals markets respond to. Students will collect data from various political and economic databases as well as conduct individual research on how well those reforms are actually implemented.

Michael Horowitz

Project 1: Military Technology and the International Security Environment

This PURM proposal involves in-depth research on emerging military technologies and the future of the security environment. What explains the diffusion of key military capabilities for power projection in a given era? How do these diffusion processes influence deterrence, crisis stability, and the balance of power? Despite research on some aspects of these topics in recent decades, integrated knowledge in academia and the policy world remains limited. Moreover, researchers lack a comprehensive data source on countries' power projection capabilities over time to use in effectively modeling diffusion processes and the consequences for the security environment. The result is that most research is either based on flawed or incomplete measures of power. This project will create new data and knowledge about the diffusion of power projection capabilities and the consequences for the security environment. The findings will

improve scholarly understanding, as well as providing insights with direct relevance for the spread of aspects of the precision strike complex, as well as emerging technologies such as robotics. Professor Horowitz is looking for a PURM student to work with him this summer on a large-scale project focused on building a comprehensible database on emerging military technologies.

Professor Horowitz is interested in two potential types of students: 1). Students who want to do research on particular technologies 2). Students with skills in statistical analysis and data management able to help build models explaining the spread of military technology. Interested students will gain research training in investigating difficult-to-find phenomena about military technologies that will aid their future research inside and outside class, as well as skills operating databases. Additionally, for students interested in careers in Washington, DC, the project is being conducted both for academic research purposes and due to interest from the US Department of Defense. Thus, interested students will be able to get experience doing policy relevant research that could assist them in moving into the policy world as a career.

Project 2: Data science approaches to international security: crisis bargaining, communications, and artificial intelligence

This PURM proposal involves in-depth research, focused on data science applications, including but not limited to survey experiments and statistical models, on the international security environment. There are two main elements to the project. The second set of research and analysis will involve drafting and analyzing survey experiments related to how people think about the use of artificial intelligence. The focus will be on behavior research assessing whether people support or oppose the use of AI in life and death circumstances, including the use of military force, autonomous vehicles, and robotic medical assessments and surgery. This research explores a critical area at the intersection of emerging technologies, society, and global politics.

The second involves trying to understand how changes in communication technology influence crisis bargaining. In today's world, Twitter diplomacy by US President Trump raises questions about whether the medium of communication could influence the probability of a war between the US and North Korea. Yet, 150 years ago, another information revolution occurred when the telegraph first enabled rapid communication around the globe. Using a new dataset, students will build statistical models explaining the spread of the telegraph around the world and how it influenced coercive diplomacy. This will then shed light on how changes in the medium of communication today can influence the probability of conflict.

Professor Horowitz is interested in students with data science skills, including data management and statistical analysis. Interested students will gain research training that will aid their future research inside and outside class. Additionally, for students interested in careers in Washington, DC, the project is being conducted both for academic research purposes and due to interest from

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the US Department of Defense. Thus, interested students will be able to get experience doing policy relevant research that could assist them in moving into the policy world as a career.

Yue Hou

Project 1: Discovering new patterns in China's political economy using firm data

How is firm activity in China affected by political policies and vice versa? What implications do these results have for foreign owned enterprises, state-owned enterprises and domestic enterprises operating in China? In this research project you will be using the most comprehensive survey data available on industrial firms in China to explore these questions. Depending on your interest and skill sets, you will assist me in data analysis and/or data discovery. The data analysis task involves exploring interesting relationships in the existing data and managing the data, and the data discovery task involves discovering new political variables that can be collected and added to the data.

Familiarity in data analysis using R or STATA is required for the data analysis role, and reading proficiency in Chinese is necessary for the data discovery role. Coursework in political science or economics is helpful, but not required.

Project 2: Is China creating a new "World Bank?": Understanding the Asian Infrastructure Investment Bank

Headquartered in Beijing and opened in 2016, the Asian Infrastructure Investment Bank (AIIB) is a new multilateral development bank with a mission to "improve social and economic outcomes in Asia and beyond." How do we understand the rise of China through this new initiative? Which countries does AIIB invest and which countries does it avoid? Are AIIB-backed loans different from the WB-backed loans? Is AIIB helping China cope with its overcapacity problem by creating outlets for its domestic supply? Does the new bank help improve China's energy security by gaining more ownership over the natural resources in other states (e.g., issuing energy-backed loans)? In this project, students will work with me to understand this new development bank and to answer these questions by carefully studying its approved and proposed projects. Students will assist with analyzing loan terms and appraisal documents, identifying similar projects supported by other institututions (e.g., Asian Development Bank, World Bank, New Development Bank/BRICS Bank) and project/case comparison and data analysis.

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Michele Margolis

Project 1: Faith Partisans: Understanding evangelicals in American politics

Born-again or evangelical Christians are an important group in American politics, making up about 20 percent of the American population and representing a crucial voting bloc on which the Republican Party relies. Despite the political importance of this group, political scientists know very little about evangelicals. Instead, many paint this large and diverse group with a single brush. This goal of this project is to better understand evangelical Christians' political attitudes and behaviors. In particular, research assistants will help answer two questions. First, what explains evangelicals' high levels of support for Donald Trump? Not only did a surprising number of evangelicals support Trump during the primaries, despite the plethora of religiously conservative candidates running for the nomination, but evangelicals' approval of Trump is also quite high despite his generally low approval ratings. Research assistants will help make sense of evangelicals Christians' enthusiasm for a thrice-married man who does not personally adhere to many key values and tenants associated with evangelical Christianity. The second question research assistants will help answer is, what mobilizes evangelical Christians? Evangelical Christians' political power rests on their ability to act, and research assistants will help uncover what causes members of this group to take political action. Research assistants will be a part of the project in numerous ways, including: coding data, following the news and keeping a detailed timeline of the Trump administration's relationship with evangelical Christians, helping design and implement experiments, and analyzing data.

Project 2: Feminist Identification and its Implication for Political Decision-making

Why do some people call themselves feminists while others do not? How does being a feminist influence how people view and interpret the world around them? What are the stereotypes associated with feminism, and how do these stereotypes influence people's political attitudes? If these questions that you find interesting, you should consider applying to be a PURM fellow. We will be answering these questions using survey data, running focus groups, coding people's responses and attitudes, and designing experiments. Research assistants will help in all aspects of the project and will learn many new skills along the way. Previous experience analyzing data would be helpful, but not required.

Brendan O'Leary

Project 1: Kurdish constitutional questions

Reading, evaluating, and EndNote filing of documentation related to Kurdish constitutional rights in Iraq, Iran, Turkey and Syria.

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Knowledge of Arabic preferred, especially useful for students who wish to learn Kurdish.

Project 2: The UK's secession from the EU and its impact on British-Irish relations

Monitoring media reports in English of Article 50 TEU negotiations. Best suited to a student who has already taken Psci 215.

An interest in British and Irish politics strongly preferred.

Project 3: Secessions and Partitions

Coding secessions and partitions (including attempted secessions) throughout the world since 1815.

Suitable for students interested in international relations and comparative politics and want to learn about places beyond the great powers.

Rudra Sil

Project 1: Russia in Comparative-Historical Perspectice

This project is aimed at producing a book under contract with Cambridge University Press (Russia Reconsidered: Fate of a Former Superpower). The book is a systematic effort to transcend black-and-white debates over the nature and direction of contemporary Russia. The goal is not to simply defend or criticize any leader or policy. The main objective is to develop a more sophisticated comparative perspective to try and counter the distracting effects of the ebbs and flows of Russia's relations with the West, and in so doing, to generate a more finessed story about Russia's overall development trajectory and long-term prospects. The book does not depend on any newly mined data or sophisticated models or methodological techniques. Instead, it aims to triangulate a wider range of existing data – most of it easily available on websites of international agencies like the World Bank or the United Nations – that do not fit well with starkly negative characterizations of Russia, whether we are talking about politics, economics, society or foreign policy. Regardless of the domain, mainstream narratives at present tend to demonize the Russian regime and its current leader, relying disproportionately on selective facts without providing much proper context or systematic analysis. In contrast, this book will systematically examine Russia's state-building experience, economic growth patterns, natural energy resources, demographic trends, and foreign policy — all within a comparative historical framework. Using such a perspective, Russia's prospects in all domains seem more promising than we are led to believe, especially by comparison to other non-Western countries (such as China, India and Turkey) that are also pursuing long-term growth and growing international influence. Taking into account Russia's current capacity, distinctive history, and geopolitical

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position, Russia's current choices on domestic and foreign policy seem less problematic and more pragmatic, and will likely remain this way barring unforeseen phenomena that might weaken the country's stability.

The PURM student will be primarily responsible for (1) collecting comparative data, (2) preparing charts and tables, and (3) doing brief annotated summaries of some recent articles or short monographs on a particular aspect of Russian politics, economics, oil & gas policy, society, or foreign policy.

Project 2: Labor Relations in India and Brazil

This project will involve surveying and comparing labor relations in India and Brazil. This involves collecting information on trade unions, changes in labor legislation, efforts to increase labor flexibility as part of economic reforms, and data on protest activities (both aggregate and localized/sectoral). The idea is to capture labor relations in democratic developing countries. There is already some material along these lines in the case of South Africa, another democratic developing country. The idea would be to develop narratives about Brazilian and Indian labor politics that are structurally similar to the narrative about South Africa so as to facilitate point-by-point comparisons.

Dawn Teele

Project 1: Politics in the household

In the United States people increasingly marry someone who shares their political opinions and partisan affiliation, or they don't marry at all. What are the origins of this convergence and has the same thing happened in other countries? One possible explanation for the US phenomenon is that partisan matching in the household stems from women's greater political knowledge and participation in politics since the 1950s; it isn't that men and women disagreed before, but that women's greater political capital has increased their knowledge and interest in politics and lead to an appearance of newly convergent preferences. Another possibility is that increasing polarization has raised stakes of marriage to someone with different affiliations in terms of marital harmony. Finally, households might merely look more homogenous due to increased divorce and declining marriage rates. This summer research project will collect and summarize literature, locate sources of data, and begin to analyze these sources to study the intra-household gender voting gap. Students will learn about household formation and partisan preferences in Western Europe and the Americas, with an ability to choose which countries most capture their interests.

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Project 2: The decision to run

Political Scientists have theorized the reasons that people choose to run for office, and many argue that the framework for this choice is different for men than for women. This project will examine the decision to run for office among women who have taken a campaign training course such as that offered by Emerge America, Ready to Run, and other similar programs. In particular, we seek to understand differences between the run rates based on demographic characteristics such as race, class, and sexual orientation. The summer researcher will help to comb through materials from interviews, intake forms that determine whether people are or are not admitted to the program, and long form responses from surveys that I enumerated last year. There will be opportunities for qualitative work, and if it is of interest, quantitative research for interested students.

PSYCHOLOGY

Sudeep Bhatia

Project 1: Modeling Choice Behavior

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 minds. In our research, we examine how this information is learnt and represented, and how it influences preferences and decisions. We use mathematical and computational models of choice behavior and memory representation. These models adopt insights from economics, computer science, linguistics, neuroscience, physics, and other fields. We test our models using experimental human data. For example, we may offer experimental participants choices between different movies or between different food items, and try to predict these choices with our models.

Students will learn how to perform literature reviews, program and implement experiments, and analyze data. Data analysis will involve both hypothesis testing as well as model fitting and parameter recovery. Students will also be exposed to programming languages like MATLAB and Python.

Prerequisites: Some experience with statistics/programming or experience conducting experimental research.

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Elizabeth Brannon

Project 1: Primative number sense supports mathematics learning in children

The ability to use numbers is one of the most complex cognitive abilities that humans possess and is often held up as a defining feature of the human mind. Alongside the uniquely human symbolic system for representing number humans possess an approximate number system (ANS) that is evolutionarily ancient and developmentally conservative. In my research group we are finding that we can harness this primitive number sense to help children learn mathematics. In this project you will test children's primitive number sense and how it relates to their beginning understandings of symbolic mathematics (addition, subtraction, division, multiplication and ratio processing). You will learn how to test children with a variety of different tasks, you will learn how to code data, summarize data graphically, and discuss data and papers in lab meetings. Your responsibilities will include aspects of recruiting participants, conducting research, and creating stimuli. You would be working daily with senior psychology graduate student Emily Szkudlarek and full-time research associate Bonnie Zuckerman and interacting with Dr. Brannon and other lab members regularly.

Project 2: Neural basis of numerical processing

The ability to use numbers is one of the most complex cognitive abilities that humans possess and is often held up as a defining feature of the human mind. Alongside the uniquely human symbolic system for representing number humans possess an approximate number system (ANS) that is evolutionarily ancient and developmentally conservative. In my research group we are investigating the neural basis of this primitive number sense and its relationship to symbolic number processing. Specifically, we using high resolution fMRI to examine the neural substrates of addition problems. You will learn how to conduct fMRI research with children and adults with a variety of different tasks, you will learn how to code data, summarize data graphically, and discuss data and papers in lab meetings. Your responsibilities will include aspects of recruiting participants, conducting research, and creating stimuli. You would be working daily with postdoctoral associate Dr. Stephanie Bugden and full-time research associate Bonnie Zuckerman and interacting with Dr. Brannon and other lab members regularly.

Project 3: Infant Foraging and Decision Making

In this project we are studying how infants and children make decisions about when to continue "foraging" or whether to move onto a new location. In other words, should I exploit the current situation or explore a new situation? We are systematically varying aspects of the environment to see how they effect children's decisions and how this correlates with other individual variables. You will learn how to conduct behavioral research with infants and children with a variety of different tasks, you will learn how to code data, summarize data graphically, and discuss data and papers in lab meetings. Your responsibilities will include aspects of recruiting

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participants, conducting research, and creating stimuli. You would be working daily with full-time research associate Bonnie Zuckerman and interacting with Dr. Brannon and Dr. Platt and other lab members regularly.

Delphine Dahan

Project 1: Language use in conversations

Language enables people to talk about entities in the world. However, the same entity can be referred to using many different linguistic expressions. For instance, if someone wants to talk about Jim Kenney, they can use his full proper name, 'Jim Kenney' if they believe that their addressee is also familiar with Philadelphia's politics and that this shared knowledge is mutually known of each other, i.e., in their so-called 'common ground'. Other expressions, such as 'Philadelphia's mayor', do not presuppose this mutual knowledge. The choice of expression also reflects the perspective the speaker adopts and assumes makes sense for their addressee, as illustrated in the differences between 'the mayor', 'the man at the podium', my neighbor', or 'Jim'. Finally, the expression can be definite, as exemplified by the examples above, or indefinite (e.g., 'a man'). The use of a definite expression may convey the presupposition that the entity can be uniquely identified by the addressee because of mutually shared knowledge (e.g., 'the mayor', 'Jim'). Conversely, the use of an indefinite expression conveys the fact that the referent is not unique or specific (yet).

How do people decide which referring expression to use when talking for the first time about a specific entity with their addressee when engaged into a conversation? On the one hand, people may largely rely on what they estimate to be in their common ground (because of past interactions or because knowledge that people from the same community are believed to share) and leave it to their addressee to ask for clarification if necessary. On the other hand, people may prefer to make fewer assumptions about what is mutually shared, and instead establish it together; they can then rely on this experience when mentioning the entity again later. The project examines how different people adopt different strategies and which, if any, demographic variables (e.g., age, sex, level of education, personality traits, cognitive abilities) may predict people's behaviors.

Students involved in this project will collect and analyze data from conversations that people hold when completing a referential communication task. In this task, participants play a matching game that requires them to interact with each other verbally. They sit on either side of a table separated by a barrier that blocks access to each other's face and workspace. Each participant is given an identical set of cards; one participant is assigned the role of director and instructs the other, the matcher, about which cards to select from their set in order to reproduce a

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series of sequences printed on a booklet that only the director can see. The game continues for several rounds, with participants exchanging roles along the way. Each card appears in multiple sequences. A video-recording of the participants' workspace allows the experimenter to assess whether or not the matcher chose the intended card and thus, provides an objective measure of communication success. The verbal exchanges between the participants are recorded and later coded and analyzed. The project will consist of coding the referring expressions that participants used throughout their conversation in order to infer how people assess and use common ground in conversation.

Geoff Goodwin

Project 1: The morality of mercy killing.

People typically favor mercy killing for a badly injured animal because killing the animal puts it out of its misery and reduces its overall suffering. Such a decision appears to be in the best interests of the animal. Oddly, however, people are much more reluctant to endorse mercy killing for a human in a similar situation. Killing a human who is in great pain and very likely to die anyway is viewed as wrong, and even as murder, with the right decision being to try to prolong the individual's life to the very end.

Attitudes of this sort seem to hold sway in several biomedical contexts, including those involving end-of-life and beginning-of-life decisions. For instance, the judgment that mercy killing (euthanasia) is wrong has prevailed in the United States with respect to gravely disabled infants. Infants born with very severe cases of spina bifada live a short life of extreme suffering. And yet, deliberately ending the life of such infants is seen as morally wrong, even though doing so is arguably in the best interests of the intended "victim," because it reduces their suffering.

This situation is arguably quite paradoxical. It suggests that decision-makers are more attuned to serving the genuine interests of animals than humans in this context. Yet, people routinely endorse the higher moral standing of humans compared to animals. So, why are they willing to sacrifice the best interests of humans and not animals when it comes to mercy killing?

The answer to this question is not yet known, but it likely has to do with particular moral rules that people hold that trump consideration of consequences. The aim of this project is first to document evidence for the phenomenon described above - greater endorsement of mercy killing for animals than for humans, and to seek its explanation. This will likely involve conducting several experimental surveys over the course of the summer.

The undergraduate student who would work on this project would ideally have a background interest in moral philosophy and/or moral psychology, experience working with Excel, and

ideally, some background in statistics. This student's responsibilities would include literature search and review, stimulus generation, and the design, implementation, and analysis of web surveys designed to explore the issue described above. This student will gain exposure to the field of moral psychology and will learn research skills such as designing studies (using Qualtrics), data collection (MTurk and pen-and-paper), data analysis (SPSS and/or R), and literature review.

Project 2: Why do people care about the existence of future generations?

Do ordinary individuals have moral concern for future generations? This question has been of considerable interest to philosophers, and it is of practical relevance to a number of pressing existential threats to humanity, including climate change, the lingering possibility of largescale nuclear or biological warfare, the possibility of a world-ending asteroid strike, or the possibility of runaway artificial intelligence. However, experimental psychologists have not yet explored this question in depth.

The basic question splits into two quite separate questions. First, do people care about the welfare of future generations? Second, do people care about the existence of future generations? From a philosophical perspective, the answer to the first question is relatively straightforward. If future generations are guaranteed to come into existence, then their welfare matters just as the welfare of currently existing people matters, and this can be accounted for on any standard ethical account of why we should show concern for other people. But, what if future generations are not guaranteed to exist? Do we care that they do come into existence at all? And if so, why?

We hypothesize that people do indeed care about the existence of future human generations, but for reasons that differ from those usually offered. Utilitarian philosophers, such as Peter Singer, argue that people should care about the extinction of future generations because of the opportunity costs involved - the extinction of humanity would prevent future human happiness from coming about. However, we suspect that this line of thinking does not capture why ordinary individuals care about the non-existence of future generations. Instead, we think that people's main concern has to do with the cessation of the larger human project, or story, of which they are a part, and to which they feel connected. We hypothesize that it is this sense of psychological connectedness (or belongingness) within this larger project, and the sense of meaning that comes from being part of this narrative, that most distinctly drives people's desire to see humanity continue.

We plan to explore these issues with novel studies that will first probe subjects' open-ended reactions to prompts regarding the destruction of humanity, followed by more focused experimental studies that examine why people care about the future existence of humanity.

The undergraduate student who would work on this project would ideally have a background interest in moral philosophy and/or moral psychology, experience working with Excel, and ideally, some background in statistics. This student's responsibilities would include literature

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search and review, stimulus generation, and the design, implementation, and analysis of web surveys designed to explore the issue described above. This student will gain exposure to the field of moral psychology and will learn research skills such as designing studies (using Qualtrics), data collection (MTurk and pen-and-paper), data analysis (SPSS and/or R), and literature review.

Allyson Mackey

Project 1: Environmental influences on early childhood brain development

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

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

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

Ayelet Ruscio

Project 1: Psychological and Physiological Responses to Threat in Anxiety

Research suggests that the defining feature of pathological anxiety is heightened sensitivity to threat. In fact, the tendency to orient toward, and react strongly to, potential threats is important in maintaining anxiety disorders. However, there is a lot we don't know about how anxious individuals respond to threat. For example, past research has focused on responses to major threats (e.g., you are fired from your job; your long-term partner breaks up with you). Much less is known about responses to minor threats (e.g., you overslept and are late for work) or

ambiguous threats (e.g., your medical test comes back inconclusive). Additionally, past research has focused on subjective, self-reported responses to threats. However, when more objective, physiological responses are measured (e.g., racing heart, muscle tension, sweating), anxious individuals show less reaction to threats than healthy individuals. This raises the intriguing possibility of a mismatch between mental and physical reactions to threat in anxiety disorders. To test this possibility, we are bringing adults with and without anxiety disorders to the lab. Participants vividly imagine major, minor, and ambiguous threatening life events while their psychological and physiological responses are assessed.

This project is ideally suited for students interested in clinical psychology, biological bases of behavior, or physiology. 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 collect data from clinical participants and assist with daily operation of the study. For more information about our research, see https://web.sas.upenn.edu/ruscio-lab/research/.

Project 2: Using Personality Traits to Predict Reactions to Stress in Depression and Anxiety

More than half of depressed individuals also suffer from anxiety at some point in their lives. Recent theories trace this overlap to common personality traits that increase risk for both disorders. For example, neuroticism—a broad trait reflecting a tendency to experience strong emotions, especially in response to stress—is a known vulnerability factor for both depression and anxiety. However, as many people experience only depression or only anxiety, there may be other, more specific personality traits involved in determining which disorder is developed. The aim of the current project is to identify personality traits that predict emotional reactions to stress in depression versus anxiety. We expose depressed, anxious, and healthy adults to a stressful experience in the laboratory, capturing their emotional reactions using self-report and physiological measures. The same participants are assessed for a wide range of personality traits, including general traits (e.g., neuroticism, extraversion) as well as traits hypothesized to be specific to depression (e.g., reward sensitivity) or anxiety (e.g., threat sensitivity). We will use these traits to predict participants' reactions as they anticipate, experience, and recover from the stressor.

This project is ideally suited for students interested in clinical psychology or the biological bases of behavior. The student will take the lead in selecting personality traits and will collaborate on data analysis. The student will also receive training in psychophysiological and behavioral data collection, collect data from clinical participants, and assist with the daily operation of the study. For more information about our research, see https://web.sas.upenn.edu/ruscio-lab/research/.

Project 3: How do Anxious and Depressed Individuals React to Stress in their Daily Lives?

Psychologists have long known that anxious and depressed individuals differ from healthy individuals in their reactions to stress. However, reactions have been studied almost exclusively

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in laboratory settings, raising questions about generalizability to real-world settings. In the current project, we are addressing this problem by having anxious, depressed, and healthy adults track events in their daily lives for one week using a smartphone. Participants rate the stress level of each event and write a brief event description. In addition, participants wear a small biosensor on their wrist that provides continuous assessment of their motor activity. By linking data across the smartphone and biosensor, we can test whether activity levels change after stressful events, whether the change depends on the type of stress, and whether levels change in different directions for anxious individuals (increased activity; agitation) and depressed individuals (decreased activity; isolation). Our results could help inform future treatments aimed at helping persons with anxiety and depression cope more effectively with stress in their lives.

This project is ideally suited for students who are interested in the intersection between clinical psychology and neuroscience, physiology, or bioengineering. The student will help develop methods for isolating, extracting, and analyzing event-related changes in motor activity from the continuous stream of psychophysiological data we are collecting. The student will also help develop a coding system for classifying stressful events, collect data from participants with anxiety and depressive disorders, and assist with the daily operation of the study. For more information about our research, see https://web.sas.upenn.edu/ruscio-lab/research/.

Daniel Swingley

Project 1: How babies learn the sounds of Mandarin or French

How do babies learn their language? In our research we have found that infants learn to understand words, and to identify their language's speech sounds, during the first year. How do they do that? This project investigates early learning by carefully analyzing maternal speech to babies in either Mandarin or French (depending on the student's skills -- native or near-native competence required for Mandarin, or fluency required for French). First we will measure characteristics of the sounds in the language, and then we will apply computational models of category learning to mimic the infant's learning process. The results will help tell us how infants can learn languages so quickly and successfully.

The student will learn skills of phonetic measurement and some new skills in computational analysis, some specific to the domain (e.g., speech software) and some quite general (unix scripting, R). Students who are particularly inclined toward computation will additionally learn some speech-technology skills. The student will also participate in the babylab's research meetings and learn about a range of diverse projects concerning language acquisition. The results of the study will be presented at a professional research conference.

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The main prerequisite is the linguistic one (Mandarin or French). Prior coursework in cognitive psychology / cognitive science, linguistics, or computer science would be helpful but are not prerequisites.

Project 2: Why are some people better at learning languages than others?

We've all experienced it: many students in language courses sound resolutely American, while some seem to master new accents well, and a very few might even be mistaken for native. What accounts for the difference? We study this question by presenting learners with a variety of tasks, both in speech perception and speech production, to try to understand what leads to successful learning and how we can understand differences among learners. This work is tied to, and sometimes inspired by, our work with infants and toddlers.

This project involves implementing perception and production tasks for adult learners, using state-of-the-art speech synthesis techniques and a range of cognitive and performance tasks. Using these procedures, we will begin to understand what skills lead to the most important variability in learners' capability in mastering speech in a second or third language.

The student will learn skills of phonetic measurement and experimental design, and some new skills in speech synthesis and computer scripting, as well as experimental design. The student will also participate in the babylab's research meetings and learn about a range of diverse projects concerning language acquisition. The results of the study will likely be presented at a professional research conference.

Prior coursework in cognitive psychology / cognitive science, linguistics, or computer science would be helpful but are not prerequisites.

RELIGIOUS STUDIES

Justin McDaniel

Project 1: The Chettiar Temples in Global History

The Chettiar Families of South and Southeast Asia were some of the wealthiest in the world in the late 19th century. They largely controlled banking/lending and cattle/sheep-herding, as well as trade in timber, salt, diamonds, arrack, and pearls in the region. Chettiar Families were not only some of the wealthiest in their home state of Tamil Nadu, but established homes, temples, and offices throughout the world. Starting largely in the 1820s, but growing significantly in the 1880s, British colonialism was a convenient vehicle for moving these locally wealthy families from their agricultural and banking base in Tamil Nadu to colonial trading cities like Penang,

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Melacca, Bangkok, Singapore, Yangon, Kandy, Ipoh, and as far as Zanzibar, Durban, Fiji, and various towns in the Caribbean.

This project requires the assistance of a Penn undergraduate that, preferably able to speak and read Tamil, can undertake research on Chettiar temples in Trinidad, Fiji, Mauritius, South Africa, and Sri Lanka. This research will both involve internet and books/article searches in English and Tamil. The student will work closely with me looking at temples in different locations one by one and compiling a database of information about each. Ideally students trained in the history of Economics, Religious Studies, Art History, or South Asian Studies would be well-suited for this project.

Steven Weitzman

Project 1: Help develop a new course on Religion and the Global Future

Seeking help in developing a new course that will explore the role of religion in shaping the global future. This course is more logistically complex than usual because it will be co-taught by a former State department official; will be organized around a series of guest lectures; and involves topics that are new to the professor himself. We are seeking a student with research interest (and ideally some academic background) in religious studies, international relations and/or political science willing to help identify, give feedback on and prepare relevant readings for a course reader, and help develop other materials and aspects of the course. Experience in webpage design may be helpful but is not required if student has other relevant background

ROMANCE LANGUAGES

Ericka Beckman

Project 1: Latin American Literature and the Peasant Question

Between roughly the 1940s and the 1980s, Latin American countries experienced one of the most decisive historical shifts of the 20th century: the transformation of predominantly rural-agrarian into predominantly urban-industrial societies. I am writing a book on how Latin American literature told the story of this broad historical shift, with special emphasis on the intensification of capitalist agriculture, mass migration from rural areas to cities, and peasant-led revolts and revolutions in the countryside. As part of my ongoing research, I am tracking the heated debates surrounding the so-called “peasant question” in political and intellectual spheres.

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I am seeking a research assistant who will help me identify, collate and analyze documents and images pertaining to the peasant question, which will be found in sources ranging from newspapers and films to government documents. I am seeking an intellectually agile and curious student, with a love for delving into historical archives. Reading knowledge of Spanish is required.

Michael Solomon

Project 1: Cinema Minimo: Micro-Short Filmmaking in Spain (2000-218)

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

RUSSIAN AND EAST EUROPEAN STUDIES

Kevin M. F. Platt

Project 1: Your Language My Ear—Russian Poetry/Website Project

This is a project for any student with interest in contemporary Russian culture, and especially poetry, as well as in innovative transnational cultural collaborations.

Six years ago, in the spring of 2011, and two years ago, in 2015, I collaborated with Kelly Writers House and many other Penn departments, faculty members, students and graduate students in organizing an international symposium for translation of contemporary Russian poetry into English and vice versa that brought cutting-edge Russian poets to Penn. Those events were titled Your Language My Ear, and they were organized around a highly innovative practice of translation, involving virtual collaboration in document clouds as well as face-to-face work

among poets, translators, students and scholars at Penn during the symposium. A third Your Language My Ear symposium is planned for spring, 2019.

Those past events produced a significant body of Russian poetry in new translations into English, which have subsequently been published in a number of prominent poetry journals including Jacket2, World Literature Today, Fence Magazine, 1913: A Journal of Forms, Common Knowledge, and in a bilingual book that appeared at the award-winning small press, Ugly Duckling Presse. American poetry in new Russian translations appeared or is forthcoming in the journals Vozdukh and Novoe literaturnoe obozrenie. There are also a number of archival recordings of public events, poetry readings and interviews with the participants.

In order to achieve a higher public profile and a certain virtual institutional persistence for this event, this summer we seek to build a permanent website for Your Language My Year that brings together the materials of past events, including programs, participant bios, links to the audio and video materials archived on PennSound and links to all of the many the resulting publications. This Internet site will also become a space for the materials relating to the new conference—one which will be used not only to house programs and so on, but also to publish real-time audio, video and textual updates on our events that can be disseminated via social media, in this way to reach a virtual audience in our face-to-face events. We also seek to create possibilities that would extend before and after the symposium, addressed to a broader, global audience: one concept is to extend completely open invitations “to the world at large” to collaborate on translations of one or two poems in the document cloud.

We seek one or two undergraduates with intermediate-advanced knowledge of Russian and a developed interest in contemporary Russian poetry to help build this new website, to archive and present all of the materials of the past symposia, and to begin building the materials and mechanisms for Your Language My Ear 2019. No special technical knowledge is required—we will teach you everything you need to know. The students will work this summer in the collegial atmosphere of Kelly Writers House under the supervision of its staff and myself. We hope that the student or students who undertake this project will become collaborators and translators in the course of the event itself in the coming year.

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SOCIOLOGY

Regina Baker

Project 1: Policy, Place, and Economic Inequality

While economic deprivation and socio-economic disparities exist throughout the United States, certain regions and states experience a disproportionate share of these issues, especially as they pertain to women and minorities. Policies can play an important role in understanding such inequalities. However, states differ in the types, timing, and implementation of state-level policies, which can contribute to differences in outcomes across time and place. This project aims to address whether differences in state-level policies can help further our understanding of disparities in outcomes across place. For example do state-level Women's Rights Policies relate to economic outcomes among women and help explain state/regional differences in women's outcomes? This study seeks to address such questions.

Student duties will vary, but may include historical research, literature review, data entry, maintenance of an EndNote database, and basic quantitative analysis. Students should have some social science background and experience with Excel. Good organization, good writing skills, and strong work ethic are a must. Knowledge of Endnote and STATA are a plus.

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Dental Medicine

ANATOMY AND CELL BIOLOGY

Claire Mitchell

Project 1: Molecular characterization of microglial state

Students will be taught the quantitative polymerase chain reaction in order to determine expression levels of key inflammatory genes in microglial cells of the brain and or retina. Students will be trained by PhD candidate Keith Campagno in basic cell culture approaches and standard molecular biology techniques. The results of the study will identify key steps in neuroinflammatory diseases.

Project 2: Immunohistochemical characterization of neuroinflammation

The student will be taught how to use antibody staining to identify markers of neuro inflammation markers in the sections of brain and retina. The student will be mentored by experienced lab manager Wennan Lu. Students will be trained in standard immunohistochemical techniques, microscope operation and image analysis approaches.

ORAL MEDICINE

Thomas Sollecito

Project 1: Inter-professional care needs for patients with head and neck cancer

Diagnostic delay as well as prolonged time for treatment initiation in patients with head and neck cancer has been raised as concern in the literature. Early recognition of the subtle sign in the orofacial region is critical and significantly affects patients' survival rate. Coordinated Inter-professional approach may play a pivotal role for this matter. The University of Pennsylvania Health System is unique in that comprehensive evaluation and treatment planning are well integrated among different types of health care professionals, including oral medicine, oral & maxillofacial surgery, otolaryngology, and radiation oncology. The purpose of this study is to evaluate the effectiveness of these collaborative efforts in our health care system, and further improve health care quality.

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This prospective study includes surveying head and neck cancer patients focusing on the detail about the referral to our clinics. Not only pre-medical/dental students, but all students who are passionate about clinical experience at a hospital will be suitable for this project. The student will be trained in accessing and viewing clinical data under the mentor's supervision. It is expected that the data will be presented at a national meeting and produce a publication in a peer-reviewed journal. Primary mentor: Takako I. Tanaka, DDS, FDS RCSEd.

Eric Stoopler

Project 1: Temporomandibular joint disorders in the pediatric population

Temporomandibular joint disorders (TMD) are often multifactorial and require an inter-disciplinary approach. Increasing numbers of patients with TMD pain in children and adolescents, particularly as a part of psychosomatic pain, are anecdotally well-recognized among dental/medical professionals today; however, effective treatments for the pediatric patients are not well-established and can be challenging. The aim of this study is to develop algorithms for the management of TMD in this population.

This project involves a retrospective chart review. The student will learn the basic principles of human subject research, how to review the medical/dental literature, and gain an appreciation for the application of basic science to clinical research. The goal is that the student presents at a professional meeting and produces a publication under close mentoring. Students who are considering pre-medical/dental studies or clinical research are encouraged to apply. Primary mentor: Takako I. Tanaka, DDS, FDS RCSEd.

PATHOLOGY

Kelly Jordan-Sciutto

Project 1: Understanding White Matter deficits in HIV

Individuals with HIV can show severe cognitive dysfunction, a condition termed HIV-associated neurocognitive deficits (HAND). Since the advent of the life-saving anti-retroviral therapy, the most serious forms of HAND have been eliminated but many HIV+ individuals still exhibit mild to moderate cognitive and behavioral dysfunction, even when their viral load is properly controlled by antiretroviral therapy. Pathological findings from these patients show that one of the most consistent deficits are abnormalities in the white matter of the brain, especially the

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myelin sheath which surrounds and protects the nerves and is required for the rapid transmission of nerve impulses and protection of the nerves. Antiretrovirals do not reverse this damage and may exacerbate it. Our work is dedicated to determining the cellular and molecular effects of the HIV virus and select anti-retroviral drugs used to treat the virus on the formation and maintenance of the myelin sheath. Identifying the route of damage to the myelin sheath by the virus and by select treatments will help design more rational drug therapies as well as adjunct therapies to improve the cognitive state of HIV+ individuals. Students on this project will learn cellular and molecular techniques including tissue culture, immunohistochemistry, immunoblotting, and microscopy, as well as how research laboratories function and collaborate with each other. They will be part of campus initiatives to understand, treat and eliminate HIV. Ms. Lindsay Roth, a graduate student in the Pharmacology Gradate Group will provide mentoring in the laboratory.

PERIODONTICS

Dana Graves

Project 1: Oral wound healing and the impact of diabetes

The ability to heal oral wounds is an important aspect of an individual's health and is negatively affected by diabetes. Our recently published studies demonstrate that activation of the transcription factor forkhead box O1 (Foxo1) in keratinocytes plays important but surprisingly, opposite roles in re-epithelialization of wounds in diabetic and normoglycemic animals. The goal of this project is to unravel the molecular mechanisms through which FOXO1 differentially activates keratinocytes to promote or inhibit connective tissue healing depending upon normoglycemic or diabetic conditions. The results will establish how FOXO1 may be an important therapeutic target in promoting wound healing in diabetes. These studies will focus on the impact of FOXO1 in organizing the expression of factors that stimulate cells in normal conditions to improve healing but fail to do this in diabetic conditions. The goal of Aim 3 is to carry out translational studies and establish functional to rescue diabetic healing. They will determine FOXO1 is a good therapeutic target to improve diabetic healing. Students will learn how to do quantitative immunofluorescence, microscopy, histostains, image analysis, cell identification, gene expression in vivo and data collection and analysis. The project is well suited to a student interested in a career in medicine or dentistry with a background in biology. It is expected that the project will involve participation during the summer and potentially independent study.

Project 2: Dendritic cells and the pathogenesis of periodontal disease

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Dendritic cells play a central role in the pathogenesis of periodontal disease. Lineage specific FOXO1 deletion in dendritic cells significantly increased susceptibility to periodontitis whereas the opposite occurs when Akt1 is deleted in dendritic cells. Dendritic cells have multiple functions that can affect periodontal inflammation and bone loss. They may produce factors that favor the formation of the regulatory T cells, which have been shown to reduce periodontal breakdown. They also promote an antibody response that is potentially protective. Alternatively, DCs can potentially transdifferentiate to osteoclasts, effector cells responsible for bone resorption. We will examine these three potential mechanisms through which the FOXO1 and Akt1 may regulate DC to control susceptibility to periodontitis. These mechanisms are compatible with each other and all three could potentially play a role. The experiments involve an in vivo experimental model of P gingivalis and F nucleatum induced periodontitis in mice with lineage specific FOXO1 or Akt1 deletion in DC along with companion in vitro studies. Students will learn how to do quantitative immunofluorescence, microscopy, histostains, image analysis, cell identification, gene expression in vivo and data collection and analysis. The project is well suited to a student interested in a career in medicine or dentistry with a background in biology. It is expected that the project will involve participation during the summer and potentially independent study.

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Design

ARCHITECTURE

Masoud Akbarzadeh

Project 1: Interactive, web-based structural design library

This project is part of ongoing research in 3D Graphic Statics at the Polyhedral Structures Lab at the School of Design. We intend to develop a web-based interactive library of structural forms and the force diagram for students, researchers and practitioners. This library will represent UPenn as one of the frontiers in this field of research and allows designers to access it from around the world as a reference for learning, teaching. We have currently developed an initial web-based platform with a limited number of interactive examples (link). However, the examples do not allow any direct transformation to be applied to their geometries which limits the interactivity a lot.

The primary objective of this project is to:

1. extend the existing library to include verity of different examples; and,
2. develop interactive models allowing direct user manipulations.

We are looking for students with background/experience in JavaScript, three.js, and WebGL/OpenGL. Any student with the mentioned experience who is interested in design/representation of highly-efficient structural forms can participate in this research. Besides, the project has essential learning values for the student research assistant:

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

Mentors: Dr. Masoud Akbarzadeh (Principal), Dr. Andrei Nejur (Postdoc)

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Project 2: Design and fabrication of ultra-lightweight structural systems

Polyhedral Structures Laboratory is currently researching design and fabrication of ultra-lightweight structural porotypes for building construction industries. This research includes various activities such as:

- geometric form finding,
- physical prototyping on multiple scales from micro to macro,
- additive manufacturing and/robotic fabrication investigations,
- concrete casting,
- load testing,
- drawings and documentation.

The design and fabrication process of these prototypes are incredibly challenging since we would like to push the boundaries of existing construction to achieve the reduce the construction materials as much as possible, but preserve the structural behaviour of the system.

We are looking for talented an undergraduate research assistant student to help us in the mentioned workflow. The researcher will get hands-on-experience in cutting-edge research in the field of architecture and structural design. For more information, please visit the Polyhedral Structures Lab website. Mentors: Dr. Masoud Akbarzadeh (Principal), Dr. Mohammad Bolhassani (Postdoc)

Robert Stuart-Smith

Project 1: Robotic Building Manufacturing: Ceramic 3D Printing

Robotic Building Manufacturing research enables autonomous production processes to be utilised for bespoke building parts made possible through novel use of material, manufacturing processes, robot motion planning and generative design processes. This research project aims to develop innovative autonomous manufacturing processes and designs for high-performance ceramics in building and furniture design applications. Research activities will include design and testing of ceramics produced through industrial robot continuous 3d printed deposition, glazing (manual and robotic application), kiln firing, robot programming, computation-based generative design and structural load testing. Students would be involved in most aspects of research, testing and production and gain first-hand knowledge in ceramics and robotic manufacturing. Applicants with ceramics, 3d modelling or computer programming experience preferred but not necessary. Faculty involved include Assist.Professor Robert Stuart-Smith, Director of the Autonomous Manufacturing Lab, ARI, PennDesign.

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Project 2: Robotic Building Manufacturing: Hot-wire Cut Formwork concrete casting house prototype

Penndesign's new ARI Robotics Lab is being utilised for the robot hot-wire cutting of EPS foam for use as formwork for innovative thin-shell precast concrete. The project involves the testing and production of a full scale tiny-house that will leverage innovative use of industrial robot fabrication processes and state of the art concrete and structural design methods. The result will be a geometrically complex, unique house design that aims to reduce the environmental and economical impact of building construction through structural efficiency and innovations in manufacturing. The house will be designed for disassembly. Research activities will involve the development of large light-weight cavity based concrete panels, robot hot-wire cutting of foam molds, concrete casting, structural load testing, small house assembly and the design and manufacture of the house parts. Prior knowledge of Rhino3D software preferred, and an interest in robotic manufacturing and hands on engagement with building construction. Faculty involved include Assist.Professor Robert Stuart-Smith, Director of the Autonomous Manufacturing Lab and Dr Masoud Akbarzadeh, Director of the Polyhedral Structures Lab, both from ARI, PennDesign.

Project 3: Machine Vision & GPU computing for Real-Time Robotic Manufacturing

Real time robotic manufacturing processes enable the possibility of integrating design and production within one seamless process. To support this, means of robot perception and design decision making are required. Leveraging the Autonomous Manufacturing Lab's previous experiences with multi-agent behaviour-based programming, industrial robot programming and ROS (Robot Operating System) programming the research aims to provide state of the art use of Intel Realsense cameras with Open CV, ABB industrial robot Externally Guided Motion programming, and the development of a low-latency Cuda GPU based generative design software platform. Research activities will involve: industrial Robot operation and programming, Cuda GPU computer programming and ROS interface with IntelRealSense cameras. Prior experience with Nvidia Cuda programming, ROS or Open CV preferred. Faculty involved include Assist.Professor Robert Stuart-Smith, Director of the Autonomous Manufacturing Lab.

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CITY PLANNING

Francesca Ammon

Project 1: Digital Humanities Project - Mapping Urban Renewal in Society Hill

Students will assist in the continued development of a multimedia, map-based website for documenting the urban renewal of Philadelphia's Society Hill neighborhood during the 1950s-70s. The website aims to provide both public and academic audiences with a ground-level perspective on historic preservation and urban renewal in this landmark project. As developed in consultation with student skill sets and interests, specific tasks may include: scanning, identifying, and geotagging buildings/landscapes depicted in historical photographs; developing a database of social, architectural, and planning history by address; editing and designing multimedia layout for oral history transcripts; and possibly also conducting new oral history interviews. While Geographic Information Systems (GIS) skills are particularly welcome, they are not necessary. The position will provide training in basic skills related to web design, mapping, and urban historical research. This position should be of particular interest to students seeking experience in digital humanities, historical GIS, public history, and the history of architecture, city planning, and historic preservation. This project offers opportunities for more than one undergraduate researcher.

Vincent Reina

Project 1: Housing and neighborhood access

There is an abundance of research that shows the importance of housing, and neighborhoods, on a host of outcomes. This project aims to specifically look at the role of subsidized rental housing programs in promoting access to higher opportunity neighborhoods, with a specific focus on whether and when rental subsidies are used to address issues of affordability and access in markets where it is more difficult to build housing.

The student working on this project will be asked to 1) conduct literature reviews related to housing, health, and other outcomes and 2) conduct descriptive, and more robust, data analysis related to subsidized housing, neighborhood quality and change, and household outcomes and 3) engage in conversations with the research team about the strengths of challenges of rental subsidy programs. The ideal student will have an interest in housing, urban development, or public health and either know how to use STATA or be comfortable learning the software.

Project 2: Neighborhood change and perception of change

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Some neighborhoods of Philadelphia are drastically changing, while others are not. At the same time, perceptions of neighborhoods and the needs of communities are also changing. This project combines census data on neighborhoods with an extensive survey conducted of residents in Philadelphia about it's neighborhoods to measure how perceptions of change is related to change that can be measured. Specifically, it focuses on how perception varies across household characteristics and types of neighborhood change.

The student working on this project will be asked to 1) conduct literature reviews related to neighborhood change and perceptions of change and 2) conduct descriptive, and more robust, data analysis of the census and survey data to quantify change and 3) engage in conversations with the research team on this topic. The ideal student will have an interest in urban development and either know how to use STATA or have the ability to learn it quickly.

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Education

LITERACY, CULTURE, AND INTERNATIONAL EDUCATION

Gerald Campano

Project 1: Community literacies project

The community literacies project is a long-standing research partnership with a community center situated in a multiethnic and multilingual faith-based community. For eight years, our project has investigated the rich literacy knowledge that immigrant populations and communities of color engage in community-based learning experiences and in their advocacy for educational access and equity. Unfortunately, the perspectives and knowledge of families, especially those from historically disenfranchised communities, do not often inform broader educational research, policy, and practice. Our partnership has been bridging these divides by bringing together neighborhood leaders, educators, families, and university faculty through collaborative, community-based research. Recently, our project has also received funding through the Spencer Foundation to establish a community-based research center.

As part of the project, a student mentee would be interacting directly with community and university-based and researchers investigating literacy learning and educational equity. Responsibilities include participating in and helping facilitate community meetings and learning experiences, collecting qualitative data about community literacy knowledge, assisting in implementation of a community survey about educational equity and attending weekly research team meetings with faculty and graduate students working on the project. Through the project, students will gain first-hand research experience and mentoring with faculty and graduate students and will have the opportunity to shape the structure of our community-based research center. Students who speak Spanish, Vietnamese, Indonesian or Tagalog are especially encouraged to apply.

Project 2: Partnership with the University of Guadalajara

This project is a collaboration between universities in Mexico and researchers across the world working together to re-think paradigms in literacy eduction in Mexico. The University of Guadalajara specifically is developing a new program for literacy educators that encourages them to question and challenge long-held ideas about what literacy and education research are in pursuit of making literacy education more accessible and inclusive. As part of this development, Dr. Campano has served as a thought-partner to Mexico-based educators, a visiting lecturer for students in the program and has also assisted in developing new coursework for the program.

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Responsibilities for students involved in this project include helping facilitate online interactions with students in Guadalajara, collecting and organizing course materials and consulting on aspects of the partnership in addition to attending weekly research team meetings with faculty and graduate students working on the project. Mentees will gain experience working in international research partnerships, organizing and facilitating coursework and will learn about global philosophies of education. Students who speak Spanish are especially encouraged to apply.

Amy Stornaiuolo

Project 1: Studying Online Collaboration & Virtual Exchange: Connecting Adolescents on Write4Change

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 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 young people in six countries, we are working with a 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 data-collection phase, particularly to study the interactions of three focal groups in Italy, Philadelphia, and India. The summer internship will involve:

- moderating adolescents' writing activities and collaboration in the online community;
- collecting qualitative data in the online platform, including taking observation notes (there may be opportunities for local data collection);
- participating in data analysis (e.g., creating catalogs, taking screenshots, tracking students' participation, working with statistical data reports);
- supporting teachers and students (e.g., giving feedback on students' writing, communicating with teachers and researchers);
- participating in weekly research team meetings

We will meet weekly from May-July. In addition to interest in online community, applicants should have relevant interest in one or more of the following areas: literacy education, digital literacy, multicultural education, global education, writing, or computer-mediated communication (no prior research experience required).

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Krystal Strong

Project 1: The Black Philadelphia Project

"The Black Philadelphia Project" is a multimodal digital humanities project, which investigates the fraught present and future of Black Philadelphia under the precarious conditions of today. "Black Philly" is a racial-spatial-imaginative construction that indexes the increasingly "endangered spaces" of Black cultural practice amid changing racial and socioeconomic demographics and the systematic displacement of longtime Black residents.

"The Black Philadelphia Project" has five components, which utilize geospatial mapping and technologies, archive making, filmmaking, journalism, and traditional ethnographic and oral history fieldwork. They are: (1) an immersive, interactive map which will layer 2D and 3D representations of sites and events that constitute the spatiality of "Black Philly"; (2) a web series that will amplify the lived realities of Black Philadelphians as they negotiate processes of urban change; (3) an oral history collection of individual and collective memory that will combine oral testimony with 3D visualization; (4) a digital archive of existing digital resources and unexplored community-based archives; (5) a blog with original content. Together, these components demonstrates how the tools of the digital and spatial humanities, media studies, and qualitative research can help us more fully understand and teach the lived realities of marginalized populations and spaces.

The student researcher will join the production team for the web series and support the filming of Season 1 of the web series, which is currently in pre-production. Additionally, the student researcher will learn how to use 3D immersive technologies to film oral histories and capture 3D film and video of cultural sites around the city of Philadelphia.

Project 2: Training a New Generation of Leaders

Education has an essential role in cultivating civic leadership and participation (Hahn 1998). "Tracking A New Generation of Leaders" is a multinational qualitative project that explores the role of educational development in the production of a new political leadership class in Africa. In Africa, educational institutions have been particularly instrumental as training grounds for leadership throughout the continent's postcolonial history. Due to rising awareness of the dangers of the generational "disconnect" between Africa's elderly leaders and its demographic majority of youth (Ibrahim 2013), African educational institutions and international leadership academies are gaining traction as conduits for the training of a new generation of leaders.

The leadership programs targeting African youth that are the focus of this study have an explicit mission of developing the capacity of African youth to play a leadership role in their societies and provide some form of academic and professional training or support. In the first phase of our research, we developed a web-based database and geo-mapping technology that aggregates and visualizes data on global educational programs targeting African youth for leadership. Thus far,

we have catalogued over 200 programs in 45 countries. Based on analysis of these programs' website content, marketing materials, news coverage, and other details related to their mission, curricula, design, and organizational structure, we identified six primary organizational forms that YLFD interventions employ at this time: (1) brick-and-mortar institutions, (2) short-term programs, (3) scholarships and grants, (4) conferences and meetings, (5) networks, and (6) online support activities. We are now beginning the second, qualitative phase of our research, which seeks to understand how the differently positioned actors within these programs (e.g., youth participants, administrators, donors, educators) understand the mission of YLFD programs and negotiate discrepancies between organizational priorities and their own.

The student researcher chosen to work on this project will help expand the database of programs captured in this study and learn how to use the mapping tool to visualize the database. Additional tasks will include: transcription of audio and video interviews; data cleaning, and coding and analysis. 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 activism in Africa and the United States.

TEACHING, LEARNING, & LEADERSHIP

Yasmin Kafai

Project 1: Evaluating Professional Development for STEM Educators

The mission of the Philadelphia Education Fund (ED Fund) is to cultivate exceptional outcomes for students. Its STEM (science, technology, engineering, and math) initiatives include professional development (PD); resources such as a monthly newsletter and STEM field trip and outreach directories; and leadership roles in regional, statewide, and national STEM activities.

The Ed Fund performs extensive evaluations of its STEM PD offerings. These evaluations involve short-term and long-term assessments and quantitative and qualitative data. Based on Guskey's (1998) levels of PD evaluation and the OSTRC's Survey Toolkit (2009), the Ed Fund strives to answer: What types of professional development for STEM educators has the most significant, positive, and sustained impact on staff, programs, and students?

The Ed Fund seeks summer interns to clean, enter, analyze, and report on data gathered from the previous year's PD activities. These findings will help shape the coming year's PD offerings and ensure positive experiences and outcomes.

Interns should be familiar with qualitative and quantitate research; have excellent written and verbal communication skills; be fluent in basic computer technology; be comfortable working

alone and a part of a team; and be passionate about STEM education among urban populations. Interns will learn about STEM programming and curriculum, professional development, and PD evaluation. Interns will also interact with multiple stakeholders from local, regional, and national STEM education organizations.

Project 2: Evaluating the Philadelphia STEM Ecosystem

The mission of the Philadelphia Education Fund (ED Fund) is to cultivate exceptional outcomes for students. Its STEM (science, technology, engineering, and math) initiatives include professional development (PD); resources such as a monthly newsletter and STEM field trip and outreach directories; and leadership roles in regional, statewide, and national STEM activities.

The Ed Fund is the backbone organization for the Philadelphia STEM Ecosystem: one of 56 national STEM Ecosystems based on a "collective impact" model, and designed to foster collaboration among STEM education stakeholders. Our Ecosystem includes an 8-member Steering Committee, 5 Workgroups, and over 120 members representing community-based organizations, government agencies, colleges and universities, schools and school districts, and businesses and corporations.

The Ed Fund seeks summer interns to develop, implement, analyze, and report on data reflecting the efficacy of the STEM Ecosystem: is it truly addressing its goals of increasing collaboration, decreasing duplication, and identifying gaps in programs andservices.

Interns should be familiar with qualitative and quantitate research; have excellent written and verbal communication skills; be fluent in basic computer technology; be comfortable working alone and a part of a team; and be passionate about STEM education among urban populations. Interns will learn about STEM programming and curriculum, as well as collective impact approaches in STEM education. Interns will also interact with multiple stakeholders from local, regional, and national STEM education organizations.

Rand Quinn

Project 1: Understanding School Choice and Parent Social Networks in a Gentrifying Neighborhood

What are the processes by which gentrification structures parent social networks and school choice?

Gentrification, the influx of middle-class residents into dis-invested neighborhoods, is a process that can not only change the economic fabric of a neighborhood, but its social and political fabric as well. These changes in neighborhoods are sustained through institutions as well as the social

capital, and social networks, of new and existing residents. Recent studies in school choice have begun to explore the influence of parent social networks on this decision-making process. Our project combines these two phenomena to examine the changes in parent social networks, particularly those that drive and/or influence school choice decision-making processes, in gentrifying neighborhoods in Philadelphia.

Philadelphia, the sixth largest city in the country, is experiencing an intense period of growth following a long half-century of disinvestment since World War II. This disinvestment came at the cost of its public institutions, with Philadelphia public schools only recently dissolving its State-mandated oversight board, the School Reform Commission (SRC). The SRC created the portfolio of Philadelphia schools (including public traditional, public charter, private and parochial schools) that makes school choice an empowering reality for those with the correct financial, social, and political capital, and a risky burden for those without.

Over the summer, our PURM student will work with us on the following research activities: (1) conducting a literature search on gentrification and schools; (2) designing, administering, and analyzing a parent survey; (3) conducting ethnographic observations of neighborhood institutions.

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Engineering and Applied Sciences

BIOENGINEERING

Danielle Bassett

Project 1: (Machine) Learning of Optimal Transmission of Bioengineering Discoveries

In this project, students will use and develop code to extract patterns in peer-reviewed articles in prestigious bioengineering and related journals. The goal will be to understand the patterns of information transmission that are most predictive of the article's impact on the existing body of knowledge and subsequent directions of scientific inquiry. Other bodies of written work will be compared to these articles, including stories, and children's soliloquies. The project requires extensive familiarity with computer programming, creative problem solving, and independence.

Project 2: The language of mathematics

Students interested in epistometrics, forms of knowledge (in the philosophical sense), and knowledge spaces (in the mathematical sense), could be a good fit to a new project focused on quantitatively characterizing the language of mathematics. The project will include curation of relationships between mathematical concepts, the study of the architecture of these relationships, and the study of how humans learn these relationships. Creativity, independence, love of mathematics, and coding experience required.

Project 3: A network science of quantum transport

Enamored after taking quantum? We have begun a new project studying the manner in which atoms transition from one energy state to another using an emerging set of conceptual tools and theories from network science and complex systems theory. Participating in the project will give students experience with an emerging sub discipline of physics (network science), and how it can offer fundamental new insights into a classical sub disciplinary of physics (quantum mechanics). Creativity, independence, love of physics, and coding experience required.

Brian Chow

Project 1: Design of genetically encoded action potential sensors from scratch

The goal of the project is to direct recent advances in protein design towards development of rapid and sensitive fluorescent sensors for high resolution optical monitoring of brain activity.

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We are engineering these sensors based on voltage controlled intra-protein electron and energy transfers that are much faster than protein rearrangements of currently available genetically encoded voltage sensors. The electron transfer based sensors, developed from scratch (they are not made by mutagenesis of natural proteins), are being designed to distinguish cell-type specific neuron firing with unprecedented resolution. They are expected to provide tools for the scientific community to decipher how brain works. We are looking for a student who is interested in neuroscience, biophysics, biochemistry, chemical engineering, or bioengineering. The student will learn about protein design, biological electron transfer, and fluorescence sensors. (S)he will gain hands on experience in molecular biology, protein purification and characterization, and spectroscopy. This is a collaborative project with Bohdana Discher at the Department of Biochemistry and Molecular Biophysics (PSOM).

Christopher Fang-Yen

Project 1: Using a worm and microfluidics to understand the sense of touch

The sense of touch is important for a wide range of animal behaviors, but there are many open questions about how the sense of touch works and how it is regulated, both at a receptor and behavioral response level. The roundworm and simple model organism C. elegans has long been used as a model of touch sensation in animals, and we know more about touch in C. elegans than in other model organisms, such as mice. Because adult C. elegans are only 1 mm long, we can use microfluidics to manipulate large numbers of them. In this project, we are developing a microfluidic assay that can measure many individual animals' touch response behavior at once. It will allow us to measure the relative touch sensitivities of different mutant strains under different osmotic and pharmacological conditions as well as the receptive field of subsets of the touch receptor neurons. Using image analysis, we will also be able to study sensory and behavioral adaptation to multiple stimuli as well as reaction time. The student will play an active role in the maintenance and preparation of equipment and animals for experiments, design and carry-out experiments, and, depending on their level of computational experience, help with image processing and data analysis. Excellent fine motor skills are a requirement (you will have to assemble devices whose precise alignment is crucial to their function and efficiently pick up and move hundreds of animals that are < 1 mm long without hurting them). A strong desire to understand how biology works is essential, and programming skills, though not required, are necessary if you want to work with the data you will generate. If successful, this work is likely to lead to meaningful, publishable discoveries about how the sense of touch and touch response behavior are regulated.

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Project 2: Probing connections in the brain of a worm

Caenorhabditis elegans, a microscopic roundworm, is the only organism that boasts a complete connectome – a map of all neurons and their synaptic connections. However, it is still unclear which synaptic and electrical connections are functionally significant in the worm's motor circuit. To address this question, we will optogenetically stimulate a motor neuron in the worm and measure the corresponding activity in the nearby neurons and/or connected muscles. We will also use an infrared laser system to kill specific cells or sever their processes. This work broadly paves the way for the functional interpretation of structural connectomes that will eventually become available in more complex species. The student will primarily be responsible for operating a microscope that supplies blue or green illumination to a targeted neuron while simultaneously recording fluorescence images of all nearby neurons or muscles. Depending on the specific interests of the student, optional tasks may include data analysis (Matlab experience is a plus) and interpretation of results (a basic familiarity with neuroscience is helpful). Excellent fine motor skills, ability to keep organized, and strong attention to detail are required.

Project 3: Understanding the biology of aging using the WorMotel

Why do animals grow old? Research over the past few decades using model organisms has revolutionized our understanding of the biology of aging. The microscopic roundworm C. elegans is an excellent model for aging research, due to its short generation time and lifespan. However, progress in this field has been delayed by the reliance on tedious manual methods. We have recently developed the WorMotel, a microfabricated device for cultivating and imaging thousands of individual worms automatically (Churgin et al eLife 2017). The student will use a robotic WorMotel system to test genetic and pharmacological manipulations that influence the rate of aging. This work is part of an international collaboration that will test these findings on other model systems with an eventual goal of developing strategies for slowing human aging. Excellent fine motor skills and some experience with computer programming are required.

Michael Mitchell

Project 1: Polymer-Lipid Nanoparticles for In Vivo mRNA Delivery to Immune Cells for Potent Cancer Immunotherapy

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

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

Project 2: In Vivo Bone Marrow Nucleic Acid Delivery Systems for Therapeutic Targeting of Multiple Myeloma-Microenvironment Interactions

Multiple Myeloma (MM) is an incurable hematologic cancer characterized by the accumulation of abnormal plasma cells within bone marrow. We and others have shown that the bone marrow niche itself, specifically bone marrow endothelial cells, provides the “soil” supportive of myeloma cell (the “seeds”) homing, colonization, and proliferation in bone marrow. Specifically, extracellular cyclophilin A (CyPA) secreted by endothelial cells promotes the proliferation, homing, and drug resistance of myeloma cells in bone marrow. Thus, inhibition of CyPA secretion from endothelial cells provides a potential therapeutic strategy via disrupting physical interactions between myeloma and the bone marrow niche. In this project, we will develop nanotechnologies that deliver nucleic acids to bone marrow microenvironment, as a paradigm-shifting myeloma therapy which disrupts interactions between myeloma and the bone marrow niche. Students will engineer novel lipid-polymer hybrid gene delivery nanoparticles for the encapsulation of small RNAs, including siRNA and microRNA. Nanoparticles will be evaluated in myeloma cell culture as well as in animal models of multiple myeloma. The resulting microenvironment-targeted nanoparticles will be combined with chemo- and immunotherapies used in the clinic, with the ultimate goal of translating this technology into clinical trials. Prerequisites: coursework in molecular/cell biology and organic chemistry lecture and labs are highly recommended but not required. Prior research experience in cell culture, molecular biology, and organic chemistry are highly recommended but not required. Students will be mentored by the PI as well as postdoctoral fellows and PhD students within the lab.

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Andrew Tsourkas

Project 1: Improving the sensitivity of immunodiagnostic assays

Antibodies, most commonly Immunoglobulin Gs (IgGs), are widely used in research and diagnostic assays. In nearly all "immunoassays", the orientation of the antibody on the surface or the site at which an reporter enzyme, nanoparticle, or dye is attached can have an enormous impact on assay sensitivity. Therefore, there has been a movement towards the development of site-specific bioconjugation techniques, which allow for precise labeling of antibodies at pre-defined locations. Despite the enormous benefit of using site-specific antibody labeling techniques, they are rarely adopted in commercial immunoassays. This is largely due to the complexity, shortcomings and economic hurdles associated with site-specific bioconjugation techniques. Recently, we developed a simple, rapid, and efficient approach to site-specifically and covalently immobilize native IgG on surfaces and/or to site-specifically label antibodies with enzymes, fluorescent dyes, or other reporter systems. Our technique for the site-specific immobilization and/or labeling of antibodies is cost-effective, easily scalable, and amenable to high-throughput processes. Students working on this project will test whether this bioconjugation technique can indeed be used to improve the sensitivity of immunoassays. The student will be closely monitored by a post-doctoral fellow in the lab. Experience with immunoassays, PCR, ligations, transformations, and other basic molecular biology techniques are preferred.

Beth Winkelstein

Project 1: Neuroscience methods in pain

Research includes working in vivo and/or in vitro to quantify neuronal activation using electrophysiological and/or calcium imaging depending on the system. Each project includes working closely with graduate students and post-docs to learn these methods, participate in data acquisition and analysis. Prior work in cell culture or with matlab is a benefit.

Project 2: Tissue biomechanics in injury

This project includes assisting with tissue testing and analysis of biomechanical metrics to determine injury, tissue failure and mechanical responses of tissues. The student will have the chance to participate in experiments and data analysis as well as assays to correlate mechanical metrics with structural assays of tissues. Experience with physics helpful.

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CHEMICAL AND BIOMOLECULAR ENGINEERING

Dennis Discher

Project 1: Projects at the interface of cancer, biophysics, and immune recognition

Students should have interest in biophysics and molecular biology, and they should be interested in working with cells, plasmids, genomics, immune cells, and microscopy. Recent papers relevant to the topic area are: (1) Mitotic progression following DNA damage enables pattern recognition within micronuclei. Nature 2017. (2) SIRPA-Inhibited, Marrow-Derived Macrophages Engorge, Accumulate, and Differentiate in Antibody-Targeted Regression of Solid Tumors. Current Biology 2017. (3) DNA Damage Follows Repair Factor Depletion and Portends Genome Variation in Cancer Cells after Pore Migration. Current Biology 2017.

COMPUTER AND INFORMATION SCIENCE

Norman Badler

Project 1: Ancient Mudbrick Architecture Lighting Studies

The prevalence of mudbrick structures in the ancient world presents a relatively unexplored opportunity for the realistic portrayal of their appearance. 3D computer models are often constructed from architectural remains to study form and function essential to understanding ancient cultures. These 3D models are usually rendered with estimated colors or photographic images for texture and color reference. Unfortunately, the reflectance properties of soil and mudbrick materials are not well captured in single view photographs. We obtained soil and mudbrick samples from a 1973 excavation of Godin Tepe in Iran and performed a Bi-Directional Reflectance Function (BRDF) capture and analysis on the mudbrick, and both wet and dry soil samples. The resulting BRDFs can be used to render the soil and mudbrick interior architecture of the Godin Tepe site. We have done preliminary illumination studies based on direct sunlight, skydome, and annualized sky irradiance. The student will work with the existing studies, and expand them using (1) Maya 3D modeling to enhance structural details and set the site into appropriate terrain, (2) the UnReal game engine to permit real-time visual exploration of the site, and (3) global illumination rendering systems to complete additional lighting studies. In addition the student will populate the existing models with appropriate virtual human characters to help bring the ancient world to life. Computer programming and 3D modeling experience is required.

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Chris Callison-Burch

Project 1: Building a Smarter Chatbot through Better Data Collection and Evaluation

Systems like Amazon's Alexa or Apple's Siri are currently able to answer simple questions like "What is the high temperature going to be today?", or execute simple commands like "play Shake It Off by Taylor Swift". However, the fall short of being hold a conversation with a human. We propose a summer research project that is focused on building an automated dialog system or "chatbot" that is capable of conversing with a person. We will build such a system by training a deep learning model. Although several papers have been published proposing learning methods for training chatbot, they fall short because there is a lack of realistic training data.

Most training data for this task has been scraped from sources ranging from Reddit to Twitter to movie scripts. However, few of these datasets model the actual kinds of interactions users would have with a chatbot. In addition, evaluation of automatic dialog systems is typically done by having Amazon Mechanical Turkers rate the quality of the system's responses to a set of pre-selected prompts, which might not reflect the actual kinds of questions a user would ask their chatbot.

In this project, a student will develop a system to address these issues. The student will build either a standalone website or use an existing chat API such as Facebook Messenger. The system they build should allow users to converse with a chatbot and rate the quality of its responses. All conversations between the user and the bot will be stored for use in retraining the automatic dialog system to improve its responses. The student will also investigate ways to gamify this task to make it as fun for users as possible.

We are looking for an undergrad with interest in web development, chatbots, and the gamification of data collection. The student will be mentored by Prof Chris Callison-Burch and PhD students Daphne Ippolito and Joao Sedoc.

Project 2: Clustering Word Senses with Images

Many natural language processing (NLP) tasks require knowing the sense of polysemous words, which are words with multiple meanings. For example, the word "bug" can mean

1. a creepy crawly thing
2. a virus or bacteria that makes you sick
3. an error in your computer code
4. a listening device planted by the FBI

In past research my PhD students and I have looked into automatically deriving the different meaning of polysemous words like bug by clustering their paraphrases. We have developed a resource called the paraphrase database (PPDB) that lists tens of millions of paraphrases for

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words and phrases. For bug, we have an unordered list of paraphrases including: insect, glitch, beetle, error, microbe, wire, cockroach, malfunction, microphone, mosquito, virus, tracker, pest, informer, snitch, parasite, bacterium, fault, mistake, failure and many others. We used automatic clustering group those into sets like:

- set 1: insect beetle cockroach mosquito pest
- set 2: microbe virus parasite bacterium
- set 3: glitch error malfunction fault mistake failure
- set 4: tracker microphone wire informer snitch

These approximate the different word senses of "bug". Clustering requires *affinity matrices*, which measure the similarity between the paraphrases to be clustered. We use vector representations of words (sometimes called word embeddings) that are derived from neural networks in order to populate the affinity matrices.

For this project, we propose to extend our work on automatically clustering polysemous words into their distinct senses. Instead of using word vectors, we propose to use image-based vectors to populate the affinity matrix. In addition to learning about our NLP research, the undergrad researcher will learn about neural networks, how to create vector-based representations of images, how to cluster, and how to evaluate their results.

Chenfanfu Jiang

Project 1: Realistic animation of lifelike natural phenomena

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

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Project 2: Perceiving the Imperceptible through Graphics Simulation: Physics-based Scene Understanding

The goal of computer vision, as coined by Marr, is to compute what are where by looking. The current dominant methods (based on visual features through massive data machine learning) have difficulties in understanding human needs, predicting personal attention and intentions, and further assisting human through a humanoid robot. To build a machine with such capabilities, we must look for the missing dimensions that go beyond visual spectrum, which often requires to reason about the dark entities through imagination. This project targets at advancing the state-of-the-art performance for the recognition of objects, scenes, and actions through physics-based animation techniques from computer graphics. With the tool of physics, the intelligent system would be able to analysis hidden features in a scene, such as telling which chair provides more comfortability, which rock is a better choice to act as a hammer, etc. These are the cases human do well while current machine learning algorithms fail on them. The student should have experience with C++ and Python, have the fundamental knowledge of computer vision/machine learning and computer graphics. Students will work under the supervision of Prof. Chenfanfu Jiang from Penn Computer and Information Science and his collaborator Prof. Song-Chun Zhu from UCLA.

Project 3: Computer graphics simulation for medical training on surgical procedures

We have entered the "Virtual Reality Age." With the recent advances in Virtual Reality (VR) and Augmented Reality (AR) technology, immersed virtual experience is now proving beneficial and even life-changing in various industries. This research project targets at investigating technological breakthroughs needed to simulate physically plausible surgery in a VR/AR environment. The key to achieving the virtual surgery system is the creation of realistic virtual humans and interactive virtual environments. The student will assist the development of high-performance real-time graphics animation techniques and interactive tools for the dynamics of human tissue at unprecedented levels of detail. Knowledge of medicine is not required. C++ experience and computer graphics knowledge are necessary. Students will work under the supervision of Prof. Chenfanfu Jiang and his colleagues from Penn Computer Graphics group as well as collaborators from Penn medical school.

Insup Lee

Project 1: Security of the Internet of Medical Things

The PRECISE Center is looking for two talented undergraduate for a project related to the security of the Internet-of-Medical-Things (IoMT). Securing the IoMT faces challenges not addressed in the security literature. Specifically, the effects of intra/inter patient variability and

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privacy constraints (e.g., HIPAA) limits the efficacy of many techniques for embedded systems and network security. In this project, students will explore the security of IoMT devices by studying a glucometer commonly used in intensive care units (ICUs) across the University of Pennsylvania Health Care System (UPHS). Given the interdisciplinary nature of the project, students will work closely with faculty advisors (Prof. Insup Lee and Prof. James Weimer) and clinical researchers (Dr. Ping Wang, et. al). The project will entail shadowing ICU staff (nurses and clinicians) to identify and report potential attack surfaces and security vulnerabilities. Students will be expected to perform a security assessment of the device and aid the faculty advisors and their graduate student researchers in developing techniques to address discovered vulnerabilities. Applicants must have a strong academic background and programming experience (C, Java, Python, Go). Prefered candidates will have experience in embedded systems security, network security, and/or tool building.

ELECTRICAL & SYSTEMS ENGINEERING

Lee Bassett

Project 1: Engineering Diamond Devices for Quantum Spin Control Experiments

Aside from their beauty and commercial value, diamonds possess remarkable properties as a platform for future quantum technologies. Tiny defects in the diamond crystal (e.g., missing carbon atoms and/or substitutional atoms of different species) can trap single electrons, whose quantum mechanical properties -- particularly, the electron's spin -- can be precisely controlled using optics and electronics, even at room temperature. Our lab seeks to use these systems to develop applications in quantum information processing and quantum sensing.

Working with Prof. Bassett and a Ph.D. candidate in the Quantum Engineering Laboratory, a PURM student will fabricate diamond devices for quantum control experiments. The student will learn how to prepare diamond samples using shared fabrication facilities in the Singh Center for Nanotechnology; characterize diamond devices; design, build and test optical systems for spin measurements; and develop associated automation and data-acquisition software. The work requires a basic knowledge of physics, optics, and electronics, at the level of PHYS 150/151. Knowledge of CAD software and programming (especially in MATLAB) will be helpful. Training for all fabrication and characterization tools will be provided.

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Deep Jariwala

Project 1: Modulating the Optical Properties of Quantum Dots in Heteostructures

The advent of two-dimensional (2D) materials has presented unique opportunities to make electronic devices with atomically thin structures. However, the defect and oxide free interfaces of these materials also present promising avenues to interface them with other nanoscale semiconductor materials which are typically hard to interface with. One such example material system is colloidal quantum dots. Colloidal quantum dots have outstanding optical properties and are being using in commercial light emitting devices. However, many fundamental and applied challenges remain with regards to active control of their properties for device applications. In this project, we expect the students to get experience in doing a thorough literature review on nanoscale electronic and optical devices fabricated using 2D materials and quantum dots and then come up with a plan for fabricating a device which a heterostructure of quantum dots interfaces with a 2D semiconductor or insulator. Our experimental goal will be to develop a methodology to integrate 2D semiconductors with quantum dots which are in solution phase to form a heterostructure.

The student will get hands on experience on preparing 2D materials on a substrate, and then try out various techniques in the lab to interface/coat/assemble quantum dots on them. Once achieved, the project will proceed to device fabrication, optical spectroscopy and other structure characterization. The big-picture goal is to realize, tunable absorption or modulated emission from the quantum dots by tuning their properties using applied voltage when they are part of the heterostructure. The results will have implications for next generation of optical modulators and tunable emitters besides, understanding of new fundamental physics of quantum dot-2D material interaction.

Students with back ground in electrical engineering, materials science, physics or chemistry preferred.

Project 2: Tunable, Atomically-Thin, Polarization Sensitive Photodetectors ***Rising Juniors only***

The advent of atomically thin semiconductors has renewed interest in novel architectures and technologies for photon sensing applications. The van der Waals bonding nature of the 2D materials allows facile integration of these materials and their devices with existing CMOS technology. As part of this REU project we propose to demonstrate visible-light, polarization tunable photo-diode sensors using a heteorstructure of Rhenium disulfide (ReS2) integrated with Silicon. ReS2 is a van der Waals layered semiconductor with a band-gap in visible part of the electromagnetic spectrum with an asymmetric crystal structure in-plane. As a result, ReS2 transistors exhibit linear-polarization sensitive response to above band-gap photons. While this property has been investigated and demonstrated, the atomically thin nature of the 2D material

allows additional tuning of the photoresponse. In particular, as a function of change in carrier concentration the degree of polarization sensitivity can be tuned. This is because the polarization sensitivity results from the strong excitonic transitions exhibited by the ReS2. However, under high carrier density (accumulation mode) the excitonic transition gets damped and the polarization sensitivity can be reduced or completely eliminated. The ability to actively tune polarization sensitivity in photodetectors is fundamentally novel and likely to open up new applications in polarization sensitive imaging.

The devices will be fabricated on p-doped Silicon with ReS2 mechanically exfoliated and transferred on hydrogen passivated Si surface inside an inert atmosphere. Following this, the electrodes will be fabricated using photolithography, metal evaporation and lift-off and then measured under a confocal microscope using polarized laser light and semiconductor parameter analyzer. All facilities to prepare samples and measure are available in Prof. Jariwala's lab in Singh Center for Nanotechnology and the fabrication facilities are also available in the Quattrone Nanofabrication facility in the Singh Center. Student will get to assist in sample preparation, device fabrication and measurements. Student will also be involved in computational modelling and simulations. Professor Jariwala will be personally working with the student and in addition there will be other undergraduate and Master's students who will be working as team members will the student. The results will have implications for next generation of polarization sensitive photodetectors and imaging devices.

Students with back ground in electrical engineering, materials science or physics preferred.

Project 3: Controlled Diffusion for Atomically Thin Heterostructures

The advent of two-dimensional (2D) materials has presented unique opportunities to make electronic devices with atomically thin structures. Thus far, the defect and oxide free interfaces of these materials have presented avenues to interface them with other nanoscale semiconductor materials which are typically hard to interface with. This is led to several research demonstrations of heterostructures by stacking 2D materials on other types of materials. However, given the variety in electronic structure and properties available for the 2D materials, there lies a great opportunity to create entire circuits and microprocessors within the 2D atomic plane. However, the lack of systematic growth, patterning and fabrication approaches have precluded that from happening. In this project we will utilize the knowledge of conventional micro and nanofabrication techniques to create masks on top pf certain 2D semcionductors and use the ion exchange/diffusion doping strategy to create abrupt yet atomically thin heterostructures.

The student will get hands on experience in exfoliating and transferring 2D materials on semiconductor chips and then use high temperature furnace to introduce dopant into the 2D semiconductor. The resulting material will be characterized by various optical spectroscopy and

high resolution microscopy techniques. The project will have far reaching implications on an emerging technology of atomically thin circuits and metamaterials.

Students with back ground in materials science, mechanical engineering, chemical engineering or chemistry preferred.

Aaswath Raman

Project 1: Harnessing the cold of outer space to meet our growing water needs

While it might sound a bit like science fiction at first glance, the cold of outer space represents an untapped energy resource for all of us here on Earth. Remarkably, we can access this resource through the emission and absorption of electromagnetic waves – light – at wavelengths that we cannot see in the infrared part of the spectrum. Motivated by growing water stresses throughout our planet, especially in rural and urban parts of the developing world, in this project, the student researcher will explore how we can manipulate and utilize the emission of heat as light at these infrared wavelengths to improve our ability to conserve, generate and remediate fresh water.

The core of the project will revolve around numerical modeling and physical prototyping of devices that exploit this 'cold resource' by a mechanism called radiative sky cooling, to collect water from the air or desalinate water. Students will learn to use concepts and principles from the field of nano-photonics (the nanoscale interaction of light and matter) to model how we can control the radiation of heat away from a surface facing the sky to passively cool to very cold temperatures. Students will also actively engage in developing prototypes to solve the engineering design challenge of coupling this cooling mechanism to desalinate salt water or to collect water from the air. Students will gain invaluable experience in rapid prototyping and experiment design, in addition to analytical skills in understanding how to model electromagnetic and heat transfer problems. Depending on progress, opportunities may exist to participate in exciting outdoor experiments with preliminary prototypes, with supervision from the faculty member and graduate students.

Desired background includes: physics/ electromagnetics or heat transfer courses, experience with MATLAB and programming, any experience with basic shop tools, data loggers and electronics.

Project 2: Lower-cost thermal infrared camera optics for autonomous vehicles

Autonomous vehicles will need a wide array of sensors that are relatively low in cost. One category of sensors are thermal cameras, which allow the vehicle to sense and see the heat emitted from all objects at long-wavelength parts of the electromagnetic spectrum. However, key components of these thermal cameras, particular their optical components (lenses and windows) are expensive due to the lack of low-cost materials that freely transmit at this wavelength. While

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Silicon is a commonly studied material system for optics and photonics at visible and near-infrared wavelengths, its unique properties at far-infrared wavelengths are largely unexploited today. In this project, we will explore the use of low-loss Silicon as a platform for nanoscale photonic design and new optical functionality at far-infrared ('thermal') wavelengths.

The student researcher will learn to use electromagnetic simulation tools to design and optimize a range of structures that, combined with intrinsic crystalline Silicon's properties at these infrared wavelengths, will enable unique capabilities. The first goal would be to examine how to design an anti-reflection surface that would enable improved performance from a Silicon wafer to act as a 'window' for infrared transmission of light. If the design looks promising in numerical simulation, the student will have the opportunity to obtain appropriate training at the Singh center to fabricate, and then experimentally characterize its optical performance, comparing it to its predicted performance in simulations. Other related opportunities may exist to design, characterize and also analytically model and understand the optical behavior of such designs with more complex device goals in mind.

The end result of this project will be an exciting step forward towards enabling lower-cost, higher-functionality optical components for a wide range of applications, including biological sensing and autonomous vehicles.

Desired background includes: physics/ electromagnetics or heat transfer courses, experience with MATLAB and programming, any experience with basic shop tools, data loggers and electronics.

MATERIALS SCIENCE AND ENGINEERING

Eric Detsi

Project 1: 3D Reconstruction of Nanoporous Gold for Structural Analysis

(Mentor: Sam Welborn, 3DAFSN Lab)

The Laboratory for Research on the Structure at UPenn is home to the Multi-Angle X-ray Scattering facility (MAXS). This instrument allows for acquisition of structural information between 2.6-900 ?, and is especially useful for nanostructured materials. Nanoporous metals, developed by etching away components of an alloy, are referred to as bicontinuous structures, where both phases (metal and void) are continuous throughout the sample. The characteristic size of these phases depends on the particular metal, its parent alloy, the dealloying conditions, and its temperature history. In developing energy systems using the nanoporous gold as a framework for which to deposit atomically thin layers on, knowledge of these characteristic sizes is extremely useful. Our ultimate goal is to use correct model of the scattering data to extract the

nanostructure (ligament and/or pore) size distribution, and eventually use this for calculation of specific surface area of our nanoporous materials.

Several small angle scattering (SAS) models of inhomogeneous media have been proposed over the past 70 years. In 1944, Peter Debye developed a model for a system with inhomogeneous regions, which was experimentally verified in 1948 by Bueche.1 This particular experiment used visible light as a probe for fluctuations in dielectric constant, however their work can be extended for X-rays, which probes fluctuations in electron density. In Debye's model, correlations in electron density decay exponentially without any repetition. To generalize this model, Teubner and Strey modeled phases of bicontinuous microemulsions (mixtures of oil and water) and repeat distance with an exponentially damped sinusoidal function.2 Unlike Debye's model, this function displays a peak in the SAXS data, which comes from a characteristic repeat distance in the sample, but it is not ordered over long ranges. We are currently working on a model to explain our data.

The goal of the summer student will be to simulate nanoporous gold using the data from the small angle scattering data. The student will be responsible for creating a 3D visualization of the structure from the parameters extracted from the model. This figure will be used as a visual comparison to the structure obtained by tomography reconstruction.

References

1. Debye, P. & Bueche, A. M. Scattering by an Inhomogeneous Solid. J. Appl. Phys. 20, 518–525 (1949).
2. Teubner, M. & Strey, R. Origin of the scattering peak in microemulsions. J. Chem. Phys. 87, 3195–3200 (1987).

Project 2: Nitride-based MAX Phase Fabrication Using Electric Arc Furnace

(Mentor: Zeyu Wang, 3DAFSN Lab)

MXenes are a new family of two-dimensional (2D) transition metal carbides, carbonitrides and nitrides that were discovered and developed in the past decade. MXenes can be used in many applications, including lithium-ion and sodium-ion energy storage systems, electromagnetic interference (EMI) shielding, water purification and so forth. These 2D layered materials are called 'MXenes' because they are produced by selectively etching the A layer from various MAX phases and few non-MAX-phase precursors and the suffix 'ene' is added to emphasize their similarity to graphene. Herein we focus on the widely investigated MAX phases, which are a large family (60+ members) of hexagonal layered ternary transition metal carbides, carbonitrides and nitrides with composition of $M_{n+1}AX_n$. M stands for an early transition metal (such as: Ti, V, Cr, Nb, etc.), A stands for a group A element (such as: Al, Si, Sn, In, etc.), X stands for carbon and/or nitrogen, and n=1, 2, or 3. Moreover, MXenes are produced with compositions of M_2X, M_3X_2, and M_4X_3.

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There were several methods for synthesizing particular MXenes, including high-temperature etching of MAX phases and Bottom-up synthesis methods such as CVD, as well as the mostly studied wet etching methods. However, the MXene family was mostly restricted to carbides and carbonitrides, only 2 nitride MXenes have been made so far (Ti3N4 and Ti2N). The difficulty in producing nitride MXenes may be caused by two factors. The calculated cohesive energies of Tin+1Nn are less than those of Tin+1Cn, whereas the formation energies of Tin+1Nn from Tin+1AlNn are higher than those of Tin+1Cn from Tin+1AlCn. Lower cohesive energy implies lower stability of the structure of Tin+1Nn, whereas the higher formation energy of Tin+1Nn implies that the Al atoms in Tin+1AlNn are more strongly bonded, therefore requiring more energy for their extraction. Another possibility of why nitride MXenes could hardly been produced is that the lower stability of Tin+1Nn caused it to dissolve in aqueous HF solution, the etchant used to chemically exfoliate Tin+1AlNn to produce Tin+1Nn.

Goal of this summer research:

In our work, we will use advanced dealloying techniques to produce nitride-based MXene. Prior to dealloying, nitride-based MAX phases need to be fabricated and characterized. The student will assist in this process by:

1. Making-nitride based MAX phases using electric arc furnace;
2. Conducting XRD characterization on the fabricated MAX;
3. Assisting in the fabricating nitride based MXene phases from the obtained MAX
4. Conducting XRD characterization on the prepared MXene powders

Eric Stach

Project 1: Splitting water with sunlight to make hydrogen fuels

I would welcome either a rising sophomore or junior majoring in materials science, chemical engineering, chemistry or perhaps even electrical engineering. The goal of the work is to continue what is presently a Senior Design project in the MSE Department. This would allow the student to overlap with the Senior Design team at the end of the semester, to ensure that they are trained on the instrumentation.

The work involves sample preparation and photoelectrochemical characterization of catalyst materials used in the creation of so-called solar fuels. The concept is that with an appropriate catalyst, one can utilize solar energy to split water into H2 + O2, and thus the creation of a hydrogen fuel. This is an active area of research worldwide. The specific project here at Penn involves the utilization of advanced electron microscopy methods to watch this process in real time, through the exploitation of microfabricated reactors that I have been responsible for designing. The students would interact with myself, Asst. Professor Deep Jariwala (ESE), two of

my graduate students, and also the Senior Design team for a bit of overlap. If this overlap is not possible, it is OK, as the other team members can provide the necessary training.

Specific responsibilities incllude:

1. Creation of samples for real time microscopy through the use of microfluidic inkjet printing.
2. Imaging of said samples with scanning electron microscopy / scanning transmission electron microscopy.
3. Electrochemical and photoelectrochemical characterization on the benchtop.
4. Working with the graduate students and I to perform advanced scanning transmission electron microscopy studies.
5. All studies would utilize resources presently available in the Singh Nanotechnology Center.

Shu Yang

Project 1: Environmentally responsive, water harvesting and self-cooling building envelopes

Cooling currently consumes about nine percent of commercial building energy in US, and contributes significantly to urban heat island effects. As population continues to grow and more people migrate to the city: precipitation and temperature patterns have changed so much that they add considerable additional stress to keep buildings and cities cool. Established architectural treatments are not adaptive to environmental conditions unless a mechanical control is added. This project aims to create a novel building envelope for water condensation and evaporative cooling by considering the ambient temperature and humidity, surface property, and shape of the envelop. The building envelopes will harvest dew water in the early morning and later release it via evaporation, thus, dramatically reducing the cooling load of building elements. The goal is to reduce temperature at least 2-3oC on daily condensation-evaporation cycles in summer. Specifically, the student will 1) apply surface coatings to the kirigami structures in Al foils and test water collection efficiency and temperature change in the daily cycle in comparison with theoretical values. 2) Optimize the cut patterns to improve water collection efficiency. The student will have a chance to work with mechanical engineers and building energy architects.

The student will be mentored by a senior PhD student or postdoc fellow in Prof. Yang's lab.

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MECHANICAL ENGINEERING AND APPLIED MECHANICS

James Pikul

Project 1: Synthetic vascular systems for soft robotics

In this project students will create synthetic vascular systems that power soft robots. Inspired by vascular system in animals, students will develop designs for and test a network of fluid channels that pumps electrochemical storage (batteries) fluid throughout the soft robot. These fluid networks will also actuate the soft robot. Students will learn basics of energy storage as well as how to characterize and fabricate robots made from low modulus (soft) materials.

Project 2: Mechanics of self-assembled ultra-high strength materials

Structural materials play an essential role in human interaction with the physical world, from the bones that support our body to the materials that send us to space and prevent injury in accidents. Organizing the structure and chemistry of materials from the nanometer scale to macroscopic will enable the next generation of high strength and lightweight materials. In addition, nanoscale organization can add additional functionality to structural materials, like self-healing and increased energy dissipation, that will transform the way engineers design future technologies. Two principle challenges for realizing this goal are the methods for organizing and manufacturing these new materials as well as understanding how microscopic structure impacts macroscopic performance. In this project, the student will build some of the strongest materials in the world, self-assembled cellular solids, and explore how the microscopic structure of these materials impacts their mechanical performance. In the process, the student will learn the wonders of nanotechnology and develop skills in self-assembling nanoscale building blocks into macroscopic materials. They will also learn techniques for depositing metals and ceramics including electroplating and electron beam evaporation deposition. The student will then learn to characterize these materials in a scanning electron microscope while performing mechanical testing that elucidates the strength and fracture of these materials.

Michael Posa

Project 1: Modeling and Estimation of Cassie Bipedal Robot

This project will focus on dynamic modeling of the Cassie Bipedal Robot (http://www.agilityrobotics.com/robots/) to support walking and running research, in collaboration with Prof. Posa and graduate students. To best control such a robot, we must first determine an accurate model of the robot, mapping from motor control torques to motion at the

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different joints. The Cassie robot design makes notable use of large springs within the leg joints, and modeling the motion of these springs poses significant challenges. One result of this project will be a dynamic simulation of the robot that closely matches the robot itself. In addition to modeling, the student will also develop state estimation tools as needed (incorporating joint, inertial, and motion capture sensors to estimate the pose and motion of the robot). The student will gain significant experience programming a state-of-the-art bipedal robot, with a focus on the practical aspects of modeling, estimation, and ultimately control. As conducting experiments on robots like the Cassie can be difficult, students will work closely with graduate students and will also assist in the development and testing of walking control strategies.

The project will involve significant programming, and so MATLAB experience is required and C++ experience is a bonus. Undergraduate dynamics is required.

Cynthia Sung

Project 1: Reconfigurable Origami Swarms for Ocean Monitoring

Robotic swarms hold great promise for missions requiring a large spread of robots, such as ocean monitoring tasks. However, individually controlling these robots is often computationally and energy intensive. Instead, the goal of this project is to simplify swarm control by taking advantage of the latent energy in the environment. In particular, we plan to model and manipulate fluid-vehicle interactions for energy-efficient ocean monitoring using reconfigurable origami. We are specifically targetting the magic ball origami pattern, which can morph from a sphere to a cylinder. The student on this project will characterize the fluid interactions for an origami ball traveling through water at a constant speed. The student will take flow measurements using an existing water tank setup, and will analyze the data to understand the major parameters affecting the flow surrounding the origami ball. The results will be used to develop an autonomous, reconfigurable, underwater origami robot.

Students interested in this project should have experience in or be willing to learn about:

- origami / folding
- computer vision techniques such as optical flow and tracking
- mechanical design

This project is a collaboration with Dr. Ani Hsieh.

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Project 2: Origami Imaging and Modeling

Origami-inspired engineering allows new products to be fabricated as 2-D sheets and folded into their 3-D form. When the folds are not fixed, origami can be used to create entire mechanisms and even robots. However, although some kinematic models for origami exist, none of them have been verified on physical models, which often deform in unexpected ways because of material flexibility. The goal of this project is to measure the state of an origami mechanism and to quantify deviations between these physical devices and the theoretical models so that we can develop models that account for such errors. The student on the project will implement a vision-based tracking system that can be used to measure the state of an origami pattern and will use this system to track the configurations of multiple origami designs. The student will analyze this data to identify key sources of error. The results will be used to develop new models of origami mechanics that can be integrated into computational engineering design approaches.

Students interested in this project should have experience in or be willing to learn about:

- origami / folding
- transformation matrices
- vision-based tracking (e.g., using OpenCV)

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Law

Cary Coglianese

Project 1: Outsized Influence and Unfair Outcomes? Business Involvement in the Regulatory Process

Professor Cary Coglianese is working on a book manuscript on the role of business influence in the regulatory process and its contribution to the rise of economic inequality. In recent years, scholars and policymakers have increasingly claimed that regulations are biased in favor of the wealthy and powerful, and polls show that many Americans today believe that the U.S. economic system is rigged. Yet there has been relatively little empirical research that assesses the extent to which business influence in the federal regulatory process yields economic "rents" and contributes to inequality. This project will critically examine and test the claim that businesses exert an outsized and regressive influence on regulatory outcomes.

The student or students involved will play a key role in collecting and analyzing data, conducting research based on government reports and academic research studies, and assisting with drafting and revising manuscripts. Students should have completed at least one course already focused on public policy or US government. Priority will be given to rising juniors. In addition to Professor Coglianese, two Regulation Fellows at the Penn Program on Regulation at Penn Law School will be involved in working on the project and mentoring the students.

Paul Robinson

Project 1: Are We Responsible for Who We Are?

The coercive indoctrination of prisoners of war makes clear that a person's beliefs and value system can be forcibly altered against the person's will. Those views might be "inauthentic" in one sense but in another they do represent who that person is at the present. While such "brainwashing" is quite dramatic and unusual, the evidence suggests that there are other mechanisms of influence, short of the forcible brainwashing of a captive, that can have as powerful an effect in influencing who a person is. This project aims to produce a book for a general audience that explores the legal, moral, social, and psychological issues using as a vehicle a series of real-world cases. The PURM student will provide research and editing assistance.

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Project 2: Emotions and the Criminal Law

We tend to think of emotions as frequently driving conduct. In the criminal context, then, an offense committed during an emotional disturbance might seem to deserve some mitigation is compared to the same conduct performed in a cool and calculated way. In fact, the criminal law recognizes just such a mitigation possibility. On the other hand, we also have some expectation that people ought to and to some extent can control their emotions. Thus, perhaps no mitigation is deserved if a person's emotion leading to a crime is one that he or she should have controlled. Complicating matters further, there are a wide variety of emotions: hate, love, anger, fear, jealousy, despair, disgust, rage, remorse, shame, fervor, and others. Some of these emotions may prompt sympathy for a defendant while others only antipathy. This project aims to produce a book for a general audience that explores the legal, moral, social, and psychological issues using as a vehicle a series of real-world cases. The PURM student will provide research and editing assistance.

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Medicine

ANESTHESIOLOGY AND CRITICAL CARE

Maurizio Cereda

Project 1: An integrated approach to predict and improve the outcomes of lung injury

Acute respiratory distress syndrome (ARDS) is a hypoxemic syndrome characterized by the spatial propagation of inflammation in the lungs, and often requires prolonged mechanical ventilation and intensive care. Although the hospital mortality of ARDS has modestly decreased, more than 40% of patients still do not survive hospitalization. In many patients, ARDS develops or worsens during mechanical ventilation, in part because the excessive heterogeneity of lung inflation caused by ventilation worsens lung injury. For this reason, we study imaging methodologies which predict propagation of experimental lung injury during mechanical ventilation, by measuring regional inflation and perfusion in large and small animal models of early lung injury from acid aspiration. This project makes extensive use of imaging—including quantitative computed tomography (CT), dual-energy CT, and hyperpolarized magnetic resonance imaging (HP MRI)—to spatiotemporally track progression of ARDS. We then test strategies to protect healthy areas of the lung from inflammatory propagation, such as inhibitors of trans-membrane calcium transport to decrease edema, pulmonary vasodilators and/or vasoconstrictors to selectively decrease excessive blood flow in areas of inflammation, and extracorporeal circulation to enable lung rest from mechanical ventilation and facilitate tissue healing.This project will lay the foundation for future applications of imaging-based techniques to predict the risk of severe ARDS and death, attenuate its development, and monitor the progression of lung injury and the effects of novel therapeutic strategies.

Thomas Conlon

Project 1: Bedside Ultrasound Curriculum Development in an Academic Pediatric Critical Care Fellowship Program

Bedside ultrasound is an emerging technology within non-radiology and non-cardiology specialties. It allows rapid diagnostics to help guide targeted therapies within our critically ill pediatric population.

For the past 4 years the Department of Pediatric Critical Care Medicine has implemented bedside ultrasound curriculum within fellowship training. During this time our fellows have had yearly

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performance measures including written test, psychomotor evaluation, clinical image quality scores and interpretation scores. We are looking to develop a database of these measures and to produce a manuscript describing our efforts and quantifying our outcomes. We are the first academic department to have implemented this training curriculum and believe that these outcome measures are essential to moving training in the field forward.

Students are not required to have any experience in medicine, but we would require someone with a strong work ethic and interest in exploring emerging technologies within the medical field and medical education in general.

Other individuals within the department tasked with mentoring include Dr. Akira Nishisaki, Dr. Christie Glau and Dr. Adam Himebauch, all pediatric critical care physicians involved in curricular development.

Jorge Galvez

Project 1: Pediatric difficult airway diagnoses mapping to SNOMED CT terminology

Pediatric anesthesiologists rely on patient history and physical exam to identify patients that may experience difficult airway management during anesthesia care. The Society for Pediatric Anesthesia's PeDI [Pediatric Difficult Intubation] collaborative group maintains a multi-institution registry of patients with difficult airways and associated conditions.[1] Despite these efforts, the prevalence of true difficult airways for these conditions is not well defined. The Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT) is a collaboratively developed comprehensive global language for health terms. SNOMED CT describes concepts in relationships to other concepts and in various hierarchies, classifying them in common disease categories.[2,3] We applied SNOMED CT concepts to the conditions associated with difficult airway determined by the PeDI collaborative. The goal is to use the SNOMED CT concepts to determine the prevalence of difficult airway conditions at a population level.

Pre-Requisites:

- Interest in pediatric anesthesia
- Interest in electronic health record research, biomedical informatics
- Experience with database programs (Microsoft Excel, R, SQL) is helpful, but not required.

Student's responsibilities:

- Manage SNOMED terminology documentation
- Curate dataset to validate SNOMED difficult airway terminology

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- Manuscript preparation
- Students will have an opportunity to extend involvement in long-term research projects and mentorship

This project will provide a foundation to allow the student to become involved in more independent projects.

Project 2: Pediatric intravenous line placement attempts and pre-operative fasting times

Children that require general anesthesia for procedures typically undergo induction of anesthesia via a mask and subsequently have an intravenous line placed prior to undergoing airway management. Establishing vascular access in a timely fashion is paramount to patient safety, but is not always possible. Some patients may experience difficulty with vascular access during the induction of anesthesia. We are evaluating a large retrospective data-set to gain a better understanding of the relationship of the pre-operative fasting time and the success rate of establishing peripheral vascular access at The Children's Hospital of Philadelphia.

Pre-Requisites:

- Interest in pediatric anesthesia
- Interest in electronic health record research, biomedical informatics
- Experience with database programs (Microsoft Excel, R, SQL) is helpful, but not required.

Student's responsibilities:

- Curate and assist in data validation
- Scientific abstract and manuscript preparation
- Students will have an opportunity to extend involvement in long-term research projects and mentorship

This project will provide a foundation to allow the student to become involved in more independent projects

Project 3: Pediatric Patient Blood Management - Maximal Surgical Blood Order Schedule

Children scheduled for surgical procedures are at risk of hemorrhage and requiring blood product administration either during or following surgery. I am interested in analyzing data-sets that review the practice of peri-operative blood product administration for children scheduled for neurosurgical procedures at The Children's Hospital of Philadelphia. The goal is to identify patient populations with high and low blood product utilization and to create interventions to optimize pre-operative blood product allocation for patients at risk of hemorrhage, and minimize pre-operative testing for low-risk patients.

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Pre-Requisites:

- Interest in pediatric anesthesia
- Interest in electronic health record research, biomedical informatics
- Experience with database programs (Microsoft Excel, R, SQL) is helpful, but not required.

Student's responsibilities:

- Validate and assist in data validation
- Scientific abstract and manuscript preparation
- Students will have an opportunity to extend involvement in long-term research projects and mentorship

This project will provide a foundation to allow the student to become involved in more independent projects

Rachel Hadler

Project 1: Advanced care planning and the Operating Room

Roughly 2 million adults die in the U.S. each year, primarily from cancer, heart failure and chronic lung disease. Medicare data suggests that at least 45% die in an acute care setting. Although roughly one third of U.S. adults complete advance directives stating their wishes for end of life care, honoring these wishes may be complicated in the acute care setting. In this project, we are evaluating how advance directives and do-not-resuscitate orders are managed when patients require surgical or other procedural interventions. This initial project will involve development and implementation of a protocol to identify when patients with advance directives undergo interventions as well as chart review to assess how their advance directive was managed during and after the procedure. This project is a preliminary component of a larger mixed-methods project examining how we elicit and respect patient wishes in hospitals at the end of life. Engaged participants will have the opportunity to be involved in the longer-term project if desired.

Participants should have an interest in bioethics as well as in developing/ improving data collection and analysis skills. Significant biomedical knowledge not required. Student will need CITI training, although this can be completed after project selection.

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Andrew McKinstry-Wu

Project 1: Brain State Transitions and Consciousness Instability Under Anesthesia

Published work using CNS recordings in animals has shown that the brain, rather than remaining static under anesthesia, undergoes sudden transitions between a variety of distinct activity patterns. Previous work in our lab has shown that similar sudden transitions also occur behaviorally at lower anesthetic concentrations. This project will look at mouse behavioral fluctuations into and out of an unresponsive state using various drugs and exposure paradigms in order to uncover intrinsic fluctuations of the brain only displayed on the border of an anesthetized state.

Responsibilities: The student will work with mice to administer varying concentrations of inhaled anesthetics while tracking behavioral endpoints.

Requirements: The student will need to receive ULAR training to perform mouse behavioral work (easily coordinated once you join the lab), and possibly eventually rodent surgery.

Alexander Proekt

Project 1: Translational Neuroscience Initiative (TNI): Understanding the Neurobehavioral Correlate of Conscious Perception and Sensory Integration

The translational neuroscience initiative clinical science project uses a novel approach to understand the mechanisms of unconsciousness in human subjects in collaboration with Dr. Max Kelz, Dr. Alex Proekt, Dr. C. William Carspecken and Dr. Andrew McKinstry-Wu. This is a translational clinical research project with human subjects with basic and clinical scientists.

Rather than analyzing ad hoc features of EEG and evoked potentials to evaluate consciousness, the project focuses on using visual and auditory sensory stimulation with high temporal resolution to identify features of multisensory event related potentials most relevant to conscious perception. This sensory stimulation will take place in healthy subjects undergoing intravenous infusions of propofol and ketamine with the goal of understanding how the brain integrates information. High density EEG will be recorded and synchronized with sensory stimulus presentation and behavioral response. We hypothesize that anesthetics cause a disruption of ongoing brain activity to make it impossible for incoming information to be incorporated into conscious awareness.

The student will help carry out this translational clinical project in a variety of ways that can be tailored to the student's interest. The student can interact with subjects, collect data in real time during drug infusions, work closely with attending anesthesiologists on sensory stimuli paradigm

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development and potentially help build features into the visual/auditory sensory system. Ideally, students would also help with data analysis and learn more advanced topics of neurophysiologic data processing during their time on this project. Specifically, helping quantify the nature of stimulus perturbations of the ongoing brain dynamics using phase synchronization and independent component analysis. Students will have exposure to clinical research settings and a team of physicians, scientists, study coordinators, engineers and data analysts to understand anesthesiology research and develop ideas of their own under mentorship of a multidisciplinary team.

BIOCHEMISTRY & BIOPHYSICS

James Shorter

Project 1: Small-molecule enhancers of human protein disaggregases

The goal of this project is to identify drug-like small molecules that enhance the disaggregase activity of human Hsp110, Hsp70, and Hsp40.

Project 2: Engineering human protein disaggregases to counter neurodegenerative disease

Protein misfolding and aggregation unify several devastating neurodegenerative disorders, including Alzheimer's disease, Parkinson's disease, and amyotrophic lateral sclerosis. There are no effective therapeutics for these disorders and none that target the reversal of the aberrant protein misfolding and aggregation that cause disease. In the Shorter lab, we define, engineer, and apply protein disaggregases to mitigate deleterious protein misfolding and counter neurodegeneration. In this project, eukaryotic multiplex automated genome engineering (eMAGE) techonology will be employed to evolve the Hsp110, Hsp70, Hsp40 disaggregase machinery to counter TDP-43, FUS, and alpha-synuclein toxicity. Duties and responsibilities will include driving the research project, and attending and presenting results at Shorter lab group meeting.

Project 3: Isolating RNA disaggregases

A collection of devastating neurodegenerative diseases, including Huntington’s disease (HD), amyotrophic lateral sclerosis (ALS), frontotemporal dementia (FTD) and myotonic dystrophy (MD), present distinct clinical manifestations but share a common molecular etiology, the expansion of genetic repeats resulting in the production of repeat RNA. These “repeat-expansion diseases” also share a pathologic hallmark, the accumulation of RNA and RNA-binding proteins (RBPs) in intracellular aggregates. This project will explore the biogenesis of these pathologic foci through the lens of liquid-liquid phase separation (LLPS). Through the generation of novel

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biosensors, high-throughput screens, and live-imaging biochemical assays, this project will identify RNA chaperones and disaggregases capable of preventing (i.e. chaperone activity) and reversing (i.e. disaggregase activity) the aberrant phase separation of GGGGCC repeats associated with ALS/FTD, CUG repeats associated with Huntington's, and CAG repeats associated with myotonic dystrophy. The modular assays developed here can be redeployed in target-specific screens for small-molecule enhancers of the newly identified RNA chaperones and disaggregases.

Gregory Van Duyne

Project 1: Optimization of Allosteric Inhibitors of HIV Integrase

The HIV/AIDs pandemic remains a severe global burden, and the continuing emergence of resistance to existing antiviral agents continues to motivate the development of new therapies. Our group uses X-ray crystallography and solution biophysics to study the drug target HIV Integrase. The long-term goal of this research is to determine atomic-level insight into the interactions of HIV-1 Integrase with small molecules to facilitate the discovery and optimization of novel small molecules against the virus. The students involved in this project would be mentored by Kushol Gupta (Res. Asst. Professor). The work involves recombinant protein expression and purification, protein-drug complex crystallization and optimization, X-ray diffraction experiments, and ligand binding experiments using microscale thermophoresis (MST). Ideal candidates will have introductory coursework in chemistry, biology, or biochemistry and associated laboratory courses, and have a developed interest in a major in chemistry, biochemistry, or biophysics. Students will participate in all aspects of the lab, including lab meetings.

Jeremy Wilusz

Project 1: Investigating the functions of circular RNAs

Nearly all the vital functions of a cell have long been thought to be mediated by proteins. Unexpectedly, in addition to classic messenger RNA, many protein-coding genes produce circular RNAs, sometimes at very high levels. In fact, for some genes, the circular RNA is 10-fold more abundant than the associated linear mRNA. Considering that circular RNAs do not generally appear to be translated to produce a protein, their production is the exact opposite of what a gene is "supposed" to do. We, therefore, suggest that the choice between linear vs. circular RNA production may be a critical, but poorly understood way that gene functions are

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modulated. Using a combination of molecular and cell biology techniques, our laboratory aims to investigate two mechanistic questions regarding this mysterious class of circular RNAs. First, we wish to explore how the critical choice between production of a protein-coding messenger RNA versus a noncoding circular RNA is made. This mechanism must be tightly regulated as nearly every gene in the human genome theoretically can produce circular RNAs. Second, we aim to identify functions for circular RNAs, thereby revealing novel paradigms for how these noncoding RNAs can regulate many biological processes. Collectively, these studies have the potential to rewrite several fundamental paradigms of gene expression. The skills learned during these studies will be essential to students wishing to continue on in a science career, including graduate school or medical school. Prior classwork in biochemistry, molecular biology, or cell biology would be helpful.

BIOSTATISTICS, EPIDEMIOLOGY AND INFORMATICS

Mary Regina Boland

Project 1: Validating Machine Learning Model Predictions Regarding Prenatal Toxicity of Drugs

The Boland Lab focuses on studying factors that affect prenatal / perinatal development including environmental exposures that perturb appropriate development. Specifically, we focus on three areas: 1) uncovering factors that influence fertility and offspring viability; 2) gestational development and genetic and / or environmental effects that have ramifications later in life; 3) integration of clinical data (e.g., Electronic Health Records) with other datasets to reveal findings of clinical importance. As an informatics lab, we focus on developing statistical and computational algorithms to solve real-world clinical problems. Knowledge of programming and computing is not required. This specific project involves validating predictions of drug toxicity during pregnancy outlined in this paper: in external datasets including a de-identified dataset from the UK. The goal of this work is to publish a peer-reviewed publication. If the project is successful, and the results are publishable, the student would be listed as a co-author on the paper. In addition, the student will gain experience with real-world clinical datasets and some basic data mining skills.

Project 2: Integrating Public Health Datasets for Retrospective Research

The Boland Lab focuses on studying factors that affect prenatal / perinatal development including environmental exposures that perturb appropriate development. Specifically, we focus on three areas: 1) uncovering factors that influence fertility and offspring viability; 2) gestational development and genetic and / or environmental effects that have ramifications later in life; 3)

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integration of clinical data (e.g., Electronic Health Records) with other datasets to reveal findings of clinical importance. As an informatics lab, we focus on developing statistical and computational algorithms to solve real-world clinical problems. Knowledge of programming and computing is not required. This specific project involves integrating many publically available government datasets including data on smoking status, alcohol usage, etc. from across the USA. In addition, data from credit card expenditures will also be used to add to the government data. The goal of this work is to use this integrated dataset for several peer-reviewed publications. If the project is successful, and the results are publishable, the student would be listed as a co-author on the paper and/or papers. In addition, the student will gain experience with real-world government datasets, issues with integrating disparate datasets, and some basic data mining skills.

Jinbo Chen

Project 1: Analysis of data from electronic health records

Clinically relevant information from electronic health records (EHRs) permits derivation of a rich collection of phenotypes. Unfortunately, since the data is primarily collected for clinical rather than research purposes, the true status of any given individual with respect to the trait of interest is not necessarily known. A common study design is to use structured clinical data elements to identify case and control groups on which subsequent analyses are based. While controls can usually be identified at high accuracy through rigorous selection criteria, the stringency of rules for identifying cases needs to be balanced against the achievable sample size. The inaccurate identification results in a pool of candidate cases consisting of genuine cases and non-case subjects. This project develops statistical methods for correcting bias in analyzing electronic health records based case-control studies.

Project 2: Statistical methods for phenomewide association studies

The linkage between Electronic Health Records (EHRs) and genotype data makes it plausible to study the genetic susceptibility of a wide range of disease phenotypes. Phenome-wide association studies (PheWAS), which examines a range of EHR-derived phenotypes simultaneously, has been shown useful for discovering susceptible genes. The analysis of PheWAS faces many challenges, however, including the high-dimensionality and inaccuracy of phenotypes. This project develops powerful statistical methods for analyzing PheWAS.

Project 3: Statistical methods for risk prediction

For predicting binary outcomes, it is common that a subset of predictors are measured only for a selected subgroup of subjects. To analyze such incomplete data for model development and

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validation, the statistical efficiency for estimating measures of predictive accuracy critically depends on effective use of completely observed data. This project considers efficient study design and analysis issues with incompletely collected data for developing and evaluating risk prediction models, with applications to predicting the risk of breast cancer.

Karen Glanz

Project 1: The Impact of Healthy Food Marketing Strategies in Supermarkets

As the prevalence of obesity has increased, public health experts have increasingly focused on environments that shape overeating and unhealthy food choices and retail grocery stores are pivotally positioned to influence choices.

The goals of the "Impact of Healthy Marketing Strategies in Supermarkets" study are:

1) to evaluate the effects of in-store healthy food marketing strategies on sales and purchase of healthier items in six product categories;
2) to evaluate the association of changes in supermarket food marketing environments with changes in sales of specific healthier food items in the same six product categories; and
3) to examine the relationships between neighborhood characteristics and changes in sales and purchases of healthier items in the six product categories.

The study is being conducted in 33 supermarkets in urban, low-income, high-minority neighborhoods in Pennsylvania, New Jersey, and Delaware. Intervention strategies include prime placement, increased visibility of healthier products, call-out signs, and taste-testing for milk. Control stores are assessment-only. Interventions are being conducted for 2 years and the primary outcome measures of purchasing is weekly sales per store for each product.

Students will assist with participant recruitment and survey completion, observational data collection, data analysis, and other research activities as needed. Data collection will take place in the supermarkets so comfort and willingness to conduct fieldwork is necessary.

Donna Paulhamus Giordano is the research manager on this project and would also be involved in mentoring the student(s).

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Graciela Gonzalez Hernandez

Project 1: Social Media Mining for Health Applications

The student will participate in developing and validating text mining tools applied to social media text, including concept discovery (classification) and extraction, and assist in data analysis of the collected data. Health-related posts are analyzed for trends in medication use, adverse effects, and life events that impact health.

Prerequisite: Students should have mastered the basics of programming in Java or Python.

This project lead developer is Dr Abeed Sarker, Research Associate in Dr Gonzalez's lab, who will be assisting in mentoring the undergraduate student.

Project 2: Integrated knowledge for geographic location determination

The student will participate in developing and validating text mining and knowledge discovery methods applied to published literature and other sources (such as GenBank records or social media text) to ellucidate the most granular geographic location associated with the GenBank record or other source data point. The extracted location will then be used for automatic analysis of geo-located trends.

Prerequisite: Students should have mastered the basics of programming in Java or Python.

This project lead developer is Dr Davy Weissenbacher, Research Associate in Dr Gonzalez's lab, who will be assisting in mentoring the undergraduate student.

Blanca Himes

Project 1: Characterizing Air Pollution and Environmental Variables in Philadelphia and Relating them to Asthma Exacerbations

Asthma is a chronic inflammatory lung disease that affects over 25 million Americans. Marked disparities in asthma prevalence and outcomes 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. Students will collect data with personal particulate matter sensors, obtain publicly available data (related to air quality, pollution, litter and housing), and analyze data to identify relationships among these variables. 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

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for research experience as preparation for graduate or medical school, or a position that requires data analysis.

Mingyao Li

Project 1: Developing a Computational Tool to Detect Differential Alternative Splicing by Bulk and Single-Cell RNA Sequencing

The Statistical Genetics and Genomics Lab, led by Dr. Mingyao Li, in the Department of Biostatistics, Epidemiology & Informatics, develops and implements cutting edge statistical and computational tools to analyze high-throughput genomics data generated from bulk RNA and single-cell RNA sequencing studies. RNA sequencing has revolutionized transcriptomics studies due to its ability to profile the entire transcriptome in an unbiased fashion. Knowledge in transcriptomic variations is critical for understanding how genes are regulated in response to internal and external conditions. A major mechanism for generating transcriptomic variations is alternative splicing, a biological process that leads to the generation of different transcript isoforms, which are then translated into functionally unique proteins. It is critical to study alternative splicing and understand how it is altered in different conditions. However, detecting differential alternative splicing using RNA sequencing data is computationally challenging. In this PURM project, the student will work with Dr. Li to develop a fast computational tool to detect differential alternative splicing using both bulk and single-cell RNA sequencing data. This tool is based upon a method we recently developed for differential alternative splicing analysis. The goal of this project is to improve the computational speed by utilizing transcript compatibility counts obtained from pseudoalignment of RNA sequencing reads. The student is expected to perform simulations to evaluate the performance of this tool, and apply it to analyze real RNA sequencing datasets. The prerequisites of this project are programming skills (R, Perl, Python) together with background in mathematics, probability and genetics.

CANCER BIOLOGY

Luca Busino

Project 1: Chemical proteomic to identify drug targets

Small molecule–mediated inhibition of protein function is the rational behind therapeutic efficacy of the majority clinically used drugs. Many small molecules developed so far have

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failed in their attempt to reach clinic because of lack of understanding of the intracellular targets. In the attempt to develop methods to identify drug targets, we have have combined our expertise in studying E3 ligase and protein degradation.

Protein degradation is the result of covalent attachment of chains of the small protein ubiquitin, which allows recruitment to the proteasome for proteolysis. The ubiquitin–proteasome system is catalyzed in a stepwise enzymatic cascade in which ubiquitin is activated by an E1 enzyme, transferred to an E2 ubiquitin-conjugating enzyme, and then transferred to a substrate specified by an E3 ubiquitin ligase. Recently, a novel technology has revealed how to generate proteolysis targeting chimera molecules (PROTACs) to directly recruit an ubiquitin ligase enzyme (an enzyme that specifically target cellular proteins for irreversible degradation) by reprogramming its function to a chosen target protein to induce its degradation. The new adapter molecule show higher potency compared to the parental compound, resulting in rapid destabilization of targets via ubiquitin-dependent proteasomal degradation at sub-nanomolar concentration. Utilizing phthalimide-based adaptor compounds couple to mass spectrometry, this project aims in elucidating the chemical proteome of drugs.

Roger Greenberg

Project 1: Synthetic lethality in BRCA mutant cancers

This project will explore CRISPR-Cas9 screening technologies to identify genetic requirements for viability in cells that harbor mutations in the breast and ovarian cancer suppressor genes BRCA1 or BRCA2.

Project 2: Mechanisms of alternative telomere lengthening

This project will explore molecular mechanisms of alternative telomere lengthening, which is required for cellular survival in approximately 15% of human cancers

Sandra Ryeom

Project 1: The role of the tumor microenvironment in pancreatic cancer

In this project, the student will learn how to generate murine pancreatic organoids with pancreatic epithelial cells, fibroblasts and endothelial cells and examine how different genetic backgrounds for each of the cell types regulates extracellular matrix production. The student will

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learn how to isolate each of these cell types from mice, will learn how primary cell culture, the generation of organoids and will learn how to assay for extracellular matrix production.

Project 2: Endothelial cell activation and lung fibrosis

In this project, the student will examine how activated lung endothelial cells contribute to lung fibrosis using both mouse models and lung organoids. The student will learn how to generate lung organoids and will assay the secretome of endothelial cells isolated from mice with different genetic backgrounds. The student will get experience in mouse work, primary cell culture, organoid generation and biochemical techniques.

CARDIOVASCULAR MEDICINE

Yuchi Han

Project 1: Reproducibility of automated measurement of cardiac volume and function

Artificial intelligence (AI) has rapidly entered the field of medical imaging post-processing. We are going to use a first of its kind software Suiteheart with AI enabled to assess the reproducibility of a thousand cardiac MRI cases to show that a novice at cardiac magnetic resonance (CMR) - an undergraduate student could get results that are highly reproducible and similar to CMR experts. We will aim to publish our results in an abstract that is due in September 2018 and eventually as a paper. Dr. Yuchi Han will be mentoring the student. The student will be trained to use the software and process routine CMR images.

Project 2: Change in diastolic parameters predict left ventricular assist device thrombosis

We will conduct a case control study matching our 40 or so left ventricular assist device (LVAD) thrombosis patients with end-stage heart failure with 40 gender, age, LV function matched LVAD patients without device thrombosis to see if temporal change in echocardiographic diastolic function parameters predict pump thrombosis. The diastolic function parameters that we will measure include mitral inflow velocities and tissue Doppler velocities. We would also include other parameters such as septal wall position and cannula color Doppler pattern and peak flow. The student will learn to analyze echocardiographic images and data. We will aim to submit an abstract and eventually a paper. Dr. Yuchi Han and Dr. Edo Birati (heart failure specialist) would be mentoring.

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Yuli Kim

Project 1: Integration of patient-generated data into electronic health records: pilot study in a cardiology clinic

The delivery of high quality care coordinated amongst a team of health care providers depends on the electronic health records (EHR). Patients can play a more active role in their healthcare by logging into a patient portal and becoming participants in the creation and maintenance of their health records. This phenomenon is known as patient-generated health data (PGHD), which the US Department of Health and Human Services' Office of the National Coordinator of Health Information Technology defines as "health-related data created, recorded, or gathered by or from patients (or family members or caregivers) to help address a health concern."

The Philadelphia Adult Congenital Heart Center serves the cardiac needs of adults with congenital heart disease. Our patients are young adults around 20-40 years of age and are high utilizers of the EHR. We are committed to patient-centered care and are invested in piloting a program integrating patient-generated data as a means to increase patient involvement in their EHR. We seek to improve patient satisfaction with their clinic visit and hypothesize that integration of PGHD can improve efficiency to the workflow during the visit. Through an app on a tablet, the patient can access and contribute to their health records in the waiting area which can be reviewed during the visit with a clinician.

In collaboration with the Principle Investigator and the Program Manager, the student will help design a study comparing patient satisfaction and clinic visit times of patients who are invited to participate in a tablet-based questionnaire compared to those who do not. He/she would administer surveys to patients to examine their overall satisfaction with their visit and track the clinic visit times from beginning to end. The student will then be able to analyze the data and write up the findings with the goal of presenting (if accepted) the findings at a local or national meeting.

Victoria Vetter

Project 1: Automated External Defibrillators (AEDs) in Philadelphia Public Schools: Implementation of Cardiac Emergency Response Programs in Schools

Youth Heart Watch (YHW) at The Children's Hospital of Philadelphia (CHOP) an affiliate of Project ADAM® has two components, a primary prevention program, the Heart Health Screening Study (HHSS), and a secondary prevention program, Youth Heart Watch School Automated External Defibrillator (AED) Program. YHW is committed to making AEDs available to all children and adolescents by being a resource for implementing pediatric public

access defibrillation programs, including cardiopulmonary resuscitation (CPR) and AED training, as well as working toward eradicating sudden cardiac death through research, education, prevention and advocacy. The overall purpose of the Youth Heart Watch School AED Program is to help all schools start and sustain a public access defibrillation program. Since 2001, AEDs have been placed in some schools in the state of Pennsylvania. In Philadelphia, all public high schools, middle schools and now elementary schools have AEDs. Pennsylvania State Law (ACT 35: 2014) mandates that schools report the presence of their AEDs, but many have not complied with this mandate. We are reviewing these placements in all schools in the state. We have developed a REDCap (scientific database) survey for schools in Pennsylvania. The student would participate in evaluation of existing placements using this database, and help in the plans of the implementation of the Youth Heart Watch School AED Program. Follow-up studies on these schools and the implementation of their AED programs is greatly needed. This would involve directly interacting with the schools, both those who have responded to our AED survey and those who have not, to determine the current status of their AED. Are batteries ok? Have pads been replaced? Is the AED in an accessible location? Are trained personnel aware of its location and on site at all time? Does the school have a Cardiac Emergency Response Plan (CERP)? The student would be directly involved in collecting and analyzing this information. This is an ongoing activity and the student could participate in visits to the schools to see how an AED based Emergency Medical Program in the schools is implemented. In addition, the student would have the opportunity to shadow pediatric cardiologists in their clinics at CHOP and learn about conditions for which AEDs may be needed.

Project 2: Prevalence of Undiagnosed Heart Disease in a Community Screening Cohort and Comparison of Electrocardiographic Screening Models

Sudden Cardiac Arrest (SCA) is a life-threatening emergency that occurs when the heart suddenly and unexpectedly stops beating, caused by an abnormality in the heart's rhythm or electrical system called ventricular fibrillation (VF), which causes the heart to stop. Sudden Cardiac Death (SCD) occurs if emergency treatment with cardiopulmonary resuscitation (CPR) or an automated external defibrillator (AED) or spontaneous recovery does not occur. It is estimated that SCA claims the lives of approximately 2,000 -10,000 children and adolescents each year in the United States (US), accounting annually for approximately 5% of all childhood deaths in children aged 5-19 years, with a reported incidence of 3–8/100,000. It has been stated that between 0.2 and 0.7% of the young population has a condition associated with SCD. The best way to prevent this occurrence in youth is controversial with little evidence for the current screening method of history and physical exam alone vs. adding an electrocardiogram (ECG), which has shown improved efficacy to identify SCA associated conditions compared to history and physical exam alone. The Heart Health Screening Study (HHSS) began in 2005 to evaluate the feasibility of adding an ECG to cardiac screening of school-aged children to identify those with conditions that are associated with SCA. Approximately 75-80% of conditions associated with SCA can be identified or suspected from a simple ECG. Over the past 11 years, we have

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been involved in a screening effort that has used three different ECG screening models, a Cardiology Office model, a Community model (schools, churches, recreation centers), and a Pediatric Office model. We have around 4500 children in our ECG screening database. The student(s) involved in this ongoing project would learn data input and database cleaning, data analysis, and would participate in this research to help determine the prevalence of these conditions in our population who have had ECG screening. Additionally, we hope to identify the best practices using the different screening models, and how this may vary by the demographic characteristics of the population. The student would learn how to develop a clinical research question and the methodology for research design and data analysis. In addition, the student would have the opportunity to learn to interpret ECGs and to shadow pediatric cardiologists in their clinics at CHOP and learn more about the clinical aspects of these conditions that cause sudden cardiac death, as well as the treatments applied to prevent this occurrence.

Project 3: Utility of Electrocardiograms (ECGs) in Children with ADHD (Attention Deficit Hyperactivity Disorder)

Sudden cardiac arrest occurs in children with an incidence of 3-8/100,000 person-years or 2000-10,000 children annually. It is frequently associated with structural congenital cardiac conditions, such as hypertrophic cardiomyopathy or electrical conditions, such as long QT and Wolff-Parkinson-White syndromes. Half of affected children are undiagnosed until the sudden cardiac arrest occurs. Medications, toxins, and other substances such as stimulants can trigger sudden cardiac arrest in susceptible children. In 2005, Health Canada suspended Adderall XL from sales in Canada. This was associated with FDA information that several children on Adderall had experienced sudden cardiac death and that some of these were found to have previously undiagnosed cardiac conditions. Although Adderall has been reinstated, there are now warnings on all stimulants that these medications “generally should not be used in children with structural cardiac disease.” In 2008, the AHA published a Scientific Statement suggesting that it could be useful to obtain an ECG prior to starting stimulant medications to increase the sensitivity of identifying underlying undiagnosed cardiac conditions. This was met with concerns regarding false positives and about the cost of such a recommendation. Others supported the effort. This controversy still exists with little data about the impact of ECGs in this population. Since 2006, over 500-1000 children/year have had ECGs prior to stimulant medication for ADHD at Children’s Hospital of Philadelphia (CHOP). This research project would involve identifying and evaluating these ECG findings in this population and reporting the results along with the lead author of the original AHA Statement (current CHOP cardiologist). The student involved in this project would learn database development, data entry, and data analysis. In addition, the student would have the opportunity to learn to interpret ECGs and to shadow pediatric cardiologists in their clinics at CHOP.

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CELL AND DEVELOPMENTAL BIOLOGY

Mary Mullins

Project 1: BMP receptor signaling interactions in the disease Fibrodysplasia Ossificans Progressiva

Our lab project, investigating the BMP receptor signaling interactions in the disease Fibrodysplasia Ossificans Progressiva (FOP), is well suited for students interested in translational research, developmental biology, and signaling. FOP is a rare human genetic disorder that causes formation of bone in extraskeletal sites. Classical FOP is caused by a single nucleotide substitution in the bone morphogenetic protein(BMP) receptor, ACVR1. This mutation results in over-activation of BMP signaling, however, the mechanism through which the mutant receptor confers enhanced signaling activity remains uncertain. To assay for mutant ACVR1 activity, we use a zebrafish embryonic patterning assay that allows us to detect small changes in BMP signaling activity in the embryos. The goal of our project is to determine the ligand and receptor partners that are involved in signaling through the mutant receptor and how it differs from the normal receptor. In addition, we are using the zebrafish to assay for potential treatments for FOP.

The Graduate student working on this project is a VMD-PHD candidate and would be able to provide insight into pursuing a career in both research and veterinary medicine. Our lab holds weekly lab meetings, and attends a weekly meeting focused on zebrafish research and many other talks that students interested in expanding their knowledge would be able to attend. Technical skills that would be learned/used in the project include: mRNA synthesis, mRNA microinjection, PCR, embryo phenotyping, and cloning. In addition, students would have the opportunity to learn fish husbandry skills in the University of Pennsylvania fish facility.

DERMATOLOGY

Sarah Millar

Project 1: Role of Wnt inhibitors in skin regeneration

Wnt/beta-catenin signaling plays key roles in regulating natural regenerative processes in the skin, including cyclical hair growth and continuous replenishment of the epidermis. In addition, this pathway is activated to permit formation of new hair follicles when the skin is wounded. Activity of the Wnt pathway is regulated by several classes of endogenous Wnt inhibitors. Our

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preliminary data indicate that these inhibitors function in postnatal skin to limit hair follicle formation and growth as well as other regenerative processes. The goal of this project is to further test this hypothesis using mice that genetically lack different combinations of Wnt inhibitors, together with application of small molecules that block inhibitor activity. These experiments have the potential to identify methods for improving hair growth and post-wounding skin regeneration. The student would be responsible for breeding and genotyping genetically modified mice, and analyzing skin phenotypes using histological, immunostaining and qPCR approaches. The student would be co-supervised by the PI, Dr. Millar, and Dr. Mingang Xu, a senior Research Associate. Course work in molecular biology and some previous lab experience is an asset.

Project 2: Role of the Wnt receptor Frizzled2 in hair follicle growth

Wnt signaling molecules activate several different downstream pathways. Our genetic experiments in mice revealed that Frizzled2 (FZD2), a Wnt receptor, mediates both canonical (beta-catenin) and non-canonical signaling in the skin, and is required for normal hair follicle growth and for epidermal homeostasis. The goal of this project is to delineate the precise roles of FZD2 in postnatal skin and hair follicles using genetic tools to specifically delete this receptor in different skin stem cell populations. The student would be responsible for breeding and genotyping genetically modified mice, and analyzing skin phenotypes using histological, immunostaining and qPCR approaches. The student would be co-supervised by the PI, Dr. Millar, and Dr. Donna Brennan-Crispi, a post-doctoral fellow. Course work in molecular biology and some previous lab experience is an asset.

Project 3: Regulation of hair follicle stem cell quiescence

We have identified a transcription factor that appears to maintain quiescence of hair follicle stem cells. The goal of this project is to define the precise roles of this factor by deleting it in different domains within the hair follicle, and identifying its transcriptional target genes. The student would be responsible for breeding and genotyping genetically modified mice, and analyzing skin phenotypes using histological, immunostaining and qPCR approaches. The student would be co-supervised by the PI, Dr. Millar, and Deborah (DJ) Moran, a graduate student. Course work in molecular biology and some previous lab experience is an asset.

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Susan Taylor

Project 1: Social Media Based Survey of African American Females with Central Centrifugal Cicatricial Alopecia

Central Centrifugal Cicatricial Alopecia (CCCA) is a form of scarring alopecia that occurs almost exclusively in women of African decent. There is a paucity of data regarding etiology, genetics, associated factors, quality of life and evidence-based treatment. This project is a Social Media Based Survey to assess in an African American female population, associations between CCCA and a patient's hair texture, childhood hairstyles and grooming practices and product use. The second survey designed to acquire data through a Social Media Survey of the association of CCCA and geographic location, environmental exposures and a history of childhood inflammatory illnesses. The PURM student involved in this study will be integrally involved in the work of the Department of Dermatology CCCA Hair Group which consists of the Chair of Dermatology, George Cotsarelis, MD, Dermatopathologist John Seykora, MD, PHD, Pediatric hair investigator, Leslie Castelo-Soccio, MD, PhD, and Temitayo Ogunleye, MD who along with myself maintain clinics specializing in hair disorders and perform CCCA research. The student will engage in identifying and monitoring appropriate social media groups on Facebook and Instagram, posting the survey questionnaires, data collection and analysis. The student must have an interest in social media as a tool to obtain important medical data. We look forward to exposing and mentoring a student interested in attending medical school, who can work in a culturally competency manner with African American populations.

EMERGENCY MEDICINE

Benjamin Abella

Project 1: Cardiac arrest and post-arrest care best practices

Our dynamic clinical research team studies cardiac arrest, CPR and outcomes following successful resuscitation. Over 300,000 people suffer cardiac arrest each year in the US, yet only 10% of these victims survive to hospital discharge, highlighting the need for increased research to improve survival.

We actively collect in-hospital data on patients who survive cardiac arrest, allowing us to study critical care interventions to change outcomes. For example, many patients following cardiac arrest receive targeted temperature management (TTM), where they are intentionally cooled to preserve brain function - we collect temperature data on cardiac arrest survivors during TTM,

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allowing us to ask questions such as: does the method of TTM affect survival from cardiac arrest? How well do we manage to control temperature and does it matter?

As a summer project, a student would have access to this unique data set and would work closely with members of our team to craft a key question on post-arrest care that could lead to a focused project with clinical impact at Penn and beyond. We are particularly interested in temperature variability among post-arrest patients and a project will likely be focused on this. The only prerequisites for the successful student is an interest in clinical medicine (pre-med students or students with Emergency Medical Services experience) and an interest in data analysis. The student will meet weekly with myself and other members of our research team to review progress and guide the project.

Zachary Meisel

Project 1: The Life STORRIED Study: Life Stories for Opioid Risk Reduction in the ED

The Center for Emergency Care Policy and Research (CECPR) falls under the Department of Emergency Medicine at the University of Pennsylvania and is home to multiple health service research projects. One such research study, The Life STORRIED Study, focuses on opioid misuse prevention and involves enrolling patients in the ER who present with acute back or kidney stone pain. The study compares the effectiveness of 3 strategies to inform patients of their risks associated with opioid misuse after treatment in the ED with these acute care issues. The objective is to explore the role that engaged patients can play in minimizing the risk of opioid misuse while achieving adequate pain relief. The three strategies used to communicate risk of opioid misuse include patient narratives of people who have experienced addiction through prescriptions for pain, a risk tool that generates an individual risk level of developing opioid misuse, and a generalized risk sheet that is given to all patients in the study.

Students involved will gain a strong understanding of topical public health research that aims to impede the opioid epidemic, a current national crisis. Students will gain firsthand knowledge of how the research process works from protocol development to implementation. There will be opportunities to assist in the enrollment process, and to engage with clinicians, research staff, and research participants. Students will also have the opportunity help with research papers, presentation preparation, and other writing opportunities as they arise.

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FAMILY & COMMUNITY HEALTH

Carolyn Cannuscio

Project 1: Reducing the harms of the opioid epidemic

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

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

Peter Cronholm

Project 1: Penn Relays Injury Study

Penn Sports Medicine provides medical coverage for The Penn Relays Track and Field Carnival, a 3-day international event which is the longest standing and largest track and field event in the country. We have injury data from 2010-2017 which we would like to retrospectively review and analyze for multiple potential publications. Our student researcher would be involved in all facets of the project including literature review, data analysis, and manuscript writing.

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The student will gain experience in evaluating longitudinal data in a clinical setting related to Primary Care Sports Medicine. The student will learn the academic skills of starting a research project and writing a manuscript. The student will also have the opportunity to shadow our sports medicine physicians in the outpatient office to gain a better clinical perspective of the research data, as well as experience a career in Primary Care Sports Medicine. This research project would be beneficial to students considering a career in medicine.

Mentors: Peter Cronholm, MD, Kristopher Fayock, MD, Rahul Kapur, MD. Dr. Cronholm will be overseeing the research project. The student will spend most of their time directly with Drs. Fayock and Kapur with data analysis and in the clinical setting.

Project 2: Philadelphia Public School Athletic League Injury Study

Penn Sports Medicine is the designated medical provider for the Philadelphia Public School Athletic League. The league encompasses all public high school and middle school athletes in the greater Philadelphia area. We have an injury tracking database that helps our athletic trainers and physicians in communicating and organizing clinical care for the athletes. The goal of this research project is to organize a database that will maintain the data each year and allow analysis for research purposes. This will provide data that we may be able to publish, but will also provide opportunities to improve clinical care of these student-athletes.

The student will gain experience in evaluating longitudinal data in a clinical setting related to Primary Care Sports Medicine. The student will learn the academic skills of starting a research project and hopefully writing a manuscript. The student will have the opportunity to shadow our sports medicine physicians in the outpatient office to gain a better clinical perspective of the research data, as well as experience a career in Primary Care Sports Medicine. This research project would be beneficial to students considering a career in medicine.

Mentors: Peter Cronholm, MD, Kristopher Fayock, MD, Rahul Kapur, MD. Dr. Cronholm will be overseeing the research project. The student will spend most of their time directly with Drs. Fayock and Kapur with data analysis and in the clinical setting.

GENETICS

Laura Almasy

Project 1: Neurodevelopment: Genes, Environment, and their Interactions

Genes influence how cognitive ability, neuroanatomy, and neurophysiology mature in normally developing children and adolescents; however, the exact genes that influence these

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developmental processes are unknown. As many mental illnesses appear to have neurodevelopmental origins, the identification of genes that influence neuromaturation may provide important clues concerning the biological processes involved in a variety of disorders. We are utilizing novel analytical approaches to investigate genetic and environmental influences on variation in brain, cognition, and behavior from a developmental perspective, modeling complex effects in both the genetic and environmental realms, and potential interactions between them, while allowing for changes in these effects across development. This project will involve conducting computational analyses to identify genes influencing neurodevelopment and assess whether the effects of associated loci change with age or with environment. This "dry lab" project is well suited to students with a basic knowledge of genetics and an interest in learning novel methods of computational analysis. The student who works on this project would gain experience with genetic analysis of quantitative traits, genome-wide association analysis, variance component models for genetic analysis, and gene-environment interaction models. Data is already in hand and ready for immediate analysis. Students will have a chance to interact with a collaborative group of investigators across the US and will be invited to be a co-author on publications and presentations reporting the results of these analyses.

Project 2: Transcriptional Correlates of Psychosis

For complex human disorders, such as schizophrenia, it is becoming clear that much of the well-established heritability of these conditions is due to regulatory variation, affecting the 'where', 'when', and 'how much' of gene expression rather than the 'what' of protein coding sequence itself. We are studying both human gene expression measured from readily available tissues (e.g. lymphocytes) and gene expression in highly relevant but inaccessible tissues (e.g. brain) inferred via computational imputation to identify genes whose expression levels are correlated with risk of psychosis and associated cognitive risk factors. This project will involve conducting computational analyses to identify genes whose expression is correlated with psychiatric diagnosis and/or neurocognitive performance. This "dry lab" project is well suited to students with a basic knowledge of genetics and an interest in learning novel methods of computational analysis. The student who works on this project would gain experience with genetic analysis of quantitative traits, transcriptional imputation, and variance component models for genetic analysis. Data is already in hand and ready for immediate analysis. Students will have a chance to interact with a collaborative group of investigators in the US and abroad and will be invited to be a co-author on publications and presentations reporting the results of these analyses.

Beverly Davidson

Project 1: Gene editing for dominantly inherited diseases

Research in the Davidson Laboratory is focused on inherited genetic diseases that cause central nervous system dysfunction, with a focus on dominant genetic diseases, specifically the CAG

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repeat disorders Huntington's disease (HD) and the spinocerebellar ataxias (SCAs). Treatments for these disorders are currently limited to symptomatic intervention. Reducing expression of the dominantly inherited, gain-of-function gene products, either by RNA interference (RNAi) or genome editing (CRISPR) are promising approaches that are in development in the lab for testing in mouse models for eventual translation to the clinic. Students would be involved with generation and screening of CRISPR guide sequences in vitro for the SCA 1 studies, and will benefit from the larger group working on gene editing for HD and SCA2. Work will involve cell culture, cloning, and analysis by molecular biology and biochemical techniques.

Eric Joyce

Project 1: Regulation of chromatin folding

Students will participate in the study of how chromosome behavior and positioning influence gene function, with implications for gene regulation, genome stability. Using the Drosophila model system in combination with genetic, molecular biological, and computational tools, students will screen for genes involved in long-range chromatin interactions. Candidate genes will then be cloned and expressed in cells to elucidate how they alter genome folding and gene expression. This project can be carried out by two students concurrently and, if desired, may be extended into the school year. No prior research experience is required.

Iain Mathieson

Project 1: Extending genome-wide association studies to diverse populations

Genome-wide association studies (GWAS) have been enormously successful at revealing the genomic basis of common diseases. Most diseases and traits are affected by tens of thousands of genetic variants in hundred or thousands of genes. However, the vast majority of association studies have been carried out in populations of European ancestry and it is questionable whether or not these results will translate to non-European ancestry populations. This project will try to answer that question, by testing whether predictions made using European GWAS results make sense in non-European populations. Initially we will use existing prediction methods, but the ultimate aim would be to develop new methods which can correct for some of the differences which are likely to affect the prediction. This project would be ideal for a student who would like to gain experience in modern computational biomedical and genomic research. Some previous statistical and/or programming (in R or python) experience would be an advantage, but no biological or medical knowledge is needed.

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Project 2: Population structure in Mesolithic European hunter-gatherers

The Mesolithic (pre-agricultural) inhabitants of Europe were largely overshadowed starting around 8,000 years ago, when the first farmers of Europe migrated from Anatolia to Europe. Traces of their genetic ancestry in present-day people are obscure. The new technology of ancient DNA extraction allows us to sidestep this problem by directly analyzing the genomes of these ancient people. This project will involve computational analysis of genetic data from around 50 ancient Europeans to test how closely related they are to one another, and whether present-day people are more closely related to ancient Europeans from one part of Europe than another. This project would be ideal for a student with interests in anthropology or archaeology who wants to gain some experience with the analysis of ancient DNA data or alternatively, a student with a more statistical or computational science background who is interested in how those skills can be applied to other disciplines.

Jason Moore

Project 1: Artificial intelligence analysis of biomedical data

We have developed an accessible artificial intelligence (AI) system for the analysis of biomedical data. Our PennAI software is easy to use and takes the guesswork out of using computational methods to analyze data. More information about PennAI can be found at http://pennai.org. Projects could involve applying PennAI to the analysis of research data or could involve the development and testing of new algorithms or methods for PennAI. Those with and without knowledge of computer programming are all welcome.

Project 2: Video game visualization of biomedical data

We have developed a method for using video game engines like Unity 3D to facilitate the visualization of biomedical data. This project would involve video game engine programming. No experience with video game engines is needed but some programming experience is required. For an example see this paper:

http://www.worldscientific.com/doi/abs/10.1142/9789814335058_0017

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Dan Rader

Project 1: Why are adults referred for clinical genetics evaluation?

Adult genetics is a growing field, particularly with increased recognition of the availability of these services and increased knowledge about inherited conditions. More adults are being tested for genetic disorders and more children with genetic disorders are living into adulthood. Limited information is known about what prompts adults to seek a clinical genetics evaluation outside of the context of prenatal or cancer genetic counseling. The Hospital of the University of Pennsylvania provides comprehensive clinical care for adults with known or suspected genetic disorders. The Division of Translational Medicine and Human Genetics comprises 3 clinical geneticists, one nurse practitioner, two genetic counselors and a clinic coordinator, and see approximately 1000 patients per year. The student will perform a chart review of patients evaluated in the division and data will be collected as to the reason for referral, genetic testing that was performed, and the results of this testing. As part of this project, the student will shadow within the outpatient Medical Genetics clinic with members of the clinical team. It is expected that the student will be the first author on the manuscript that they will write for publication. This project will be an excellent introduction to clinical research and is ideal for a student who is interested in medicine, genetics or genetic counseling. This project will be completed primarily under the guidance of Dr. Staci Kallish.

Sarah Tishkoff

Project 1: Genetic basis of lactose tolerance in African populations

The focus of the Tishkoff lab is to characterize genomic and phenotypic variation in ethnically diverse Africans in order to better understand human evolutionary history and the genetic basis of variable traits, including disease risk. This project involves investigating the genetic basis of the lactase persistence trait in ethnically diverse Cameroonian populations. A major focus will be on the Fulani pastoralist population. The main aim of the project is to identify, through resequencing, novel genetic variants associated with the lactase persistence trait in African populations. The unique dataset the student will be working on is composed of both genetic and phenotypic data for the lactose tolerance test, data recently collected in Cameroon by my lab. The student will have the possibility to build up a skill set of both molecular techniques and genetic data analysis on the data they will be collecting in the lab. In order to carry out the project, the student will learn how to perform DNA quantification, gel electrophoresis, PCR (including primers design), Sanger sequencing as well as the correct use of Sequencher software for the analysis of the DNA sequences, population genetics analysis programs and other genotype-phenotype association methods. They will also have the opportunity to participate in

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lab meetings (and to present the results of their research), journal clubs and seminars focused on human genetics research. Students should have taken genetics and/or molecular biology courses and some basic laboratory skills.

Project 2: Characterization of Genomic 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.

We have generated high coverage whole genome sequence data from ethnically diverse Africans. We are using computational approaches to characterize single nucleotide variants, structural variants, and regulatory variants and to determine their functional impact on adaptive traits and disease risk.

The student working on this project will assist with analyzing high coverage whole genome sequence data from ethnically diverse African populations. 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.

MEDICAL ETHICS AND HEALTH POLICY

Norma Coe

Project 1: Measuring Medicaid Access to Care and its Downstream Implications: The Case of Hepatitis C

The expense of Hepatitis C treatment has led to unprecedented rationing of access to drugs within the Medicaid market, despite evidence that early access and treatment is both best for the patient and cost-effective. This study first identifies across-state and within-state variation in access based on three domains: disease severity; sobriety requirements; and prescribing limitations. Second, the study will examine how these changes in access impact state-level prescribing behavior. Finally, the study will examine the downstream effects of loosening access

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within the Medicaid program by examining liver transplants and Medicare prescribing behavior and expenses for Hepatitis C.

I am seeking a motivated student with an interest in health policy to assist with this research project. My Co-PI on the project is Paula Chatterjee, MD, MPH, who is a Post-Doctoral Fellow in General Internal Medicine. The summer student will have an opportunity to hone their research and writing skills through working on a literature review, managing EndNote citations, and assisting with the early stages of the writing process. The student will have the opportunity to learn how to work with large government datasets and learn STATA programming skills to help with the analysis. If the student is interested and available, there may be an opportunity to continue on the project after the summer program has ended. The student will also have the opportunity to work closely with the project manager to review the project budget and track spending.

Project 2: Leveraging National Databases to Understand Access to Medication-Assisted Treatment for Opiate Abuse under Medicaid

Opioid fatalities among young and middle-aged adults have risen to epidemic levels. This project will measure the impact of Medicaid on mitigating this public health threat. I will examine the association between Medicaid expansion and changes in prescriptions for medication-assisted treatment (MAT). I will also assess the relationship between Medicaid expansion and overdose deaths over time. I will then examine differences in MAT prescriptions between Medicaid managed care and prospective payment systems. Finally, I will assess whether increased availability of naloxone rescue treatment options may have served to decrease the propensity to seek longer-term treatment options for opiate abuse.

I am seeking student with an interest in health policy to assist with this research project. My Co-PI on the project is Paula Chatterjee, MD, MPH, who is a Post-Doctoral Fellow in General Internal Medicine. The summer student will have an opportunity to hone their research and writing skills through working on a literature review, managing EndNote citations, and assisting with the early stages of the writing process. The student will have the opportunity to learn how to work with large government datasets and learn STATA programming skills to help with the analysis. If the student is interested and available, there may be an opportunity to continue on the project after the summer program has ended. The student will also have the opportunity to work closely with the project manager to review the project budget and track spending.

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Holly Fernandez Lynch

Project 1: Evaluating IRB Quality and Performance

Institutional Review Boards (IRBs) are responsible for oversight of federally-funded research with human subjects and FDA-regulated clinical trials, but IRB policy and practice is not itself evidence-based. Few studies assess whether IRBs achieve goals related to protecting research participants, treating investigators fairly, and efficiently reviewing research without sacrificing quality. As part of a set of projects to fill that gap, I am seeking a research assistant to undertake the following tasks:

(1) Analyze standards for assessing IRB quality. The student will review the literature to identify the range of tools available for assessing IRB quality, undertake a descriptive analysis of these tools, develop a mechanism for comparing them on standardized criteria, and begin to analyze areas of overlap, disagreement, and gaps.

(2) Identify analogous quality measurement examples. Although efforts to define and evaluate IRB quality are immature, other sectors have well-defined models that may offer lessons for how to evaluate quality. Possible examples include hospital quality, air-traffic safety, and evaluation of FDA performance. The student will undertake exploratory analysis to identify potential analogies and how they may be fruitful in the IRB context.

Interested students should be highly organized with strong attention to detail. The selected student will have the opportunity to develop research, analytical, and writing skills, while gaining expertise in human subjects research and quality assessment. Projects are ideal for students interested in medicine, biomedical research, and health policy. I am a lawyer by training, and will also be happy to mentor students interested in pursuing law school.

Project 2: Curriculum Development for Bioethics and the Body

I am developing a graduate-level bioethics course titled “Bioethics and the Body.” The course will cover ethical (and sometimes legal) issues related to various uses, perceptions, and states of the human body, including comparisons to artificial intelligence and non-human animals. The course will cover frameworks useful to understanding how society interacts with the body, such as commodification, employment, and human rights models. Specific topics will likely include: participation in clinical trials, research with biospecimens and body parts, reproductive surrogacy, the status of the embryo, products of the body (such as blood, gametes, organs), definitions of death, the status of dead bodies, sex work, human trafficking, and professional sports.

I am seeking a student research assistant to help develop the syllabus, identify appropriate reading selections, and generate course materials and slides, including debate topics and essay

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prompts. The student may also assist with curriculum support for the new Master of Health Care Innovation program offered out of the Perelman School of Medicine.

Interested students should have strong research and organizational skills and attention to detail. Students will become familiar with key scholarship in the field, which can be useful in their own development of paper and research topics down the road. They will also gain an understanding of how faculty design courses and pedagogical objectives. The project is ideal for students interested in medicine, biomedical research, and health policy. I am a lawyer by training, and will also be happy to mentor students interested in pursuing law school.

Heather Schofield

Project 1: Poverty, Productivity, and Cognitive Function in India

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

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

Currently the lab is building on these early results to consider what other aspects of life in poverty might have similar effects -- for example, we are beginning to explore how chronic sleep deprivation impact labor market outcomes, cognitive function and broader decision-making, such as savings choices and other aspects of health. We are planning on expanding these studies and developing others on the effects of reducing depression and loneliness.

Depending on interests and qualifications, students working on the research may either work at Penn or in India over the summer.

Roles and Responsibilities:

- Assist with field research activities (e.g. survey or experimental task design)
- Assist with data collection
- Clean and manage datasets
- Conduct statistical analysis using Stata

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- Prepare literature reviews, background research, and other draft content for grant proposals
- Communicate with partner organizations

Desired Qualifications and Experience:

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

MEDICINE

Charu Aggarwal

Project 1: Evaluation of patients with metastatic and recurrent head and neck squamous cell carcinoma: outcomes following immunotherapy

I am currently an Assistant Professor the University of Pennsylvania and a board certified oncologist with expertise in thoracic and head and neck cancers. My research, to date has focused on the development of novel biomarkers and personalized therapeutic approaches in thoracic and head and neck oncology. I have led a number of novel immunotherapy clinical trials using targeted immunotherapeutic approaches like vaccines. An active area of research is to improve therapies in the post immunotherapy setting for patients with Head and neck squamous cell cancer (HNSCCa). HNSCCa is a common malignancy with a rapidly changing demographic profile given the ongoing epidemic of Human Papilloma Virus (HPV)-related oropharyngeal cancers. Most patients present with locally advanced disease and receive combination therapeutic approaches with substantial curative potential, but with significant acute and chronic toxicities. In addition, up to a third of patients, depending on smoking status and other factors, will eventually develop recurrent /metastatic disease. The prognosis of the latter patients is dismal, as palliative treatment options remain limited in efficacy. Therapy for incurable HNSCCa has dramatically changed following the approval of the immunotherapy with PD-1 inhibitors, pembrolizumab and nivolumab. Unfortunately, most patients do not respond to

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immunotherapy and among those who do respond, progression appears to be inevitable. It is not clear how best to manage patients who have failed to respond to or progressed after PD-1 antibody therapy. Clinical data on post PD-1 therapies are lacking. We are evaluating clinical outcomes of patients with metastatic incurable HNSCCa (HPV + and HPV-) treated with PD-1 inhibitors at Penn. The student will be mentored by me, and under my supervision will conduct evaluation of these patients, summarize data and analyze results. The student will also be exposed to the clinical aspects of head and neck cancer patient treatment, including participation in tumor boards. There may also be clinical shadowing opportunities within the head and neck cancer center and other collaborating physicians in addition to opportunities to participate in studies involving other cancer types. This is an ideal project for a student who is interested in medical science, but may be undecided between medical and graduate school.

Jason Karlawish

Project 1: Early diagnosis and the psychosocial wellbeing of older adults

People who learn they are at risk for Alzheimer's disease report changes in how they feel about themselves and they worry about how they might be treated by others. We are studying how the general public reacts to knowing someone has Alzheimer's disease and how the psychosocial experience of cognitive decline changes across a continuum from cognitively unimpaired to impaired. We are gathering and analyzing data from varied sources. In this program, students will have the opportunity to analyze data from secondary sources that help inform our understanding of how advances in early diagnosis may affects the social and psychological wellbeing of individuals. Work closely with Dr. Karlawish, Dr. Shana Stites, Research Scientist, Penn Project on Precision Medicine for the Brain (P3MB), and the rest of the P3MB staff to understand how the psychosocial wellbeing of older adults is affected by cognitive decline and social and cultural factors, including policy and practices. Develop the ability to make reasoned arguments both in writing and in speech, through review of relevant literature, construction and application of analytic plans, and the presentation at the end of project. Gain introductory knowledge and experience of computer programming used in quantitative statistics. Complete a final project (written, video, photo essay or some combination of media) that communicates what the scholar did and learned. Collaborate on drafting the manuscript and be included as a co-author dependent on your interest, skills, and availability. Successful candidates should have an introductory knowledge of statistics and a strong interest in learning how to apply these skills as well as a willingness to learn.

Project 2: REVEAL SCAN: Risk Evaluation and Education for Alzheimer's Disease – the Study of Communicating Amyloid Neuroimaging ***Rising Juniors only***

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The Penn Memory Center conducts and participates in a wide range of studies related to Alzheimer's disease, mild cognitive impairment, cognitive aging, and lifelong brain health. These studies enroll older adults with cognitive problems and those with normal memory and thinking, known in research as "normal controls." We are seeking students to assist with a volunteer-based, non-treatment clinical study in which cognitively normal older adults learn about their risk for developing Alzheimer's disease dementia. Participants are followed for six to seven months in order to study how they interpret, cope, and adapt to their risk information. Participants' memory, thinking, and emotional wellbeing are also actively measured throughout the study. Student research assistants will be primarily involved in participant recruitment and screening, assisting with study visits, and data collection, entry and management. Student research assistants may also be asked to assist with other clinical studies. We are looking for highly conscientious, responsible, detail-oriented students who are enthusiastic and self-motivated, and are interested in gaining hands-on experience in conducting clinical research and being part of a multi-disciplinary research team. Students will work closely with research coordinators and other team members, under the supervision of Dr. Karlawish.

Peter Klein

Project 1: Hematopoietic stem cell expansion

The goal of this project is to develop methods for ex vivo expansion of hematopoietic stem cells with the long-term goal of improving stem cell transplants and to expand genome edited hematopoietic stem cells.

Emily Ko

Project 1: Effect of Patient Directed Education on Palliative Care Knowledge and Acceptability and Outpatient Palliative Care Effect on Symptom Management among Gynecologic Oncology Patients

This study is a randomized, controlled trial that aims to assess the potential effectiveness of patient directed education regarding palliative care knowledge, acceptability and symptom management in women with a gynecologic malignancy. The goal of this study is to 1) determine whether patient directed education will impact the initiation of outpatient palliative care consultation and 2) increase patient knowledge regarding palliative care. 3) Change in cancer-related symptom burden after palliative care consultation will also be assessed.

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This project will afford students the opportunity to directly assist in conducting a prospective clinical trial. Students will have direct patient contact and will learn the proper techniques in conducting a clinical trial, consenting patients and reviewing charts. Students will distribute surveys, assist in chart review and data entry as well as contribute and learn basic data analysis and manuscript preparation. This is a thesis project with anticipation of publication within the year after completion.

Students will also be working directly with Dr. Ashley Graul, the gynecologic oncology fellow working on the project as well as Dr. Emily Ko and Dr. Ashley Haggerty, gynecologic oncology attendings on the IRB.

These skills will be important both academically and professionally in the future as they involve professionalism in patient interaction as well as insight into the clinical workings of patient trials. Students will also benefit from learning data collection techniques and basic analysis for their own future work.

Mitch Lazar

Project 1: Role of the Nuclear Receptor RevErb in Circadian Cardiac Metabolism

The importance of circadian rhythms in cardiovascular biology is highlighted by the increased frequencies of myocardial infarctions (heart attacks) and heart surgery complications in the morning. We hypothesize that circadian clock proteins play a major role in this, and are investigating whether the circadian nuclear receptor Rev-erb is a critical regulator of cardiac function. As a core component of the molecular clock, Rev-erb links diurnal rhythms to lipid metabolism, through interaction with HDAC3 (a deacetylase that represses gene transcription) in other tissues such as skeletal muscle and liver. Fatty acids are the main energy source of the heart, and since disruption of their metabolism can lead to severe cardiac dysfunction, we hypothesize that Rev-erb and HDAC3 are critical mediators of normal heart physiology.

By the use of several state-of-the art molecular biology techniques, we want to study the interplay between Rev-erb and HDAC3 in the heart by analyzing genetic knock out mice for Rev-erb and/or HDAC3 that are fed a normal as well as a lipid-rich Western diet. This will contribute to a better understanding of the molecular mechanisms that regulate circadian cardiac metabolism and aid to identify pathways that may be targeted to prevent high-fat diet-induced heart failure. The student will participate in studies that include tissue culture using sterile technique, mouse husbandry and surgery, molecular biology techniques such as cloning, measuring gene expression by use of quantitative pcr and westerns, and pathway analysis using next generation sequencing.

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Elizabeth Lowenthal

Project 1: Exploring the experience of young people reducing HIV stigma in communities

This project will utilize data from a community-based study in Zimbabwe that aimed to reduce HIV-related stigma while encouraging families to test their children for HIV infection. Pairs of young adults-- one of whom is living with HIV and one of whom is not living with HIV-- worked together to sharing information and their own personal stories. At the end of each day, they narrated their experiences which were transcribed in English. The student will assist with coding the themes in the transcripts to create a clear description of the range of experiences encountered in this community-based project. The student will utilize NVivo qualitative analysis software and will work closely with Zimbabwe-based members of the team to gain insights into the transcripts. The student should have excellent communication and organizational skills as well as a passion for global health.

Project 2: Neurocognitive Assessments of Children Infected with and Affected by HIV in Botswana

This project will culturally adapt and validate the Penn Computerized Neurocognitive Battery for the assessment of children affected by HIV in Botswana. The student will assist with setting up a study database using RedCAP software and setting up reports for study monitoring. The student will be based in Philadelphia and will communicate with members of the team in Botswana to verify Setswana translations and reporting needs. The student will be co-mentored at Penn by Dr. Cobb Scott and will work closely with Jennifer Chapman, MPH, for database support. The student should have excellent communication and organizational skills. Preference would be given to a student from Botswana.

Project 3: Developmentally-appropriate Adolescent HIV Differentiated Care Options

The student will assist with set-up of a large 2-country study (Zimbabwe and Tanzania) that aims to improve the care of adolescents living with HIV in sub-Saharan Africa by providing them with developmentally-appropriate supportive care and treatment options. The study is proposed in collaboration with the Elizabeth Glaser Pediatric AIDS Foundation and UNICEF and is currently undergoing review for funding. If funded, the study will begin in July, 2018. The student's roles on the project would include supporting local investigators and in-country teams to design materials for Standard Operating Procedures to ensure uniform set-up of the services at each of the clinical sites to be involved in the study. If the student has the requisite programming skills, the student might also assist with adaptation of a cell phone-based pharmacy refill application. A native speaker of Tanzanian Swahili would be preferred. However, there are no prerequisites for this position.

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Kim Reiss Binder

Project 1: Personalizing care for gastrointestinal cancer patients through next generation sequencing of circulating tumor cells and circulating tumor DNA

The Circulating Tumor Material (CTM) Center develops and implements cutting edge technologies to support the delivery of personalized medicine to patients with cancer. Our research is clinical and translational in nature. Translational research applies discoveries from basic science to a directly relevant clinical context, allowing a student to explore both dimensions of biomedical research simultaneously. We focus on the identification, capture, and analysis of Circulating Tumor Cells (CTCs) and cell-free DNA (cfDNA) from blood, bone marrow, pleural effusion, and other non-invasively captured patient samples. These approaches allow: 1) early detection of disease as well as post-therapy monitoring of minimal residual disease, 2) an efficient means of determining clinical and biological response to therapy and, thus, clinical decision making, and, 3) cancer genetic phenotyping to drive personalized medicine that obviates the need for serial biopsies in a population of patients for which these procedures are difficult, risky, and insufficient. The focus of the CTM Center is driven by the needs of translational investigators and clinicians, such as Dr. Kim Reiss Binder, MD, who will serve as co-mentor for this project, and realized through collaborative work with investigators in the Penn School of Medicine, the Penn School of Engineering, and the Center for Personalized Diagnostics. Moreover, when it is determined that outsourcing of technology development is preferable, collaborative efforts with industry partners are actively sought, and these efforts have already been initiated in focused areas.

Here, the student will focus on the development of highly sensitive approaches for the isolation and next-generation sequencing of cell-free tumor DNA and CTCs isolated from the blood of gastrointestinal cancer patients enrolled on Dr. Reiss Binder's clinical trials. The student will conduct assay development, perform sample preparation, and summarize/analyze results. The student will also be exposed to the clinical aspects of gastrointestinal cancer patient treatment, including participation in meetings (called Tumor Boards) to review next-generation sequence data and its clinical implications. There may also be clinical shadowing opportunities with Dr. Reiss Binder and other collaborating physicians in addition to opportunities to participate in studies involving other cancer types studied in our lab. This is an ideal project for a student who is interested in medical science, but may be undecided between medical and graduate school, and would like to gain experience in both translational and clinical research.

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Allan Simpao

Project 1: Create a virtual human

There are major research initiatives in simulating all aspects of human physiology, but most focus on specific organs at a cellular and tissue level. There are less detailed whole-body physiology models which can simulate the interaction of the major events we see under anesthesia: e.g. major blood loss, drug administration, and variations in ventilation and cardiac function.

This research project is about creating a proof of concept virtual human which uses machine learning to update its assumptions based on live anesthesia data. The virtual copy of an anesthetized human can be used to reveal the internal state of a patient, and eventually predict events and recommend treatments. In pediatric anesthesia, monitoring is more limited and less reliable than adult anesthesia, making a surrogate model more important, especially for infants.

You will develop or learn skills in medical informatics, control systems engineering, and machine learning, while working with a dynamic bioinformatics research group at CHOP which has had long-lasting relationships with students through this program. The most interesting research projects transcend traditional academic boundaries, so we are looking for a bright undergraduate who is able to work and learn across these different domains. Coding experience is essential.

The goals this summer will be: complete a proof of concept integrating anesthesia data with a virtual human; and, submit a report for publication in a major informatics journal. Conference abstract submission and attendance also likely. Students will be co-mentored by Dr. Simpao and Dr. Jack Wasey.

Project 2: Machine learning and pediatric spine surgery

Wound infection is a fairly common, serious and expensive complication of spine surgery in children. The complex anesthesia set-up often leads to children getting very cold. We hypothesize that this deep hypothermia increases the risk of wound infection.

Your contribution this summer will be to dig deep into the rich anesthesia, infection and surgery data to explore links between the anesthetic and infectious outcomes, particularly relating to temperature. Particularly interesting will be students who can go beyond traditional statistics, specifically in machine learning or optimized matching techniques. These are things you can bring with you and develop further, or learn while working on this project with our supportive and talented bioinformatics research group which has machine learning expertise. R and SQL experience is an advantage but not essential.

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Ethics approval is complete and the data is available now, so you would be able to dive right into the project, with the expectation of completing a manuscript for publication by the end of the summer, and likely a conference abstract and attendance. Students will be co-mentored by Dr. Simpao and Dr. Jack Wasey.

Laura Su

Project 1: Test if Campylobacter exposure potentiates immunity against influenza virus in mice

We are interested in how environmental exposure to common and/or pathologic microbes changes later response to another infection. We have previously identified cross-reactive T cells in humans that recognize both Campylobacter jejuni and Influenza virus. We are now moving into mouse model to test these interactions. I am looking for a student who is dedicated and highly motivated to be an integral part of this project. No prior animal experience is necessary. Selected student will learn to work with mice, colonize mice with Campylobacter, infect mice with influenza virus, perform immunologic assays to test T cell responses to specific antigens. The student will be mentored by myself and another researcher in the lab.

Project 2: Identify microbial triggers of autoreactive T cells from patients with rheumatoid arthritis

Microbes have been postulated to trigger autoimmunity in animal models, but whether this happens in people remains unclear. Our lab has previously identified CD4+ T cells that recognize self-peptides from patients with rheumatoid arthritis. We are interested in identifying microbial antigens that can activate these self-reactive T cells. I am looking for a student who is dedicated and highly motivated to be an integral part of this project. Selected student will learn tissue culture techniques, generate and maintain T cell clones, operate flow cytometer, and perform his/her own analyses. The student will be mentored by myself and another researcher in the lab.

Kirk Wangensteen

Project 1: In vivo genetic screening the liver with CRISPR/Cas9 to find genetic drivers of liver regeneration

Our lab is conducting exciting research on the genetics of liver repopulation and hepatocellular carcinoma (HCC). We have developed two highly innovative in vivo genetic screening

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paradigms to elucidate genetic pathways involved in carcinogenesis and liver repopulation in the setting of toxic injury. We aim to discover pathways that lead to drug sensitivity and resistance in HCC. One of our assays involves CRISPR activation screening in vivo in the liver, the first-ever use of this type of screening in live mice. We are seeking dedicated, curious and ambitious students to join us in the lab. Students will be expected to perform diligent background reading, to follow protocols closely, and to eventually work independently performing assays. Careful note-taking is a must. Students will work day-to-day with post-doctoral fellows in the lab, and will meet with the faculty at least weekly to discuss scientific progress.

MICROBIOLOGY

Hao Shen

Project 1: Epigenetic approach to immunotherapy

CD8 T cells (a.k.a. Cytotoxic T Lymphocytes) are killer T cells that lyses virus-infected and tumor cells. Functional exhaustion of CD8 T cells is a defining characteristic in many tumors and many chronic infections, but the underlying mechanisms of T cell dysfunction are not well understood. In our recent work, we found that chromatin remodeling is involved in the loss of T cell function and that manipulating epigenetics helps the exhausted CD8 T cells regain their functionality. In this project, we aim to determine if epigenetic manipulation alone or together with blockade of other inhibitory signals can reprogram and restore the functionality of exhausted CD8 T cells. In doing so, we hope to develop optimal therapy that combines repair of internal defects by epigenetic reprogramming with blockade of external inhibitory signals that will maximize immune control and clearance of tumors and chronic viral infection.

Project 2: Vaccine 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

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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: Study of gut microbiome effects on colistin-resistant enteric bacteria

The evolution and widespread distribution of antibiotic-resistance elements in bacterial pathogens has made diseases that were once easily treatable deadly again. Recently, this issue heated up dramatically with the spread of colistin (often considered to be a last-resort antibiotic) resistant Escherichia coli in the United States and abroad over the summer. Our lab is currently studying molecular mechanisms of the pathogenesis of multi-drug resistant Klebsiella pneumoniae. We found that members of gut microbiome and oxygen tension greatly affect colistin resistance of K. pneumoniae. The summer project will apply classic genetics and cutting-edge highthroughput sequencing to dissect the underlying mechanisms of bacterial cell-cell communication that modulates antibiotic resistance efficiency. Prior lab experience is preferred. I myself will mentor the student directly with the help from a PhD student (Yitian Zhou).

NEUROLOGY

Nicholas Abend

Project 1: Seizures in Critically Ill Children

My clinical research focuses on seizure detection and management in critically ill neonates and children. About 30% of critically ill patients with acute brain conditions experience electrographic seizures, most of which can only be identified by EEG (brain wave) monitoring. These seizures are associated with worse neurobehavioral outcomes. Thus, identifying and managing these seizures may reduce secondary brain injury and serve as a neuroprotective strategy. This project involves clinical research related to neurology, pediatrics, and critical care medicine. Most of the work would involve working with patients/families in the ICU to gather

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data (likely by attending NeuroICU rounds) and chart review from the electronic medical record. Prior student projects have led to abstracts or papers.

Nabila Dahodwala

Project 1: Anti-apathy app trial

Under the supervision of Dr. Nabila Dahodwala in the Department of Neurology at the University of Pennsylvania, the student will work on a clinical research project studying cognitive neuroscience and Parkinson's disease. Student responsibilities will include recruitment of study subjects, data collection in patients (including clinical and psychological assessments), and conducting analysis of these data. The student will also assist in maintenance of research database in compliance with HIPAA regulations. The student will attend group lab meetings and meet individually with Dr. Dahodwala. Prerequisites: Interest in neuroscience, psychology, biology, biomedical engineering, computer science, or related fields; experience with library research tools; strong organizational and interpersonal skills is preferred.

Kathryn Davis

Project 1: Fabrication of transparent Ti3C2 titanium carbide electrodes for studying neural circuits

The development of 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. Though great advances have been made in implantable electrode technology, there still exists a significant trade-off between achieving high spatial resolution and scaling the devices up to monitor large brain areas. Optical recording techniques, which rely on calcium or voltage-sensitive fluorescent reporters, offer the ability to monitor thousands of individual neurons simultaneously. However, these techniques do not offer the temporal resolution necessary to decode the firing patterns of neural circuits. The combination of high temporal resolution electrophysiology recording with high spatial resolution optical recording offers the potential to study neural networks in unprecedented ways and greatly enhance neuroscience research. The Litt Lab is currently developing a first-of-its-kind neural electrode technology based on Ti3C2 titanium carbide, a recently discovered 2D nanomaterial known as MXene (pronounced “MAX-ene”) with excellent optical and electrical properties. The next phase of this project involves optimizing processing parameters including MXene solution concentration and spin-coating procedures to create devices with a high degree of optical transparency, as our current devices

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are non-transparent. This will involve fabrication and characterization of the optical transparency and conductivity of MXene films under different processing conditions. This project is intended for a student interested in learning more about neuroengineering and materials science and potentially looking for a longer-term research experience to extend into the academic year. Some prior wet lab or fabrication experience is preferable.

Project 2: Development of an implantable SU-8-based device for neural recording and stimulation

Bidirectional implantable neurotechnologies are unique tools for understanding the complex neural dynamics underlying behavior, sensation, and disease. Such devices, which allow us to record and stimulate the activity of neural circuits, have become the standard of care for treating a variety of neurological and neurodegenerative disorders affecting the central nervous system, such as epilepsy and Parkinson's disease. Our lab focuses on leveraging novel materials and microfabrication processes to optimize the performance of these devices. One material of increasing interest to us is SU-8, a photoresist originally developed for use in the microelectronics industry, but which has since proven to be a versatile and highly biocompatible polymer with many applications in microfluidics, bio-MEMS, and implantable biotechnologies. In this project, the student will develop and optimize a fabrication protocol that integrates microscale neural electrodes into an SU-8 polymer encapsulation. Previous experience with microscale fabrication is encouraged, but not required; however, the student should be comfortable with the fundamentals of mechanics and materials science. The candidate will become familiar with design of experiments by the end of the project, and will also gain invaluable experience in microscale fabrication techniques. The result of this work will be an implantable SU-8-based neural device for recording and stimulation in neural tissue.

Previous experience with microscale fabrication is desired, but not required.

Project 3: 7T MRI Glutamate Imaging in Epilepsy

In this project students will learn to analyze structural and function (GluCEST, which measures glutamate) imaging obtained at 7T MRI from humans with drug resistant focal epilepsy. They will work with investigators to segment regions of interest on imaging scans and analyze the structural and functional imaging. Requirements are knowledge of MATLAB and/ or Python. Prior imaging analysis experience is desired, but not required.

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Ethan Goldberg

Project 1: Disease pathomechanisms in experimental models of severe childhood epilepsy

The laboratory is interested in developing novel treatments for severe childhood-onset epilepsy in preclinical experimental models that could potentially be translated to the clinical arena. The laboratory uses electrophysiology and two-photon calcium imaging in heterologous systems, cultured neurons, acute brain slices, and in intact, awake, behaving experimental mice in vivo, to ascertain novel pharmacological or neuroengineering approaches as well as the use of cell transplantation. Students will be paired with a research associate or graduate student and will perform immunohistochemistry, animal surgery, behavioral testing, and/or data analysis, commensurate with skills and prior research exposure and experience.

Roy Hamilton

Project 1: Virtual Reality for Unilateral Spatial Neglect

Unilateral spatial neglect (USN) is the inability to attend to or act toward one side of space as a result of a lesion to the brain. In severe cases, individuals may only eat the food from one side of their plate, walk into objects they cannot “see” and even ignore people or voices who present themselves in the neglected field of space. Previous research has demonstrated that applying Transcranial Magnetic Simulation (TMS)—a non-invasive brain stimulation technique that uses electromagnetic pulses to focally excite neural structures—to the right posterior parietal cortex (PPC) and right superior temporal gyrus (STG) can create a temporary “virtual lesion” in healthy individuals and induce mild neglect-like symptoms. Recently, advances in virtual reality (VR) technologies have proved a promising approach for assessing and rehabilitating neglect symptoms. The Laboratory for Cognition and Neural Stimulation (LCNS) is working towards finalizing the development of an immersive VR environment to quantify neglect symptoms. The current research project will use TMS of the right PPC and STG in healthy individuals to create a temporary “virtual lesion”, and thus induce neglect-like symptoms, in order to validate our newly developed VR neglect assessment. Students will aid our VR developer (Alex Miller) in piloting and finalizing the VR neglect assessment, and aid our research manager (Daniela Sacchetti) in implementation of the TMS experiment, data collection and data processing. There may be opportunities for experience in literature searches and aiding in preparing manuscripts. Prior coursework in computer science and/or cognitive neuroscience are recommended.

Project 2: Optical Imaging to Characterize Hemodynamic Effects of Brain stimulation

Transcranial Direct Current Stimulation (tDCS) is a non-invasive brain stimulation technique in which small electrical current are delivered to the brain, influencing neural activity and behavior.

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TDCS has been employed in prior research to positively influence performance in a variety of cognitive domains including attention, language and creativity. Despite continuing advances in the use of tDCS, the relationship between stimulation parameters (i.e. intensity, duration, number of sessions) and changes in brain physiology remains poorly characterized. In order to advance understanding of these relationships, the Laboratory for Cognition and Neural Stimulation has partnered with the Physics department to develop a hybrid device combining tDCS with diffuse optical spectroscopy (DOS), to simultaneously stimulate and measure brain oxygenation and blood flow. Pilot work this device during a creativity task has already yielded a dataset, which we would ask an undergraduate to help analyze. Additionally, a new pilot research project aims to employ the tDCS/DOS device to investigate how different tDCS parameters interact to alter brain hemodynamic in the context of stimulating language centers. Students will be trained by our research manager (Daniela Sacchetti) to administer neuropsychological assessments, set-up and administer tDCS, and will work with a physics postdoc (Lin Wang) to utilize the optical probe during testing sessions. Once trained, they will work in a mentored but independent manner to collect, organize, and process study data. There may be opportunities for experience in literature searches and to aid in preparing manuscripts. Prior coursework in statistics, engineering, and/or cognitive neuroscience experience is desirable.

Project 3: Elucidating State-Dependent Effects of Neuromodulation on Brain Networks

Transcranial Magnetic Stimulation (TMS) is a form of non-invasive brain stimulation that uses electromagnetic pulses to focally excite neural structures, and is being explored for a variety of clinical and experimental applications in neuroscience. Recent evidence suggests that the response of the brain to TMS and other forms of noninvasive stimulation may depend heavily on the state of endogenous brain activity at the time of stimulation. The aim of this project is to characterize relationships between brain states and physiologic and behavioral responses to TMS, and to determine how these relationships vary across individuals. We will first combine TMS with continuous EEG recording, then leverage recent advances in network neuroscience to identify dynamic network-level neural correlates of inter-individual variability in TMS response patterns. The ultimate goal of this work is to cultivate a basic ability to predict individual responses to TMS such that stimulation can be tailored to clinical presentation and neural activity patterns. This will both help to optimize the therapeutic and diagnostic potential of TMS. An undergraduate student will assist a postdoc (Brian Erickson) and research assistant (Apoorva Kelkar) in the set-up and administration of EEG during TMS experiments, analysis of induced motor responses to TMS, and EEG data processing and analysis in Matlab. They may also be instructed in network neuroscience analysis methods. There may be opportunities for experience in literature searches and to aid in preparing manuscripts. Prior coursework in engineering (signal analysis), statistics, and/or cognitive neuroscience are highly recommended.

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Frances Jensen

Project 1: Epilepsy in Alzheimer's disease

Alzheimer's disease (AD) is the most common form of dementia and a major public health problem. AD patients can suffer from epilepsy, particularly early in the progression of dementia. While clinical observation suggests that epileptic seizures can accelerate AD progression there is little understanding as to mechanism. As there is an urgent need to find new treatment for AD, we hypothesize that targeting epileptic activity may be one relevant approach.

The goals of this project are 1) to examine the impact of epilepsy and seizures on AD brain pathology and cognition, and 2) to determine the effects of antiepileptic drugs on AD disease progression. The student will work with an established mouse model of AD and will learn and perform mouse genotyping, drug treatments, as well as brain tissue analysis using Western blotting and immunohistochemistry techniques. The student will be mentored by Dr. Frances Jensen and a post-doctoral fellow. Basic computer skills and neuroscience background is needed.

Brian Litt

Project 1: Seizure Detection, Prediction and Analysis of Prolonged EEG Recordings

In this project PURM students will learn to use cloud-based tools to analyze continuous EEG recordings from implantable devices, Intensive Care Unit Recordings, or the EEG laboratory. Students will write programs to identify biomarkers of epileptic networks, seizures, interictal epileptiform discharges and other ways to map epileptic networks and events. Algorithms will be applied to animal and human data in health and disease, including epilepsy, after head trauma, and in patients undergoing surgery. The goals will be to make automated analysis pipelines that can be applied in numerous research and clinical settings. Matlab and/or Python experience required

Project 2: Virtual Cortical Resection ***Rising Juniors only***

In this project students will learn to analyze neurophysiology signals from humans implanted with intracranial electrodes during evaluation for epilepsy surgery. They will work with investigators to map epileptic networks and simulate different surgical procedures and device placement. Knowledge of Matlab and/or Python required

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David Lynch

Project 1: Basic Research in Friedreich ataxia

The laboratory of David Lynch, MD, PhD studies molecular mechanisms involved in the autosomal recessive disease, Friedreich's Ataxia (FRDA). Considered a rare disease, FRDA affects 1 in 50,000 people, and significantly decreases life expectancy of affected individuals. Our lab seeks to better understand the underlying mechanisms and provide potential targets for therapeutic intervention.

The accepted student will be responsible for working together with other members of the lab to develop a project specific to their interests involved with mitochondrial biogenesis and/or mitochondrial dysfunction. All lab members are expected to collaborate toward collective end-goals focusing on their unique strengths. The student will learn many biochemical assays generic to most basic research laboratories, and will be expected to become proficient in these techniques.

Requirements: Passion for science, desire to learn, basic laboratory skills are required (i.e. pipetting, preparing solutions) and understanding of laboratory terms (i.e. concentration, molarity, ect.)

Project 2: Mouse models of Friedreich Ataxia

The laboratory of David Lynch, MD, PhD studies molecular mechanisms involved in the autosomal recessive disease, Friedreich's Ataxia (FRDA). Considered a rare disease, FRDA affects 1 in 50,000 people, and significantly decreases life expectancy of affected individuals. Our lab seeks to better understand the underlying mechanisms and provide potential targets for therapeutic intervention.

An important step toward therapeutic target identification is validation of disease models. The accepted student will be responsible for molecular phenotype characterization in selected tissues from a mouse model of FRDA. Validation of this mouse as an appropriate FRDA model is an important step toward therapy. The student will learn several biochemical assays common to most basic research laboratories, and will be expected to become proficient in these techniques.

Requirements: Passion for science, critical thinking, desire to learn, basic laboratory skills are required (i.e. pipetting, preparing solutions) and understanding of laboratory terms (i.e. concentration, molarity, ect.)

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Eric Marsh

Project 1: Neuronal Firing Before Seizures

We are interested in understanding the biological basis of seizures in the developing brain. We are using a model of early onset seizures and recording neuronal activity in freely moving/behaving animals. The person who performs this work would be responsible for building electrodes, performing implantations, recordings and data analysis. This project will be supervised by Almedia McCoy and Eric Marsh

Project 2: Thalamo-Cortical Activity in early onset epilepsy

We are interested in understanding the biological basis of seizures in the developing brain. We are using a model of early onset seizures and recording activity in the thalamo-cortical (TC) circuit. The person who performs this work would be responsible for making acute TC slices, recording and analyzing data from these experiments. This person may also perform in vivo EEG recordings. This project will be supervised by Becca Ahren-Nicklas, Almedia McCoy and Eric Marsh.

Project 3: Cholinergic activity in early onset epilepsy

We are interested in understanding the biological basis of seizures in the developing brain. We are using a model of early onset seizures and recording activity in the hippocampus and modulating cholinergic activity. The person who performs this work would be responsible for making acute TC slices, recording and analyzing data from these experiments. This person may also perform in treatment experiments modulating cholinergic activity and monitoring for seizures. This project will be supervised by Becca Ahren-Nicklas, Almedia McCoy and Eric Marsh.

Dawn Mechanic-Hamilton

Project 1: Goal-Directed Behavior App for Treatment of Apathy in Neurodegenerative Diseases

Patients with Alzheimer's Disease and Related Dementias (ADRD) present with a constellation of cognitive and neuropsychiatric symptoms. Impairment of goal-directed behavior (GDB), often labeled apathy, is one of the symptoms that impacts significantly on the patient's ability to engage in everyday activities and increases caregiver burden. This project will develop a mobile app to engage both patients and caregivers in order to increase goal-directed behavior to improve functional and neuropsychiatric outcomes for patients and decrease caregiver burden. The mobile app will target key and distinct components of GDB (motivation, planning and initiation),

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incorporate individualized patient goals, and measure outcomes in both the patient and care partner. Subjects – patients and care partners – will be recruited from the Penn Memory Center and the Penn Frontotemporal Degeneration Center. This project will include two stages: stage 1 will include building the app and collecting focus group responses to the app components and stage 2 will include pilot testing of the app in a small group of patients and care partners with mild behavioral variant Frontotemporal Dementia (bvFTD) and mild Alzheimer's Disease (AD).

The student will be involved in stage 1 of the project, which will include app design development, pilot testing, and collecting feedback from users. Students will also have an opportunity to join Penn Memory Center (PMC) and Frontotemporal Degeneration (FTD) Center consensus conferences and shadow in PMC and FTD clinics. The student will be mentored by members of the interdisciplinary team, including Dawn Mechanic-Hamilton, Ph.D. (neuropsychologist).

Project 2: Memory App for Rapid Assessment of Cognition in Aging

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

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

David Raizen

Project 1: Finding sleep genes

The project entails genetic, behavioral, and molecular analyses to discovery new genes that regulate sleep in the microscopic round worm C. elegans. The student would be mentored by Dr. Raizen and by other members of the lab. The student should have taken a basic biology course including molecular biology (such as BIOL121 or equivalent). Prior PURM summer students in the Raizen lab have typically continued their research during the academic year and have later published scientific papers with Dr. Raizen prior to graduation and matriculation in graduate school (or medical school).

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Project 2: Understanding how and why infection makes animals sleepy

The student would work closely with a graduate student to study the mechanism by which a viral infection causes sleepiness in the round worm C. elegans. Techniques used by the student will include genetic, behavioral, and molecular methods.

Project 3: Searching for the simplest animal that sleeps

The function of sleep, which led to its evolution, remains a deep mystery of science. Many current theories focus on a role for sleep in the nervous system. Identifying sleep in an animal that does not have a nervous system would throw a big wrench in all neural theories of sleep function. The summer project would consist of attempts to identify such a sleeping animal. We have a candidate animal, called Trichoplax adherens, which is the sole species representing the phylum Placozoa. The student would work with Dr. Raizen and other members of the Raizen lab to perform behavioral and molecular characterization of Trichoplax.

Adeline Vanderver

Project 1: Aicardi Goutières Syndrome (AGS)

Aicardi- Goutières syndrome (AGS) is an auto-immune disease occurring due to several different genetic mutations, leading to accumulation of nucleic acids and a phenotype of elevated interferon (IFN) alpha in patients. The clinical manifestations include encephalopathy, loss of motor and cognitive skills with severe intellectual disability. This accompanies progressive neurodegeneration resulting in cerebral and brain stem atrophy, bilateral striatal necrosis and intracerebral vasculopathy. Numerous genetic mouse models have failed to show a CNS phenotype for the disease while they may have a peripheral immune response. We are interested in creating models to study AGS and understand whether this IFN mediated effects are contributed through a peripheral activation or central nervous system (CNS) activation. To address the peripheral immune activation, we will be using in vitro cultures of hematopoietic stem cells expressing over-expressing lentiviral vector of the AGS causing ADAR1 mutation. We will examine IFN signature of the cells and then conduct in vivo bone marrow transplantation in mouse model to assess if the mice show a CNS phenotype as seen in AGS. To investigate the role of CNS glial cells called astrocytes, we will derive mouse astrocyte cultures and over-express ADAR1 mutation to test if they contribute to the IFN phenotype and eventual neurodegeneration in AGS. The student will have the opportunity to learn tissue culture technique, molecular and biochemical assays, in vivo mouse studies and light/confocal microscopy. The Research Associate in the lab Dr. Akshata Almad will be involved in mentoring for this project.

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Project 2: Hypomyelination with atrophy of the basal ganglia and cerebellum

Hypomyelination with atrophy of the basal ganglia and cerebellum (H-ABC) is TUBB4A associated leukodystrophy, which affects children at an early age and symptoms include delayed motor development, cognitive impairment, rigidity. The diagnosis of H-ABC is based on clinical MRI findings and het-TUBB4A pathogenic variant identified by molecular genetic testing. The known mutation causing classical H-ABC is the D249N mutation in TUBB4A. TUBB4A is tubulin beta-4A chain protein encoded by TUBB4A gene which is building block of cytoskeleton and expressed in brain. In this context, we will be using Crispr knock–in mouse model of TUBB4A D249N and characterize their phenotype through a series of molecular and biochemical experiments to understand how mutations in TUBB4A cause H-ABC. As patients show hypomyelination and neuronal atrophy progressively after onset, we have generated several different transgenic mouse lines to study the cell specific effects of H-ABC in neurons and oligodendrocytes. Ultimately, our preclinical goal is to treat these mice by Anti-sense oligos in order to rescue the H-ABC phenotype and increase their life span. Simultaneously, we are working on a human induced pluripotent stem cells (iPSCs) platform, which will be differentiated towards a neuronal and glial phenotype to understand the cellular and molecular mechanisms in H-ABC patients. Students will have the opportunity to learn mouse neonatal behavior tests for assessing motor and cognitive function, histopathalogy of mice, live imaging for studying trafficking mechanisms and working on human iPSCs. The post-doc fellow Dr. Sunetra Sase and Dr. Almad will be involved in mentoring the student.

David Wolk

Project 1: Environmental & Lifestyle Factors Influence Disease Progression

Neurodegenerative diseases including amyotrophic lateral sclerosis (ALS), frontotemporal degeneration (FTD), and Alzheimer's disease (AD) have variable rates of disease progression, with individuals surviving 2-15 years. Heterogeneity in disease progression presents challenges for determining clinical prognosis and for monitoring response to therapeutic agents in clinical trials. This project will evaluate lifestyle factors (e.g., education, hobbies, etc...) and environmental factors (e.g., laborer occupations vs. professional occupations) that are associated with prolonged survival in ALS, FTD, AD, and related disorders. It will additionally involve the implementation of an environmental risk factors questionnaire to evaluate lifetime exposure to toxins and pollutants that may influence onset and rate of disease progression. Completion of an introductory statistics course is preferred but not required. This research will be done in collaboration with Dr. David Wolk and Dr. Corey McMillan

Project 2: Genetic Influences on Age-Related & Alzheimer Pathology ***Rising Juniors only***

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Nearly every adult >50 years of age has evidence of age-related pathological accumulation (e.g., misfolded protein tau) and many adults ultimately develop Alzheimer's disease composed of tau and amyloid pathological accumulation. My lab is interested in why some individuals only develop tau while others develop amyloid. In this study we will evaluate many sources of genetic variation to determine if there are common variants, or single nucleotide polymorphisms (SNPs), associated with amyloid risk or tau severity. We will also use several bioinformatic tools to evaluate genetic pathways associated with age-related pathology. Some basic working knowledge of genetics and/or neurodegenerative disease would be helpful as well as some basic experience with computer programming (e.g., ability to write a simple script). This research will be done in collaboration with Dr. David Wolk and Dr. Corey McMillan

Project 3: Electronic Medical Record Mining for Neurodegenerative Disease

The diagnostic work-up for neurodegenerative diseases like amyotrophic lateral sclerosis (ALS), frontotemporal degeneration (FTD), and Alzheimer's disease (AD) often involves a variety of tests including cerebrospinal fluid lumbar puncture, blood tests, and magnetic resonance imaging (MRI) exams. However, each of these tests is typically used as exclusion critieria (e.g., ruling out a stroke) and not consider quantitatively across cohorts of individuals. This projection will involve the extraction of several features from the electronic medical record (EMR), organization of a clinical research database, and basic statistical analyses. A student should either have (1) some background biology or medical knowledge or (2) have basic programming (e.g., Java, Python, Perl) or database (e.g, REDcap, SQL) experience. This research will be done in collaboration with Dr. David Wolk and Dr. Corey McMillan

NEUROSCIENCE

John Dani

Project 1: Optogenetic Modulation of Dopamine Neuron Circuits and Alcohol Self-Administration

Using a rat model of alcohol abuse, we will use optogenetic techniques to control the release of dopamine from brain cells in the ventral striatum during alcohol drinking. Optogenetics will enable us to control specific populations of dopamine neurons that we hypothesize contribute to increased alcohol intake after stress. We have generated a viral-mediated Cre-Lox recombination system in rats to express light-sensitive proteins in midbrain dopamine neurons (TH-Cre rats). For optical control over dopamine release in brain cells that connect the midbrain to the ventral striatum, we will surgically insert a light fiber into the ventral striatum. The student's duties will include training rats for alcohol drinking, learning the rat survival surgeries to implant the light

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fibers, and helping to stain and analyze the brain tissue to confirm the expression of the light-sensitive proteins. The student will be mentored on a day to day basis by William M. Doyon, a Research Assistant Professor in my lab, who is leading this project.

Project 2: In Vivo Dopamine Mechanisms in Long-Term Memory

The goal of the project is to understand the in vivo dopamine's role in long-term memory. Dopamine is likely required at the time of memory acquisition. We are currently developing technologies that will allow us to manipulate dopamine release during learning, and monitor the associated electrophysiological changes. The experiments in the project involve an integration of behavior, optogenetics, in vivo pharmacology and in vivo electrophysiology. In this regard, we are seeking highly motivated undergraduates to join our ongoing efforts to understand the in vivo mechanisms of memory. The students will perform the following tasks: preparation of micro-drives used for optical stimulation and electrophysiology, recording neural data using computer software, histology and analyzing the data in MATLAB. The student will be mentored on a day to day basis by Manivannan Subramaniyan, a Post Doctoral scientist in my lab, who is leading this project.

Joshua Gold

Project 1: The relationship between arousal and coordinated neural activity

Arousal can profoundly affect learning, attention, and other aspects of higher-brain function, but little is known about the underlying neural mechanisms. My laboratory has several ongoing projects that are testing the hypothesis that these effects arise, at least in part, from arousal-mediated changes in coordinated neural activity throughout the brain.

This project involves analyzing complex data sets that we are in the process of collecting from monkeys. These are among the most comprehensive data sets ever collected that combine measures of arousal (pupil diameter, heart rate, and EEG) with measures of neural activity (from the brainstem nucleus locus coeruleus, or LC, which mediates arousal, and several of its cortical and subcortical targets). Because of the complexity of these data sets, analysis must be done in stages. The goal of this project is to tackle one stage of this analysis process, likely to involve relating a single arousal measure to a single neural measure. These analyses will be integrated with other, ongoing analyses to create a comprehensive picture of the relationship between arousal and coordinated activity throughout the brain.

This project would benefit from a student with strong quantitative skills and proficiency with Matlab. The student will be mentored by Dr. Siddhartha Joshi, a post-doctoral fellow who is leading this project.

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Project 2: Relating arousal to neural activity in ECoG recordings

Arousal can profoundly affect learning, attention, and other aspects of higher-brain function, but little is known about the underlying neural mechanisms. My laboratory has several ongoing projects that are testing the hypothesis that these effects arise, at least in part, from arousal-mediated changes in coordinated neural activity throughout the brain.

This project involves collecting a novel data set relating pupil diameter, a measure of arousal, with neural activity recorded from human epilepsy patients using electrocorticography (ECoG). The goal of this project is to help to collect and analyze these data sets to identify pupil-linked changes in coordinated activity throughout the brain.

This project would benefit from a student with strong quantitative skills and proficiency with Matlab. The student will work directly with Chris Pizzica, a research technician in the Gold laboratory.

Project 3: Pupil diameter as a biomarker of tauopathy-related degeneration of the locus coeruleus

Frontotemporal lobar degeneration (FTLD) is a spectrum of neurodegenerative diseases that result in progressive behavioral, language, and motor dysfunction. FTLD can be classified into two major pathologies that are associated with a buildup two different proteins in the brain ("proteinopathies"): those with intracellular aggregations of the microtubule binding protein, tau (FTLD-tau), and those with inclusions of the DNA-binding protein TDP-43 (FTLD-TDP). Unfortunately, for many patients the specific form of the disease can only be distinguished post mortem, which denies us the capability to provide them with the treatment best suited to their specific FTLD affliction.

Among the brain areas heavily affected by FTLD-Tau, but not FTLD-TDP, is the locus coeruleus (LC). Therefore, a biomarker of LC function could be used to distinguish FTLD-Tau from TFLD-TDP and other forms of FTLD. The goal of this study is to determine if and how measures of pupil diameter, which have been shown to reflect LC function in healthy subjects, can be used as such a biomarker. The student will help design and test a battery of tasks designed to evoked LC-mediated changes in pupil diameter, which will then be used to test FTLD patients.

This project would benefit from a student with strong quantitative skills and proficiency with Matlab. The student will be mentored by Dr. Hannah Lefumat, a post-doctoral fellow who is leading this project.

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Guo-li Ming

Project 1: Impact of adult neurogenesis on learning and memory

This project will focus on the role of newborn neurons in mediating acquisition, consolidation, and/or recall of hippocampal-dependent memory in mice. In the adult brain, the dentate gyrus subregion of the hippocampus is one of the only brain areas to support neural stem cells, which give rise to newborn neurons that gradually mature and integrate into the local circuitry throughout life. Recently, adult hippocampal neurogenesis has been implicated in various behaviors, including the ability to recognize subtle differences in the surrounding environment, an important feature of episodic-like memory formation. The student will receive training on how to design, analyze and interpret a behavioral experiment. Additional laboratory experience and training may include assisting with surgeries, immunohistochemistry, image analysis, mouse breeding and genotyping, and optogenetic techniques. No prior experience is required but the student should be comfortable being trained to work with mice. Co-Mentor: Dr. Kimberly Christian

Project 2: Imaging neural activity in the adult brain

This is a new project in the lab in which we are adopting established technology to build miniaturized microscopes that can be head-mounted to visualize neural activity in awake behaving mice. The ultimate goal is to use this technology to record transient calcium signals in populations of endogenous or transplanted neuronal populations in the hippocampus of adult mice. The student would be involved in building miniscopes and assisting with pilot experiments and data analysis following surgical implantation of specialized lenses in the brain. No prior experience required. Co-mentor: Dr. Kimberly Christian

Project 3: Using human induced pluripotent stem cells to investigate brain development

Building on recent advances in cellular reprogramming technology, this project is focused on 3D modeling of brain development using human induced pluripotent stem cells (iPSCs). We have developed targeted differentiation protocols and cell culture techniques to generate organoids from iPSCs to model different brain regions including the cerebral cortex. Students will assist with various assays and immunohistochemistry experiments to characterize the brain organoids at structural, functional, molecular and cellular levels. Prior experience not required. Co-mentor: Dr. Kimberly Christian

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Michael Platt

Project 1: Predicting the effectiveness of anti-smoking advertisements using eye-tracking

The reactivity of eyes, such as gaze shift and pupil dilation, reflects a lot about the underlying stream of information processing. Consequently, it's promising to measure how well a piece of information, such as an advertisement, is received from the eye reactivity of the audience. In this project, we aims to establish a set of biometrics based on eye-reactivity to advertisements to predict the effectiveness of the advertisements. Specifically, we will design an eye-tracking experiment to measure gaze and pupil in response to a set of anti-smoking ads in a laboratory sample, and examine whether gaze and pupil in response to each of the ads measured in this laboratory sample can predict the influence of these ads at the population-level. Students will be engaged in setting up eye-tracking experiments, collecting and analyzing the data of gaze and pupil from the laboratory sample. This interdisciplinary project is suitable for students majored in psychology, neuroscience, computer science or marketing with quantitative and programing skills and an interests in the neurocognitive basis of communication.

Dr. Feng Sheng, postdoctoral fellow, will help supervise and mentor students

Project 2: Genomic analysis of Cayo Santiago rhesus macaques

Our research combines intensive field observations of monkey social behaviors with cutting-edge genomics techniques to produce an unprecedented dataset of genes and behavioral patterns. This work allows us to discover how genes and the environment interact to influence social behavior. Because the genomes of monkeys and humans are so similar, we can use our findings in monkeys as a guidepost for understanding the genetics of, and possible treatments for, disorders of social behavior in humans. This is an invitation for two undergraduate students to join as researchers on a project studying the genetic correlates of behavior, cognition, and health in a population of rhesus macaques living on Cayo Santiago island, Puerto Rico. Students will be trained in various computational and statistical packages to develop skills in the field of bioinformatics. In doing so, PURM researchers will incorporate the use of population genomic data to assess the biological impacts of genetic variants on associated animal phenotypes. More specifically, we are interested in how social and genetic variation might impact social proximity scores: Are the genetic correlates of autism spectrum disorder in humans associated with social proximity scores in the primate population? This project is suitable for any biology, biological anthropology, psychology, neuroscience or computer science major with strong quantitative skills and an interest in the biological mechanisms that underlie decision-making in social environments. Students can expect to be exposed to a multitude of research projects concurrently run in the lab across these disciplines.

Please contact Dr. Mike Montague with questions (postdoc, montag@upenn.edu). Dr. Montague will help supervise and mentor students on this project.

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Hongjun Song

Project 1: Epigenetic plasticity in the adult brain

This project is designed to identify mechanisms underlying dynamic epigenetic modifications in the adult brain that may contribute to long-lasting changes in gene expression and cellular plasticity. Recent studies have shown robust and pervasive activity-dependent epigenetic modifications, including DNA demethylation, in post-mitotic neurons. This discovery revealed a new level of regulation for gene expression and provides another mechanism to explain how the brain can encode information about different experiences throughout life. The student will assist in several types of experiments to systematically investigate the molecular mechanisms of epigenetic modifications in response to neuronal activation. Experiments and techniques include mammalian cell culture, molecular biology, and animal surgery. The student will be exposed to advanced sequencing technologies and bioinformatics. No prior experience required. Co-mentor: Dr. Yijing Su

Project 2: Identifying novel markers of neurogenesis and neurodegeneration

This project will take advantage of recent advances in RNA sequencing technology, such as "Drop-seq", to generate molecular profiles of biological processes that occur during neurogenesis and/or neurodegeneration. Students will be exposed to state-of-the-art sequencing technologies and assist with molecular biology techniques including sample preparation and library generation prior to sequencing, ensuring quality standards at each stage of the process, as well as immunohistochemistry techniques for validation. Students will learn the principles behind the sequencing technology and start to learn bioinformatic approaches to identify markers that may reveal novel insights into these fundamental processes involved in brain development and neurodegenerative disorders. No prior experience is required. Co-mentor: Dr. Yijing Su

NEUROSURGERY

Zarina Ali

Project 1: Neurosurgery Enhanced Recovery After Surgery

Though significant advances have been made in neuroanesthesia and perioperative neurosurgical care, spinal surgery still often results in significant postoperative morbidity. Excluding complications related to anesthesia or surgery, the surgical stress response with its increased

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metabolic demands on the body serves as a critical pathogenic factor in postoperative morbidity. Introduced in 1997 by Henri Kehlet, Enhanced Recovery after Surgery (ERAS) proposes a multimodal, evidence-based approach to prepare patients for surgery. The principles of ERAS have been implemented for a variety of surgeries. The evidence to support ERAS with regards to major spinal surgery has been proposed to enable patients a faster recovery and to lower surgical morbidity. Application of ERAS in the neurosurgical arena has the potential to enhance productivity gains and cost savings. However, explicit guidelines are lacking for the neurosurgical spinal patient. We propose to study a prospective cohort of patients undergoing spinal surgery to assess the feasibility and efficacy of a novel ERAS protocol in the neurosurgical population in order to improve postoperative patient satisfaction as well as clinical/functional status.

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

OBSTETRICS AND GYNECOLOGY

Anuja Dokras

Project 1: Differences in Body Image Distress, Depression, Anxiety and Quality of Life measures between women with PCOS and controls

This study aims to identify the prevalence and relevance of body image distress (BID) in women with polycystic ovary syndrome (PCOS). PCOS is the commonest endocrine disorder in reproductive age women. These women have gynecological, dermatologic and metabolic comorbidities. The prevalence of depression and anxiety is high but the etiology is unclear. We propose to survey body image distress, depressive and anxiety symptoms and quality of life in women with PCOS and controls. This data will be analyzed to understand the relationships between BID and PCOS comorbidities. The student involved in this project will recruit and consent subjects, use redcap for data entry, and help analyze the data. The student will be part of the research team at the PENN PCOS center. This currently includes the reproductive endocrinology fellow, obgyn resident, a post bac student and research coordinator. These team members will be available to train the student in the various clinical research tasks listed above. Students with interest in women's health and some prior research experience preferred.

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OPHTHALMOLOGY

Jean Bennett

Project 1: Modeling LCA and RP blinding disorders using gene editing strategies

Blinding disorders such as Leber Congenital Amarousis (LCA) and Retinitis Pigmentosa (RP) are currently untreatable and resulting in a significant burden on patients, families and society. The molecular etiology of many of these disorders have been identified as mutations in genes responsible for ciliary function, protein transport, synaptic interactions, and cellular maintenance and growth, which are expressed either in RPE, bipolar cells, Müller glia (MG), or photoreceptors (PhR). Gene editing strategies, such as CRISPR/CAS9, provide the opportunity to introduce disease causing mutations or correct known mutations to rescue disease phenotypes. Our project will be to introduce mutations in known genes involved in blinding diseases (CRB1, PRPF31, PRFP6). These mutations will be generated in induce pluripotent stem cells (iPSC) where animal models are currently not available for these blinding disorders. The PURM student will be involved in the following activities and trainings: 1) weekly meeting with mentors (Jean Bennett, MD, PhD, Jason Mills, PhD), 2) one-on-one graduate student (Lindsey Weed) mentoring, 3) weekly laboratory meeting, 4) bi-monthly journal club, 5) technical training: iPS cell maintenance and expansion, transfection, microscopy, DNA and RNA isolation, bacterial preps, CRISPR/CAS9 plasmid and RNP construction. Our labs have had many years of mentoring high school students, undergraduates, graduates, fellows and post-doctoral researchers.

Jessica I. W. Morgan

Project 1: Probing the Limits of Vision

The Morgan laboratory in the Department of Ophthalmology studies the human visual system using adaptive optics, a technology which permits visualization of individual light-sensing cells—rod and cone photoreceptors—in the living retina. Using the same technology, we can probe the limits of vision by presenting small light stimuli confined to single or small groups of cones and investigate visual system function both in normal sighted individuals and in patients with retinal disease. This summer project is part of an ongoing effort to incorporate these advanced visual function testing tools into our high-resolution adaptive optics ophthalmoscope. Two overarching goals of this ongoing project are (1) to link cellular-scale structure and function in patients with inherited retinal degeneration, and (2) to better understand how the retina and brain convey information about the world by studying the percepts elicited by stimulating individual neurons in the retina. The student will have the opportunity to participate in data collection and analysis and will be responsible for investigating how eye/pupil movement affects

the delivery of the visual stimulus to the retina. During this project, the student will participate in state-of-the-art ophthalmic research, interact with research subjects, and learn optics and retinal anatomy. In addition to lab work, students will attend weekly lab meetings giving them exposure to all ongoing projects in the lab. Motivated individuals with an interest in bioengineering, clinical research, psychology, biology or neuroscience are encouraged to apply. Prior experience with using Matlab is preferred but not required.

Project 2: Characterizing the Living Human Eye at the Cellular Level

The Morgan laboratory in the Department of Ophthalmology studies the human visual system using adaptive optics, a technology which permits visualization of individual light-sensing cells—rod and cone photoreceptors—in the living retina. With the ability to noninvasively observe the photoreceptor cells comes the ability to quantify parameters of the cell mosaic in the diseased retina in comparison to the normal retina. To date, cone density is the metric most often used to describe the cone mosaic in these high-resolution adaptive optics images. However, our group has found that cone density on its own cannot fully characterize the abnormalities found in patients with inherited retinal degenerations. This summer project will be part of an ongoing research project writing software analysis tools that are aimed at investigating other metrics to characterize the living human eye at the cellular level, including analysis of the reflectance profiles of the individual cells. The student will have the opportunity to participate in data collection, software/analysis development, and application of analysis techniques to imaging data, comparing normal with diseased patient populations. During this project, the student will participate in state-of-the-art ophthalmic research, interact with research subjects, and learn image processing techniques and retinal anatomy. In addition to lab work, students will attend weekly lab meetings giving them exposure to all ongoing projects in the lab. Motivated individuals with an interest in bioengineering, image processing, or computer programing are encouraged to apply. Prior experience with using Matlab, C/C++/C#, or Java is preferred but not required.

Project 3: The Human Connectome Project

The Morgan laboratory in the Department of Ophthalmology studies the human visual system using adaptive optics, a technology which permits visualization of individual light-sensing cells—rod and cone photoreceptors—in the living retina. With the ability to noninvasively observe the photoreceptor cells comes the ability to quantify parameters of the cell mosaic in the diseased retina in comparison to the normal retina. Students will work with data collected from normal and diseased retinas to measure and compare cone densities at several retinal eccentricities and quantify abnormalities in cone density in patients with known retinal pathology. The project will include compilation of a normative database of cone densities which also will be integrated into the human connectome project, and used to compare the variation in normal cone density with the variation in normal visual cortex collected by collaborators using

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

Gui-shuang Ying

Project 1: Literature Review and Meta-Analysis for Design of Clinical Trials of Geographic Atrophy

Many randomized clinical trials for treating geographic atrophy (GA, an advanced type of dry age-related macular degeneration) have been conducted, there is still no effective treatment for GA. Our previous systematic review of GA trials (Ophthalmology Retina, in press) found that GA growth is the most commonly used primary outcome measure. Various natural history studies reported the growth rate of GA and its associated risk factors. Meta-analysis of the GA growth rate and its risk factors from these studies will provide valuable information to design of future GA treatment trials efficiently. This project aims to perform the literature review and meta-analysis for:

1) The annual growth rate of GA
2) The correlation between baseline GA size and the GA growth rate
3) The risk factors associated with faster or slower GA growth.

This project is particularly suitable for undergraduate students who have strong interest in clinical research or clinical trials, and desire to develop skills for data collection and statistical analysis. The student will do the literature search for eligible studies, record the useful data from literature, perform statistical analyses, and lead writing up the results for publication and presentation. The student will undertake this work under the mentoring of an associate professor of Ophthalmology and Biostatistics who has extensive experience in the trial design, conduct, and statistical analysis of data for eye diseases and published over 220 research papers.

Project 2: Proper Analysis of Data for Clinical Trials with Paired-eye Design: A Simulation Study

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Many eye diseases are symmetric, and paired-eye design is often use in clinical trials with one eye assigned to treatment and the follow eye of the same patient as control. To determine the treatment effect of clinical trial, the proper statistical analysis needs to take account for the inter-eye correlation in the same patient and the pre- and post-treatment correlation in the same eye. Several statistical approaches are commonly used for analyzing data from such design, but these approaches may yield different results and it is uncertain which statistical approach is most appropriate. Simulation study for comparing these different approaches under various scenarios may guide us selecting the most appropriate statistical method for analysis data from paired-eye design.

This project is particularly suitable for undergraduate student who has interest in statistics and desire to develop programming skills for clinical research. The student will write codes in statistical software (R, SAS, etc) for simulation study, and summarize simulation results for publication and presentation. Student will undertake this work under the mentoring of an associate professor of Ophthalmology and Biostatistics who has extensive experience in statistical analysis of data for eye diseases.

ORTHOPAEDIC SURGERY

Nathaniel Dyment

Project 1: Elucidating the cellular response within tendon and ligament healing

Tendons and ligaments are one of the most frequently injured orthopaedic tissues. Their limited innate healing potential leads to chronic pain for the patient and a difficult challenge for surgeons and scientists attempting to repair these injuries. One of the significant shortcomings in this field is understanding the origin (i.e., location) and phenotype (i.e., behavior) of cells that contribute to tendon and ligament healing. Our lab utilizes novel transgenic mouse models to tag specific types of cells prior to injury and then map their fate (i.e., determine what they become) during the healing process. We then create injuries in these models to mimic what happens to patients. We finally repair the injury using different surgical and tissue engineering strategies to improve the repair outcome. These studies will be compared to normal growth and development to identify shortfalls in the adult healing process that could potentially be altered to improve the repair outcomes. Students interested in developing regenerative therapies to traumatic injuries will likely enjoy working on this project. Students will learn novel histological, fluorescent imaging, microCT, and biomechanical techniques during this project. Ideally students will continue on with us after the PURM program has ended to continue their training and mentorship.

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Project 2: Defining the cell lineage within tendons and ligaments

Injuries to tendons and ligaments often do not heal on their own and can be difficult to repair surgically. Because of this, people with these injuries often cannot use their joint without significant pain, leading to poorer quality of life. One of the main focuses of our research program is to define cells at different stages of the lineage within tendons and ligaments. Specifically, we aim to identify markers that define a resident stem/progenitor cell, markers that define a terminally differentiated tenocyte, and biological/mechanical stimuli that regulate differentiation. Defining the cell lineage is crucial to improving repair of tendon and ligament injuries as mimicking the normal differentiation process is likely needed for successful outcomes. Currently, tendon cells are thought to be a relatively homogeneous population. However, utilizing novel transgenic fluorescent reporter mouse models, our lab has demonstrated that cells at different stages of the lineage exist. Similar realizations have been found in other fields such as cancer research where we now know that tumor cells are quite heterogeneous, making targeted therapies difficult. A similar case will likely be found in tendons and ligaments, where researchers will need to develop therapies that precisely target specific types of cells within these tissues. Students interested in stem cell biology and cell lineage tracing will likely enjoy this project. Students will learn flow cytometry, cell culture, histological, and imaging techniques using fluorescent GFP mouse models. Ideally students will continue on with us after the PURM program has ended to continue their training and mentorship.

X. Sherry Liu

Project 1: Effects of Lactation and Weaning on Maternal Bone

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

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analysis. An interest in working with animals and a basic understanding of computer programming are helpful for this position.

Project 2: The structure-function relationship in bone due to osteoporosis treatments

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

Foteini Mourkioti

Project 1: Stem cell regulation in muscular dystrophy

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

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Project 2: Innervated engineered muscle to augment functional neuromuscular regeneration after muscle loss

Musculoskeletal injuries leading to volumetric muscle loss (VML) account for the majority of large traumas, often leading in chronic functional deficits. Two of the biggest challenges in tissue engineering of muscle are generating robust skeletal muscle in a dish and facilitating appropriate somato-motor innervations in a patient. The purpose of this study is to investigate the efficacy of pre-innervated tissue engineered muscle in augmenting functional regeneration following clinically relevant VML. We aim to use a co-culture of myocytes (primary culture or freshly isolated adult muscle stem cells) and spinal motor neurons to assess the effect of neurons on growth and morphology of skeletal muscle fibers. These constructs will then be implanted in rat models of VML and functional regeneration of injured muscle will be monitored after injury. We are seeking a motivated individual to work closely with a talented student in the lab (David Sidibe) in the analysis of the muscles. Work will include several techniques, such as animal and tissue handling, stem cell isolation, histology, immunochemistry and quantification using an imaging software. As a result of these efforts, the student is going to be a co-author in any publication, which will utilize these experimental efforts. We anticipate that the proposed studies will lead to accelerated development of a new technology to ultimately enhance functional recovery of diseased muscles.

Project 3: Essential telomeric protein is cardiac development and disease

Cardiogenesis is a sensitive developmental process that requires myogenesis and morphogenesis to occur simultaneously with contractility. Any perturbation in the cells that participate in cardiac development results in embryonic/perinatal lethality or subtle cardiac anomalies that become evident with age. Congenital heart disease is the most common human birth defect occurring in 1% of the population worldwide, whereas another 1-2% harbor mild cardiac developmental defects that deteriorate over decades. Despite emerging therapies, the prevalence of heart disease continues to increase worldwide, highlighting the need to better understand heart development and cardiac disease etiologies. Our lab recently demonstrated for the first time that cardiomyocyte-specific telomere shortening is a hallmark of heart failure in humans. These human findings highlight the need to fully understand telomere dynamics by studying mouse models that take cardiomyocyte telomere biology into account. We recently generated mice that carry a mutation of one of the telomeric proteins specifically in cardiomyocytes and found that these mice are embryonic lethal. We are seeking a motivated individual to work closely with Dr. Mourkioti in the lab in the cardiac analysis of these mice. Work will include several techniques, such as mouse and tissue handling, cardiomyocyte isolation, Westerns, RNA isolation, cardiac histology, immunochemistry and quantification using an imaging software. As a result of these efforts, the student is going to be a co-author in any publication, which will utilize these experimental efforts. We anticipate that by identifying the primary nature of telomeric-mediated cardiac defects will uncover previously unknown etiologies for cardiac birth abnormalities, providing valuable insights for curing cardiac birth defects in the future.

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Comron Saifi

Project 1: Motion Analysis of Activities of Daily Living in Patients with Spinal Pathology

This is a prospective study to determine functional outcome measures for patients with spinal pathology who undergo spine surgery. Patients have motion analysis, including gait, stairs, and force plate analysis, prior to surgery. Patients then undergo the same functional testing post-operatively. The student would be able come to the operating room and observe spine surgeries. Students would be responsible for working with patients and the staff in the motion analysis lab to collect and analyze data.

Project 2: The rise of neuromonitoring throughout the United States over the past decade

Neuromonitoring consisting of MEP, SSEP, and EMG are utilized in the operating room during spine surgery to minimize the risk of neurologic injury. This is a big data study that is in the final stages. The student's responsibilities include creating graphs/figures and helping to write the manuscript.

Project 3: Textbook Chapter in Spinal Deformity Surgery

Chapter on spinal deformity surgery in a prominent spine surgery textbook. The chapter includes a multimedia component which will require filming a spinal deformity surgery done here at Penn. The student would assist in collecting references, filming of the surgery, video editing, and assisting with authorship of the chapter.

Louis Soslowsky

Project 1: Orthopaedic Bioengineering

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

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OTORHINOLARYNGOLOGY

Jason Brant

Project 1: Novel Cochlear Implant Electrode

Cochlear implants are the only medical device that can restore a human sense and have become the standard of care for severe hearing loss. Although they can be transformative for patients who cannot benefit from hearing aids, they still do not approach normal hearing. This project proposes a novel design for a cochlear implant electrode to overcome existing limitations. The student will be involved with design and fabrication of prototype electrodes and testing in artificial and cadaver cochleae. They will learn nanofabrication techniques, surgical techniques and anatomy, and principles of stimulation of the nervous system. This project is ideal for students with an engineering background interested in medicine or surgery and is being jointly mentored by Flavia Vitale, Ph.D. from the Center for Neuroengineering and Therapeutics.

Project 2: 3D Neural Constructs for Hearing Restoration

Rehabilitation of hearing loss via stimulation of the central auditory pathways has achieved limited clinical success. Novel methods for accessing these complex pathways are needed to develop suitable brain-machine interfaces for the restoration of natural hearing. An innovative approach for reestablishment of damaged neural pathways has been developed by the Cullen Lab at UPenn, but this strategy has yet to be applied to the auditory system. The proposed project will be to adapt the anatomically-inspired 3D neural constructs developed by the Cullen Lab, termed “living electrodes”, for integration with - and stimulation of - the central auditory pathways. These constructs will be developed and tested in vitro before being transplanted into an appropriate animal model to evaluate auditory perception generated by the technique. The project represents a unique combination of bioengineering and neurophysiology with direct applications for future translational work. This project is ideal for a summer term, however it may form the foundation for an expanded, longer-term project moving forward.

Noam Cohen

Project 1: Chemosensory testing of patients with chronic rhinosinusitis

The hypothesis of our laboratory is that the same taste proteins on the tongue that allow us to perceive sweetness and bitterness are also present in other parts of the body, so defective taste receptors that lead to 'taste blindness' contribute to problems elsewhere, perhaps leading to susceptibility to infections. We are developing a taste bioassay for patients in the clinic to

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evaluate protein function by having them sort (by tasting) rising concentrations of sucrose and bitter compounds in the correct order. Inaccurate sorting indicates they may have inborn problems in their taste receptors. We are would like a summer student to help with the chemosensory testing of patients with or without chronic rhinosinusitis. Ultimately, this project may generate data that will help stratify patients to different therapeutic options.

Project 2: A taste for R programming: coding statistical analysis of sorting data

The hypothesis of our laboratory is that the same taste proteins on the tongue that allow us to perceive sweetness and bitterness are also present in other parts of the body, so defective taste receptors that lead to 'taste blindness' contribute to problems elsewhere, perhaps leading to susceptibility to infections. We are developing a taste bioassay for patients in the clinic to evaluate protein function by having them sort (by tasting) rising concentrations of sucrose and bitter compounds in the correct order. Inaccurate sorting indicates they may have inborn problems in their taste receptors. We would like a summer student to program using either R (preferred) or Python a script capable of analyzing the clinic taste data and making the script mobile-enabled for the clinic. We favor students with programming experience, who have an interest in medicine and are curious about the sense of taste.

Erle Robertson

Project 1: Training in Tumor Virology

The Robertson Laboratory continues to support undergraduate trainees who are interested in biomedical research during their tenure at Penn. Over the last 16 years we have supported many undergraduates who have gone on to careers in Medicine and Biomedical research by pursuing MD, PhD and MD, PhD degrees. Our group investigates the mechanisms of oncogenesis by viral agents and the human microbiome. We focus on how these infectious agents drive the oncogenic process through initiation and progression of these cancers via targeted dysregulation of a number of cellular processes. We investigate these questions using a wide range of molecular biology tools which includes biochemistry, genetics, epigenetics, molecular biology and cell biology to determine the fundamental mechanisms by which these agents disrupt cellular processes. The majority of undergraduates who are focused, determined and have a curious mind as well as the will and drive to succeed have flourished in our lab, as seen by co-authorships on many publications by themselves or working with graduate students and post-doctoral trainees.

Some specific projects include understanding the role of Epstein Barr Virus (EBV) oncoproteins in dysregulating cell cycle and tumor suppressors; Kaposi’s sarcoma associated herpesvirus (KSHV) antigens which regulate genome replication and oncogenic activities which enhance cell survival and apoptosis. Ongoing work also involves identification of the Oncobiome associated

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with a range of different cancers and development of drugs that can target hematologic malignancies with the potential to go on to phase 1 trials in the near future. These studies will allow students to develop a vast array of technical cutting-edge skills that will position them for success in biomedicine.

PATHOLOGY

Naiara Aquizu Lopez

Project 1: Uncovering Causes of Phenotypic Variation in Two Scar20 Mouse Models

Spinocerebellar ataxia autosomal recessive 20 (SCAR20) is a form of spinocerebellar ataxia characterized by perinatal onset loss of cerebellar tissue and intellectual disability. Recent studies have identified loss of function mutations in the gene Sorting Nexin 14 (SNX14) as the underlying cause of SCAR20, however pathogenic mechanisms remain mostly unknown. In order to determine how SNX14 mutations lead to SCAR20 we recently generated two Snx14 mutant mouse models using CRISPR/Cas9 gene editing technology. Although the two models bear genetic deletions that cause a reading frame shift and a premature stop codon on Snx14 gene, they are phenotypically different. The goal of this project is to determine the cause of the phenotypic variation between the two mouse models. To do this, the student will analyze SNX14 RNA and protein levels by RT-PCR and western blot analysis respectively. In parallel she/he will sub-clone the wild type and the two genetic variants of Snx14 with a N-terminal flag in a mammalian expression plasmid. The student will then transfect a mammalian cell line (Hek293T) with the three expression plasmids and determine levels of full length SNX14 protein or shorter fragments by western blotting with anti-Flag antibody. This work may uncover unexpected intracellular mechanisms to deal with frameshift mutations and/or novel functions of SNX14 protein fragments. The student will be trained by PI and personnel in the lab and expected to become more independent progressively. Student will gain technical experience but also critical scientific thinking by participating in weekly lab meetings and scientific discussions.

Project 2: Uncovering Intracellular Snx14 Interacting Partners

Spinocerebellar ataxia autosomal recessive 20 (SCAR20) is a form of spinocerebellar ataxia characterized by perinatal onset loss of cerebellar tissue and intellectual disability. Recent studies have identified loss of function mutations in the gene Sorting Nexin 14 (SNX14) as the underlying cause of SCAR20. SNX14 is a poorly characterized protein involved in lysosomal function regulation. In order to determine how SNX14 regulates lysosomal function we recently identified several interesting potential intracellular interacting proteins. The goal of this project is to validate these interactions in relevant model systems. To do this, the student will co-transfect

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plasmids encoding Flag tagged Snx14 and candidate interacting proteins in neural and non-neural cell lines. SNX14 will be pulled down with an anti-Flag antibody and interacting proteins analyzed by western blot. Positive interactions will be further validated by co-immunostaining of endogenous SNX14 and interacting proteins in cell culture and mouse brains. This work may uncover new interacting partners that will suggest mechanisms by which Snx14 regulates lysosomal function and will set the foundation for future projects. The student will be trained by PI and personnel in the lab and expected to become more independent progressively. Student will gain technical experience but also critical scientific thinking by participating in weekly lab meetings and scientific discussions.

Michael Cancro

Project 1: Mechanisms regulating the Tbet+ B cell fate

Tbet+ CD11c+ B cells are associated with virus-specific immune responses and with humoral autoimmunity in both mice and humans. Our lab has recently shown that the cytokines IL4, IL21, and IFN-gamma interact to determine Tbet and/or CD11c expression in murine B cells stimulated by Toll-like receptor 9 (TLR9). The student will be part of a team working on a project to investigate intracellular mechanisms through which these cytokines regulate the Tbet+ B cell fate. Team members who may be involved in mentoring (in addition to Dr Cancro) are Drs JL Scholz, A Myles, or J Knox, graduate student R Rosenthal, and technicians M Kostiv or J Madej. The student will learn how to magnetically sort and culture murine B cells; receive an introduction to flow cytometry; attend and present data at weekly lab meeting;, and complete assigned lab chores. Pre-requisites are a strong interest in immunology, prior examples of successful self-monitoring, and a minimum B grade average in freshman and sophomore chemistry and biology courses.

Paula Oliver

Project 1: A cullin E3 ligase that regulates pathogen clearance and adaptive immunity

One core feature of an adaptive immune response is the activation and clonal expansion of antigen-specific T cells. Clonal expansion allows for a massive increase in the numbers of antigen-specific T cells, generating millions of cells from a small number of naïve precursors. As T cells expand, they differentiate into CD4+ helper cells, that direct the generation of antibody secreting plasma cells, or become cytokine producing CD4+ and CD8+ effector and cytolytic T cells, that promote pathogen clearance. Since clonal expansion was discovered in the 1950's, we have accumulated a detailed perspective on the signals and transcription factors required for T cells to expand, and we have defined the factors required for their differentiation into specific

effector and memory subsets. However, many of the regulatory mechanisms that control the numbers of T cells that provide protective immunity remain unknown. We have discovered a novel E3 ubiquitin ligase pathway that regulates the homeostasis of CD8+ T cells as well as the expansion and survival of antigen-specific CD4+ and CD8+ T cells. This project will focus on exploring how this relates to T cell function, pathogen clearance and underlying biochemical mechanisms. This project will be under the direction of a postdoctoral fellow in the lab.

Project 2: Itch regulation of B cell metabolism, antibody production and autoimmunity

The NIH estimates that up to 23.5 million Americans suffer from autoimmune disease. The majority of autoimmune diseases depend on pathogenic autoantibodies that arise from dysregulated germinal centers. Germinal center (GC) formation and maintenance requires complex interactions between activated B and T helper (Th) cells, and defects in either B cells, Th cells, or both can lead to the emergence of autoantibodies from germinal centers. The E3 ubiquitin ligase Itch is required to prevent autoimmune disease, and loss-of-function mutations in Itch is sufficient to drive severe autoimmune disease in both mice and humans. We have determined that Itch limits the magnitude of GC B cells and antibody production. This correlates with a role for Itch in limiting GC B cell proliferation and glycolytic metabolism. In this project we will further explore the underlying metabolic changes that fuel B cell proliferation and GC B cell numbers and define the mechanisms by which Itch limits these functions. Our hope is that this work will ultimately be used to develop new therapies with which to treat autoimmune disease. This project will be under the direction of a postdoctoral fellow in the lab.

PEDIATRICS

Lamia Barakat

Project 1: Development of a Decision Support Tool (DECIDES) for Adolescents and Young Adults with Cancer and their Caregivers

Compared to their younger and older counterparts, adolescents and young adults with cancer (AYA) are considered underserved and vulnerable with increased morbidity and mortality including psychosocial challenges during and after cancer treatment. One explanatory factor for limited survival rates is reduced AYA participation in clinical trials in this age group, which may exacerbate morbidity or mortality for AYA while slowing advances in treatment. Consequently, the AYA Committee of the Children's Oncology Group (COG: international cooperative of institutions offering pediatric clinical trials for the study and treatment of cancer) has designated the lack of clinical trials enrollment for this age group as a priority area for research initiatives. Our prior research suggests that AYA and their primary caregivers need support in

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understanding cancer, cancer research, and Phase III clinical trials, including access to information, the ability to review trial materials and ask questions, and a structure to facilitate AYA inclusion in decision-making. In addition, AYA and their caregivers may benefit from the opportunity to make treatment decisions based on their values. The proposed study will test the acceptability and feasibility of an engaging, theoretically informed, web-based decision aid (DECIDES) for newly diagnosed AYA and their caregivers. DECIDES was developed through an iterative process with stakeholder input for AYA newly diagnosed with cancer and their primary caregivers and includes information and activities to improve knowledge of cancer and cancer clinical trials, a values clarification exercise, and resources for AYA with cancer. We expect that AYA and their caregivers who are provided with DECIDES will report positive decision processes and make decisions aligned with their values.

The PURM student will learn about psycho-oncology and behavioral research methods by participating in a range of research tasks including medical file review, recruitment of potential participants in the study, shadowing DECIDES implementation and data collection, and conducting a critical review of the literature. The PURM student, an active member of our research team, will also participate in biweekly research meetings related to this project and will be encouraged to attend other Behavioral Oncology Program research meetings as well as lectures and seminars at CHOP to gain a better understanding of research processes and pediatric health care disciplines. The PURM student will receive mentorship from Dr. Barakat and behavioral oncology clinical research coordinators--Evelyn Stevens, MPH, and Blanca Velazquez-Martin, MA.

Heather Burris

Project 1: Spatial Patterns of Spontaneous Preterm Birth in Philadelphia

There are massive racial and socioeconomic disparities in preterm birth risk. Using Penn Medicine's Database, we will identify all preterm births over a 10-year period, and then determine which preterm births were medically-indicated or spontaneous. We geocode each woman's address to assign census tracts/block groups to each woman for the purpose of identifying spatial patterns and environmental characteristics that may track with excess spontaneous preterm birth risk. We will use multilevel modeling tools to understand the relative contributions of individual- and area-level variables to spontaneous preterm birth risk. The student will help contribute to data acquisition, analysis, and craft an abstract for submission to a national medical meeting.

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Leslie Castelo-Soccio

Project 1: Stigma of Skin disease in Pediatric Patients

This is a Pediatric Dermatology Research Alliance Project looking at stigma associated with chronic skin disease. It uses a series of validated instruments to measure the effect of highly visible, chronic skin disorders, including atopic dermatitis (AD), Alopecia, Vitiligo, Genetic skin disease, on patients 8 years of age and above in causing stigma and psychiatric issues, particularly anxiety and depression. These include measures in the PROMIS (Patient Reported Outcomes Measurement Information System) toolbox, among them short form assessments for pediatric anxiety, depression and social functioning, as well as a modified Neuro-QoL stigma instrument that includes skin-specific questions. Patient and parental instruments will be used to allow comparison in outcome assessment. Through quantifying the extent of stigma and correlating it with disease severity, parental responses about stigma, and the occurrence of anxiety, depression and social functioning we expect to generate data that can be used to measure the value of disease intervention and to measure the burden of stigma to support the development of new therapeutics and strategies to support patients and their families. Opportunity to interact with patients while consenting and providing surveys. Opportunity to be part of a larger group of researchers interested in improving care for patients with chronic disease. Opportunities for additional case report write-ups and projects based on student interest. Mentor: Leslie Castelo-Soccio, MD, PhD

Project 2: Natural History of Pediatric Atopic Dermatitis

This study is a retrospective cohort study using existing electronic health records from CHOP PEDSnet, a large multi-specialty pediatric learning health system and existing data from the national Ambulatory Medical Care Survey (NAMCS) to examine the variation in the use of systemic medication and phototherapy for AD. Student will have the opportunity to gather data, learn about an exciting pediatric learning health system. Student would work with two dermatologists-one with PhD training in epidemiology and statistics and the other the research director of the section. Opportunities for additional case report write-ups and projects based on student interest. Mentor: Primary Leslie Castelo-Soccio, MD, PhD Secondary Joy Wan, MD,PhD.

Project 3: Access to Care in Pediatric Dermatology

This is a project that will include retrospective chart reviews and surveys of patients and providers to understand what leads to difficulties with access to dermatology care. Student would have opportunity to see patients as an observer, learn and perform reviews of the medical record, write about access to care issues and be an important part of the pediatric dermatology research team. Opportunities for additional case report write-ups and projects based on student interest. Primary Mentor: Leslie Castelo-Soccio, MD, PhD; Secondary Mentor: Joy Wan, MD, PhD

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Lori Christ

Project 1: Validation of a new automatic image based screening technique for hyperbilirubinemia in neonates

Jaundice is an important medical issue in the newborn; if left undiagnosed and untreated, elevated bilirubin levels can lead to severe neurologic sequelae. In the United States, neurologic complications due to hyperbilirubinemia are rare due to a robust screening program; however, in resource limited countries these complications are far more common. Smartphone based screening tools are inexpensive and could meet screening needs in resource limited settings.

This study validates a smartphone-based application (BiliScan) against laboratory evaluation of serum bilirubin levels in well newborns.

Student duties will include identifying well newborns eligible for the study via chart review, approaching families for consent for the study, and maintaining study data records (demographic data, bilirubin results). The mentor and study staff will provide training and orientation. The student must obtain online CITI certification and meet all other requirements put forth by the IRB for study staff.

The student will also have an opportunity to observe other clinical neonatology studies in progress, as well as become familiar with the newborn nursery and neonatal intensive care unit (NICU) environment at the Hospital of the University of Pennsylvania.

Marcella Devoto

Project 1: Identification of disease causing mutations in children with very early onset inflammatory bowel disease

Very early onset inflammatory bowel disease (VEO-IBD) is a severe disease affecting very young children (<6 years old). Although the primary manifestation is IBD, the disease in young patients is more severe than the common, adult onset form, and conventional therapy is often unsuccessful. We use whole exome sequencing (WES) of patients' DNA to identify disease-causing mutations, and this approach has in some cases allowed to direct treatment to the underlying molecular defect, with resolution of the disease. We have recruited more than 300 patients into our study, possibly the world largest single-center study of VEO-IBD. Students working on this project will learn about the clinical characteristics of the disease, and how to correlate these to the DNA variants identified by WES to perform meaningful interpretation of

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genetic data. They will learn to perform bioinformatics analysis of WES data and apply bioinformatics approaches to identify disease causing mutations. They will interact with all members of our group, including two pediatric gastroenterologists (Drs. Judith Kelsen and Maire Conrad) and a bioinformatician (Dr. Noor Dawany), in addition to Dr. Devoto. They will participate in group meetings where results will be presented and discussed. Results of this work are typically presented at national and international gastroenterology and genetic conferences and published in top-tier peer-reviewed journals, and students contributing to it will be co-authors of any such publications. Students interested in pre-med curriculum or computational biology are particularly encouraged to apply. Some knowledge of genetics and/or bioinformatics or computer programming would be preferable.

Project 2: Genome-wide association study of biliary atresia

Biliary atresia (BA) is a rare, severe pediatric disease characterized by cholestasis, fibrosis, cirrhosis, and liver failure. The etiology of BA remains unknown, although environmental, inflammatory, infectious, and genetic risk factors have been proposed. One approach to identify genetic variants responsible for disease susceptibility is genome-wide association study (GWAS) of single nucleotide polymorphisms (SNPs). Through GWAS, millions of genetic variants are compared in the DNA of patients and controls, to identify those that are more frequent in the patients and therefore associated to disease risk. Our group has performed a GWAS in US patients and identified a BA candidate gene, EFEMP1. The goal of this project is to analyze data from a sample of Polish BA patients and controls, and test whether the association of BA with EFEMP1 is confirmed. Students will learn about BA, to perform bioinformatics analysis of SNP array data, and apply statistical tests for association between disease and genetic variants. They will interact with members of our group, including a pediatric gastroenterologist (Kathleen Loomes, MD), a geneticist (Nancy Spinner, PhD), and a bioinformatician (Ramki Rajagopalan, MSc), in addition to Dr. Devoto. They will participate in group meetings where results will be presented and discussed. Results of this work are typically presented at gastroenterology and genetic conferences and published in top-tier peer-reviewed journals, and students contributing to it will be co-authors of such publications. Students interested in pre-med curriculum or computational biology are particularly encouraged to apply. Some knowledge of genetics, bioinformatics or computer programming is preferable.

Marni Falk

Project 1: Investigating role of Mitochondrial Complex I in the progression of ALS

Our lab employs the model organism Caenorhabditis elegans (C. elegans) to understand mitochondrial physiology and function, with a major focus of mitochondrial complex I.

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Recently, it has been demonstrated that perturbations in mitochondrial function can lead to neurodegenerative diseases, such as amyotrophic lateral sclerosis (ALS). Therefore, we are interested in understanding whether mitochondrial complex I plays a role in the progression of ALS phenotypes driven by mitochondrial dysfunction. Superoxide Dismutase 1 (SOD1) is a major antioxidant protein which is ubiquitously expressed and predominantly localized in cytoplasm but also can be found in mitochondria, nucleus, and endoplasmic reticulum. Loss of SOD1 function has been implicated in 15-20 % cases of Familial ALS and over 200 mutations in SOD1 have shown to cause ALS. Transgenic worm strains with pan-neuronal expression of a mutant version of human SOD1 will be used, which show abnormal motility and protein aggregation, and are validated as a tool to study ALS disease progression and to screen for therapies.

The summer student will learn and perform effective behavioral and phenotype assays using microscopy and an automated worm behavioral imaging technique (WorMotel) to investigate the role of Complex I in the progression of ALS, and to test candidate therapies that treat this disease. They will work under the supervision of PhD researchers in the lab and get hands on experience in the following areas: C. elegans microscopic nematode handling and maintenance, molecular biology techniques (RNAi, PCR), imaging and cell sorting (confocal microscopy and COPAS biosorter), and high-throughput lifespan analyses (WorMotel).

Project 2: Evaluating therapies for mitochondrial disease using CRISPR/Cas9 Genetics Models

We utilize CRISPR/Cas9 to generate knock-out and human disease mutation knock-in models of diverse primary mitochondrial disorders. These include genes involved in the function of the electron transport chain, and other metabolic diseases. These animals have a range of phenotypes affecting survival, behavior, physiology, and histology read-outs that are readily quantifiable. The student will partner with a PhD researcher to learn zebrafish husbandry/maintenance, phenotype analysis, and drug screening, under the guidance of Dr. Falk and the CHOP Zebrafish Core Director, Christoph Seiler, PhD.

Project 3: Human cell line studies to evaluate mitochondrial disease therapies

We utilize human cell lines from primary mitochondrial disease patients in which to functionally validate and understand the mechanisms of novel genetic causes we find that are suspected to cause disease. These lines are also used to evaluate the cell processes that are abnormal in mitochondrial disease, and to screen new therapies to be used as well as toxins to be avoided in patients with mitochondrial disease.

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Rebecca Ganetzky

Project 1: Nutritional regulation of Mitochondrial Complex V (ATP Synthase)

Mitochondrial complex V is the part of the mitochondria that actually generates ATP. This complex molecule essentially acts as a motor: releasing the proton gradient generated by the electron transport system, capturing the electrical energy and converting it first to kinetic energy, spinning the catalytic domains, and then to chemical energy in the form of ATP. The complexity of the enzyme allows multiple opportunities for regulation.

In invertebrates, the nutritional status of the cell directly regulates complex V. I am interested in figuring out whether nutrients regulate complex V activity in human cells. Learning this could help treat patients with mitochondrial disease. In this project, we will manipulate the nutritional status of human fibroblasts and measure the effects on complex V activity in normal human cells. If time permits, we will also try nutritional changes in cells with a genetic defect of complex V activity. Responsibilities include human cell culture and treatment, measuring ATP levels using a kit and potentially more advanced biochemical assays depending on student interest and background. Basic wet lab experience (pipetting, making solutions) is required; sterile technique experience is preferred. In addition to Dr. Ganetzky, the supervisory group would also include Sheila Clever, technician, who can help with training and troubleshooting.

Project 2: Facial differences in subjects with genetic mitochondrial disease

Genetics diagnoses can often be made based on differences in facial features ("dysmorphic features"). For example, Down Syndrome is a genetic diagnosis that is often recognizable from facial features. My area of interest is helping diagnose patients with inherited diseases of the mitochondrial respiratory chain ("mitochondrial disease.") This category of diseases is extremely challenging to diagnose and there is often a lag between the presentation of symptoms and making a successful diagnosis. In our clinical practice, our group has noticed that people with mitochondrial diseases sometimes have different facial features. We are interested in determining whether this is a true association and whether there are recurrent facial differences that could help with diagnosis.

The student would perform chart review of a cohort of ~100 patients with genetically-confirmed mitochondrial disease and track recorded facial differences, patient age, clinical features and the type of mitochondrial disease. They would then perform statistical analysis of how many patients have facial differences, and what facial differences seem to be common. Subgroup analysis would also be possible if time permits. Depending on student interest, we could also evaluate facial photographs using software designed to detect dysmorphic features and compare computer-based facial evaluation with expert evaluation. No prior experience is needed. In addition to Dr. Ganetzky, the supervisory group would also include Colleen Muraresku, certified

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genetic counselor, who can help with understanding any ambiguous information on chart review. Statistical support is also available.

Project 3: Biochemical analysis of zebrafish

Zebrafish are good animal models for better understanding genetic disease because they are transparent, reproduce extremely quickly and are very easy to modify genetically. Our group is using zebrafish embryos to model many genetic mitochondrial diseases. In human cell models and animal models of mitochondrial disease, we are able to measure ATP levels, mitochondrial function (how good mitochondria are at oxidative phosphorylation), lactate levels (as a sign of reliance on glycolysis) and other biochemical markers. However, many of those methods have not yet been fully developed for zebrafish.

We are looking to further develop biochemical techniques for zebrafish, by finding ways to apply established techniques to zebrafish embryos. In this project, the student would be responsible for breeding zebrafish, collecting embryos and preparing zebrafish larvae in different ways for biochemical analysis. We would work together to apply previously established biochemical techniques (ATP luciferin/luciferase assays, respirometry, organic acid analysis and others) to the larvae and the student would be responsible for comparing the results across preparation techniques to determine the best methods. Prior experience with basic wet lab techniques (e.g. pipetting and making solutions) is preferred; no zebrafish experience is necessary. The student would work with Dr. Ganetzky, Sheila Clever (research technician) who can help with training and members of the zebrafish research core at CHOP, who can also help with training and troubleshooting.

Louis Ghanem

Project 1: Role of the Poly(c) binding protein family (Pcbp's) of RNA-binding proteins in the differentiation and maintenance of the gastrointestinal epithelium.

The successful student will participate in established research studying mammalian intestinal epithelial development and function. Studies employ Pcbp conditional knockout mice and primary intestinal stem cell cultures ("enteroids"). A major area of focus within these models is the study of post-transcriptional gene regulation mediated by protein:RNA interactions. The student will employ standard genetic and molecular techniques to facilitate investigation of Pcbp gene functions in mice and cell culture systems. The student will operate within a fun multi-laboratory working group in the Department of Pediatrics at CHOP and Department of Genetics at Penn. Training required for specialized procedures and methods (e.g., enteroid culture) is expected and will be provided by the PI or current laboratory personnel.

Project 2: Role of the Poly(c) binding protein family (Pcbp's) of RNA-binding proteins on T cell function and inflammation

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The successful student will participate in established research studying animal models of CD4+ T-cell mediated inflammation under the direct supervision of the PI and senior members of the laboratory. A major area of focus within these models is the study of post-transcriptional gene regulation mediated by protein:RNA interactions. The student will employ standard genetic and molecular techniques to facilitate investigation of Pcbp gene functions in mice and cell culture systems. The student will operate within a fun multi-laboratory working group in the Department of Pediatrics at CHOP and Department of Genetics at Penn. Training required for specialized procedures and methods (e.g., PCR, genotyping, immune cell purification, T cell culture, immunostaining, flow cytometry) is expected and will be provided by the PI or current laboratory personnel.

Erik Jensen

Project 1: Efficacy of zinc supplementation for improving growth in premature infants

Extremely premature infants are at high risk for growth restriction (particularly in poor growth in length) after birth. Zinc supplementation has been shown to improve growth in developing countries where adequate nutrition is not always available. Whether zinc also improves growth in medically complex preterm infants in developed countries is unknown. We have treated > 100 babies in the CHOP neonatal intensive care unit with oral zinc following a diagnosis of postnatal growth restriction. The proposed project will be a retrospective cohort study (using existing data) to evaluate changes in growth (weight, length, head circumference) before and after starting zinc. This project can be completed, start to finish, within a summer research experience.

The student's duties will involve mentored drafting of an IRB application, some medical chart review (much of the necessary data is available for download from the CHOP data warehouse), and mentored data analysis. The student will have the opportunity to work with members of the neonatal chronic lung disease team at CHOP including physicians and dietitians. Shadowing on ward rounds and in case conferences will also be available. We expect this project to lead to a first authored abstract for presentation at a local and/or national meeting and a journal publication. We have a strong track record of helping students and young trainees reach this goal. There are no prerequisites required, but an interest in medicine and pediatrics/neonatology specifically may improve motivation and the overall experience.

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Shana McCormack

Project 1: Carbohydrate and fat metabolism in cell models of mitochondrial impairment

Individuals with genetic disorders affecting the mitochondria are more likely to develop diabetes. To determine the mechanistic basis for altered carbohydrate and fat metabolism, we use pharmacologic and genetic-based cell models of mitochondrial disruption to complement human studies. For this project, we test the metabolic effects of pharmacologic disruption with mitochondrial inhibitors (rotenone, a complex I inhibitor; antimycin A, a complex III inhibitor) in liver-like and muscle-like human cell lines. To support parallel work in vivo, we have expanded this work to test the impact of varying hormonal (e.g., insulin) and nutritional (e.g., glucose) concentrations on intermediary metabolism in the setting of respiratory chain impairment. Organic acid extraction and isotope measurement by mass spectrometry and analysis is being performed. The student's main responsibility is to complete organic acid extraction from cells, and learn techniques to analyze metabolic flux data. It is anticipated that the student would be involved in the collation of analyses for a manuscript. The student will learn under direct supervision from the PI and members of her research team.

Dr. McCormack is a pediatric endocrinologist at the Children's Hospital of Philadelphia and an Assistant Professor of Pediatrics at the University of Pennsylvania Perelman School of Medicine. Her translational research program is focused on the neuroendocrine systems that regulate energy balance in humans, and how these operate during childhood and adolescence in both health and disease. She has a particular interest in the role of disordered mitochondrial metabolism in the pathogenesis of obesity-related health problems like type 2 diabetes. To gain novel insights, she studies endocrine function in individuals with primary genetic mitochondrial disorders and other rare conditions.

Project 2: Skeletal muscle mitochondrial function in humans with mitochondrial disorders

Individuals with genetic disorders affecting the mitochondria are more likely to develop diabetes. The goal of the parent study is to characterize the association between mitochondrial function and glucose metabolism in humans with primary mitochondrial disease and "typical" diet-induced obesity subjects, relative to healthy volunteers. For this project, the student will learn to analyze skeletal muscle phenotyping data generated using magnetic resonance imaging (MRI). Specifically, this imaging technique yields information about muscle mitochondrial function that informs our study of the relationship between muscle mitochondria and diabetes. It is anticipated that the student would be involved in the collation of analyses for a manuscript. The student will learn under direct supervision from the PI and members of her research team.

Dr. McCormack is a pediatric endocrinologist at the Children's Hospital of Philadelphia and an Assistant Professor of Pediatrics at the University of Pennsylvania Perelman School of Medicine. Her translational research program is focused on the neuroendocrine systems that regulate energy

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balance in humans, and how these operate during childhood and adolescence in both health and disease. She has a particular interest in the role of disordered mitochondrial metabolism in the pathogenesis of obesity-related health problems like type 2 diabetes. To gain novel insights, she studies endocrine function in individuals with primary genetic mitochondrial disorders and other rare conditions.

Cynthia Mollen

Project 1: An exploration of the utilization of pediatric health care facilities by trafficked youth in Philadelphia

Context: There is a growing awareness of the problem of the trafficking of minors in the U.S. While survey data in the existing literature have shown a majority of trafficked victims do access medical care during their exploitation, the research has mainly been on adults. Fewer studies focus on minors exclusively, and little is known specifically about the interaction of trafficked minors with the health care system during their period of exploitation.

Objectives: Explore which pediatric health care settings trafficked youth in Philadelphia are presenting to during their period of exploitation, and to elicit ideas for how pediatric health care providers can safely and sensitively assist in identifying and intervening on behalf of trafficked minors.

Study Design: A qualitative methods design using semi-structured interviews to explore the experiences of approximately 30 previously trafficked minors with the local healthcare system during their exploitation.

Setting/Participants: Interviews will take place at the Covenant House in Philadelphia, PA. Participants are adolescents between the ages of 18-21 years old who have been trafficked prior to their arrival at the Covenant House.

Study Interventions and Measures: The raw data will consist of narrative responses to the semi-structured interviews, and basic demographic data. The interviews will be based on an interview guide developed by the investigative team. They will be digitally recorded and later transcribed. The transcriptions will then be analyzed using a modified grounded theory approach in order to identify and synthesize recurring themes and identify any quantitative attributes that are linked to specific themes in a patterned way.

Student Responsibilities: Attend one-on-one training sessions with mentor and project PI on qualitative research methods and use of NVIVO software for transcript coding. Attend team meetings to discuss coding of interview transcripts. Code assigned transcripts in NVIVO and participate in team analysis of the data. The student will be participating in data analysis, and

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will NOT be used as a transcriber. Transcripts will be transcribed by a professional transcription company.

Student Pre-requisites: None, although interest in a career in medicine and care of the underserved and vulnerable populations would be a plus, and prior experience with anthropological or qualitative research methods and interview analysis would be helpful. The student should be self-motivated and interested in writing and thematic analysis. An interest in a career in medicine is also a plus, as the student would benefit from working directly with pediatric emergency medicine faculty and this may lead to opportunities for clinical shadowing, volunteering, or further project involvement. The PI on this project is public health and advocacy oriented and with the right student, would be willing to involve him/her in further work.

Steve Paridon

Project 1: Exercise Stress Test Normative Data in Healthy Children

We will be evaluating exercise stress test data in healthy children to define normative data for healthy children. The goal will be to establish new normative data for healthy children undergoing exercise stress tests using the largest comprehensive exercise stress testing to date. The student will help with data collection and analysis under the guidance of co-PI's Dr. Steve Paridon and Dr. Julie Brothers in the department of Pediatric Cardiology at the Children's Hospital of Philadelphia.

Ronald Rubenstein

Project 1: Novel Drug Therapies for Cystic Fibrosis

We are interested in novel drug therapies for cystic fibrosis (CF). By understanding the molecular defects in the mutant Cystic Fibrosis Conductance Regulatory Protein (CFTR), which is absent in the disease, we aim to use novel pharmaceuticals to overcome those molecular defects and "repair" the dysfunctional CFTR. We have focused on the repair of the most common CFTR mutation, deltaF508-CFTR, which is not found at its appropriate location within epithelial cells. We are studying one particular "protein repair" agent, sodium 4-phenylburyrate (4PBA), which repairs this mistrafficking. We use standard cell and molecular biology techniques in cultured cells and in vitro to assess the influence of 4PBA on proteins important in the intracellular trafficking of deltaF508-CFTR. As we identify 4PBA-regulated proteins that interact with deltaF508-CFTR, we aim to perform specific modulations of protein expression

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that will afford insight into the mechanism and repair of deltaF508-CFTR's aberrant intracellular trafficking. We ultimately aim to extend and translate these observations into clinical trials of 4PBA and other "protein repair" agents in patients with CF.

Students will be encouraged to participate in all aspects of a chosen project, including experimental design and execution, and data analysis. Science majors with basic laboratory experience preferred.

Robert Schultz

Project 1: Linguistic Markers of Social Intervention Success in Adults with Autism

Individuals with autism spectrum disorder (ASD) are characterized by social communication challenges that include difficulty understanding verbal subtleties like hinting. In this project, a student will work closely with Dr. Julia Parish-Morris at the Center for Autism Research to analyze language data collected as part of an intervention study (PI: Brodkin). The successful applicant will be an eager and self-motivated team player, with a strong interest in language, social development/psychology, and autism. Computational skill or interest is a plus. Student duties and responsibilities will include transcribing clinical interactions, behavioral coding, language coding, data munging using R or Python, literature reviews, making tables/figures, and writing drafts. Summer students at the Center for Autism Research participate in a variety of activities that include regular language team meetings and journal clubs, all-staff Science Meetings focused on a variety of topics in autism research, career development talks, and field trips to visit other research centers at CHOP and Penn.

Project 2: Conversational Dynamics in School-aged Children with Autism Spectrum Disorder

Children with autism spectrum disorder (ASD) often have difficulty engaging in smooth back-and-forth conversation, which can impede their ability to make friends and be socially successful. In this project, a student will work closely with Dr. Julia Parish-Morris at the Center for Autism Research to analyze language data collected as part of ongoing research on conversational dynamics in school-aged children with ASD. The successful applicant will be an eager and self-motivated team player, with a strong interest in language, social development/psychology, and autism. Computational skill or interest is a plus. Student duties and responsibilities will include transcribing clinical interactions, behavioral coding, language coding, data munging using R or Python, literature reviews, making tables/figures, and writing drafts. Summer students at the Center for Autism Research participate in a variety of activities that include regular language team meetings and journal clubs, all-staff Science Meetings

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focused on a variety of topics in autism research, career development talks, and field trips to visit other research centers at CHOP and Penn.

Roy Wade

Project 1: Parent ACE Survey

Adverse Childhood Experiences (ACEs) such as abuse, neglect, and household stressors have been associated with developmental delay, cognitive impairment, behavioral problems, and physiologic problems in children. Animal models have demonstrated a sex-specific link between parental stress and poor health outcomes among offspring, highlighting the role of epigenetic processes in the transgenerational transmission of stress effects on offspring health. Current studies investigating the specific molecular markers responsible for the transgenerational transmission of early life stress-effects in humans have largely focused on maternal stress, despite epidemiological studies illustrating the importance of paternal environmental exposures on offspring health. As a result, little is known regarding the influence of paternal early life stressors on offspring health in humans.

This research study is a multi-stage project that looks at a different child diagnosis for each stage. The goal is to examine the association between paternal childhood adversity and offspring developmental delay (Aim 1), behavioral/mood disorders (Aim 2), neurocognitive impairment (Aim 3), asthma (Aim 4) and obesity (Aim 5) by age 8.

The research team is contacting thousands of parents and caregivers of children with these diagnoses that were seen at a Children's Hospital of Philadelphia's primary care sites between the years 2007 to 2015 in order to complete a survey either over the phone or online. The survey includes questions about child and biological parent health, diet and exercise trends, parenting practices, and more. Using a matched case control study design, we will determine the association between paternal childhood adversity and offspring health outcomes.

Project 2: ACE Measure Development

Prior research has established a strong link between childhood adversity and negative long-term health outcomes including psychiatric illness, chronic illness, and even early death. The seminal work in this field, the Adverse Childhood Experiences (ACE) Study, developed an adverse childhood experience measurement scale that encompassed three domains: abuse, neglect, and family dysfunction. This widely used scale was developed based on surveys within a white, middle-class population whose experience of adverse events likely differ from those of low-income urban youth. Thus, the scale may be insufficient for measuring childhood adversity in

other populations including urban, low-income settings. Little work has been done to develop better measures of early childhood adversity for low-income, urban communities.

The goal of this project is to develop novel pediatric item banks for assessing childhood adversity using a developmentally driven approach. The specific aims are to conceptualize four novel childhood adversity constructs (personal, family/household, peer, and community level childhood adversity) and develop pediatric item pools these constructs.

We will accomplish this through a literature review and a consensus process among international childhood adversity experts. Refinement of this framework will be further informed using semi-structured interviews with 40 children and youth ages 10 to 18. We will generate item pools for each of the constructs (personal, family/household, peer, and community level childhood adversity) within the childhood adversity framework using a review of existing childhood adversity measures. Item pools will be revised using cognitive interviews with 40 children and youth (ages 10 to 18).

Project 3: Implementation of ACE Assessment

Childhood adversity negatively impacts the health and well-being of children and their future health as adults. Strategies that reduce exposure and mitigate the negative impact of adverse childhood experiences (ACEs) exist. Unfortunately, health and social service organizations have not adopted assessment strategies to guide the application of ACE interventions, limiting the efficacy of these programs. As a result, these organizations may miss opportunities to intervene on the behalf of affected people. There are few examples of how to integrate childhood adversity assessment into agency workflow and organizations are dissatisfied with the current set of narrowly focused adversity measures. The first step in providing trauma informed care is building accurate systems to assess trauma amongst patients.

The goal of this project is to partner with social service agencies and primary care sites throughout Philadelphia in order to integrate an effective ACE-screening system into each organizations' workflow. We will also address what steps need to occur within the organization once the ACEs are identified.

In order to accomplish this, the research team is working with organizations to identify potential pathways of screening for adversity and trauma, testing out these pathways of implementation, and reviewing data collected from each pathway to determine the most effective means. Data includes statistics of reported ACEs and opinions of key players in the process. Once the research team and the implementation team of the organization have established the most effective pathway, we will implement it into the workflow again in order to solve any problems and streamline.

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PHARMACOLOGY

Julie Blendy

Project 1: Neurobehavioral consequences of early opioid exposure: Molecular and behavioral analysis

Infants exposed to opioids in utero are at high risk of exhibiting Neonatal Abstinence syndrome (NAS), a withdrawal syndrome characterized by incessant crying, sleeplessness, irritability, and in the worst cases, seizures. However, the underlying factors that impact the syndrome's severity are unknown. The current project involves determining critical periods of gestational and early-life opioid exposure on neurodevelopment and withdrawal severity in neonatal mice. Students will be trained in fundamental and transferable laboratory techniques including animal handling, drug administration, brain sectioning, behavioral testing, and molecular techniques such as PCR and immunohistochemistry.

Students will be mentored on a day-to-day basis by Dr. Shivon Robinson, a highly trained postdoctoral fellow, and will meet with me once a week to discuss their progress on the project. Students will attend weekly lab meetings and have the opportunity to present their findings. In addition, they will participate in other academic activities, such as relevant scheduled talks and journal clubs. High-achieving students who make significant contributions to the project may also have the opportunity to co-author a peer-reviewed publication.

Project 2: Molecular mechanisms underlying antidepressant therapy

Major Depressive Disorder (MDD) is a serious medical issue however, the most commonly prescribed first-line pharmacological therapy for MDD, selective serotonin reuptake inhibitors (SSRIs), are effective only after several weeks of treatment. The delayed onset of therapeutic efficacy has been an unresolved issue and, despite decades of research, the molecular mechanisms underlying this delayed onset of antidepressant effects remains unknown. The current project involves using a mouse-line that expresses enhanced green fluorescent protein (eGFP)-tagged ribosomes to track their location in the cell body and axon terminals of serotonin neurons. Students will be trained in behavioral pharmacology, molecular techniques (RNA isolation, real-time PCR, immunohistochemistry), and bioinformatics analysis.

Students will be mentored on a day-to-day basis by Dr. Melissa Manners, a highly trained postdoctoral fellow, and will meet with me once a week to discuss their progress on the project. Students will attend weekly lab meetings and have the opportunity to present their findings. In addition, they will participate in other academic activities, such as relevant scheduled talks and

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journal clubs. High-achieving students who make significant contributions to the project may also have the opportunity to co-author a peer-reviewed publication.

PHYSICAL MEDICINE AND REHABILITATION

Michelle Johnson

Project 1: Designing Affordable Rehabilitation Robotics for Low Resource Areas

The majority of people living with a disability reside in low and middle income countries (LMICs). However, barriers that prevent access to rehabilitation, assistive technology, and services for the disabled population include high costs, insufficient number of trained professionals, absence of facilities and equipment, ineffective service models, and lack of integration and decentralization of services. The Rehabilitation Robotics Lab is looking for undergraduates interested in gaining hands-on research experience at the intersection of robotics, medicine, and global health to work on the Rehabilitation Community-Assisted Robot Exercise System (Rehab C.A.R.E.S.) project. The goal of this project is to develop an affordable and accessible robot-based rehabilitation system that can be deployed in low resource settings around the world to address the shortage of rehabilitation professionals and treatment options for people living with physical disabilities resulting from diseases such as stroke. The student will work on one component of the system, such as sensorizing exercise equipment to interface with our software, designing new end effectors to increase the versatility of the robots, or building tools to help patients and therapists track data and performance results. Highly motivated students with an interest in or experience with mechatronics, programming (C++, Matlab, or Python), mechanical design, robotics, global health, and/or bioengineering are encouraged to apply. They will receive direct mentorship from a Ph.D. student and Dr. Johnson and gain valuable experience in robotic applications to human health and working in a clinical setting.

Project 2: Developing Analytical Methods for Infant Play and Neural Development

The current methods of diagnosing developmental disabilities in infants are often inexact and subjective. There is a need to objectively assess infants in order to maximize the chances of early detection and treatment. The Rehabilitation Robotics Lab has developed a multimodal system called the Play and Neural Development Assessment (P.A.N.D.A.) Gym which uses sensorized toys and a vision system in a natural play environment in order to provide more quantitative metrics that are indicative of potential development impairments. The ultimate goal is to identify infants with atypical development patterns in real time. The student on this project will work on developing aspects of the system as well as on algorithms to analyze vision and sensor data, assisting in data collection, and validating the system. Highly motivated students with an interest

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in or experience with mechatronics, programming, computer vision, mechanical design, robotics, and/or bioengineering are encouraged to apply. They will receive direct mentorship from a Ph.D. student and Dr. Johnson and gain valuable experience in robotic applications to human health and working in a clinical setting.

Project 3: Development a Mobile Service Robot for Pediatric and Geriatric Healthcare Application

As part of our exploration of the mobile healthcare robotics space, we have been working to develop a mobile service robot that is capable of providing assessments and rehabilitation to children in various settings, ranging from hospitals to remote locations without access to care. This robot would combine telemedicine, analytical assessment, and robot-based rehabilitation into one integrated system. We are looking for a student who is interested in the healthcare robotics space to work on one aspect of the robot's development. Based on interest and experience, this project would entail working to develop a voice system to communicate between the robot and patients, working on the physical design of the robot to maximize its social acceptance, or building a navigation system for hospital settings. Highly motivated students with an interest or experience in voice synthesis research, product design and prototyping, or robot-based navigation are encouraged to apply. They will receive direct mentorship from a Ph.D. student and Dr. Johnson and gain experience in robotic applications to human health and working in a clinical setting.

PHYSIOLOGY

Joseph Baur

Project 1: Nicotinamide adenine dinucleotide in heart failure

Nicotinamide adenine dinucleotide (NAD) is a critical cofactor for many enzymes that is derived from vitamin B3. Recently, novel NAD precursors such as nicotinamide riboside (NR) have been shown to protect rodents from a range of diseases and conditions. We are currently exploring the consequences of NAD depletion or supplementation in a condition with enormous clinical significance: heart failure. It is now established that NAD depletion occurs in human heart failure and several mouse models have suggested a protective effect of NAD precursors. We have generated a novel mouse model to test whether NAD deficiency per se is sufficient to cause the metabolic or functional changes associated with heart failure. Based on our data suggesting that the heart benefits more from intravenous precursors that from oral dosing, we will also collaborate with Dan Kelly's group here at Penn to test the utility of intravenous NR in two human-relevant models: heart failure secondary to ischemic injury or treatment with a

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chemotherapeutic drug. Together, these studies will reveal fundamental details of how NAD metabolism influences physiology, and will help guide efforts to develop novel therapeutic approaches for the treatment or prevention of diseases associated with obesity and aging.

Project 2: CRISPR Modification of Primary Hepatocytes

Primary hepatocytes are a useful culture system in which to study certain aspects of liver metabolism that are not adequately modeled by hepatoma cell lines, including glucose production. However, hepatocyte lifespan under standard growth conditions is only about 48 hours, which does not allow sufficient time for genetic modification. Using optimized media and growth factor conditions, we can now maintain viability and glucose production for up to 8 days. We seek a summer student to help develop efficient methods for CRISPR-based modification of primary hepatocytes within this 8-day lifespan. This technique will have wide-ranging applications, but will initially be used to test the mechanisms required for metformin action. Metformin is a front-line antidiabetic drug that suppresses hepatic glucose output, but there is ongoing controversy over the downstream pathways that mediate its effects. The ability to knock out individual components of these pathways in hepatocytes would help to resolve this question. The selected student will gain experience in mammalian cell culture, use of viral vectors, and biochemical assays, and will have the opportunity to work with live mice and observed surgical procedures.

Project 3: Role of mTORC2 Signaling in Hypothalamic Neurons

Obesity is fundamentally caused by an imbalance between energy intake and energy expenditure. Although voluntary exercise and dieting can temporarily correct or reverse this energy imbalance, there is a growing recognition that the body will adjust behaviors to attempt to return to the obese “set point” and that very few people are able to achieve stable long-term weight loss. Some promise has been shown for drugs that inhibit nutrient absorption or suppress appetite, but comparatively little is known about the control of basal activity levels. We have recently shown that mice lacking Rictor, an essential component of the mTORC2 kinase, in hypothalamic have a ~50% decrease in spontaneous locomotor activity. They are also hyperleptinemic from shortly after weaning – even before they gain weight. We seek to understand which signaling pathways are responsible for mTORC2 activation in hypothalamic neurons, and how this may interact with the pathways that control leptin expression in adipose tissue.

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Melike Lakadamyali

Project 1: Super-resolution imaging of tau oligomer formation in neurodegenerative disease

The goal of this project is to identify the early molecular events at neurodegenerative disease onset that lead to the aggregation of the protein tau. Tau is an essential protein in the brain with several important functions that help maintain the health of neurons. A hallmark of neurodegenerative diseases like Alzheimer's Disease is the accumulation of large protein tangles formed from tau proteins in the brains of patients. The formation of these protein tangles are thought to contribute to neuronal degeneration and disease progression. In normal brain, tau protein is found mostly as a monomer (single tau protein). A trigger leads to the interaction of tau proteins with each other to form small "oligomers" composed of multiple tau proteins. These oligomers are thought to act as seeds that eventually lead to the formation of tau tangles. However, visualizing tau oligomers at the early stages of aggregation has been impossible due to their small size (only few tens of nanometers, million times smaller than a meter). In the last decade, a revolution in optical microscopy has improved the spatial resolution of the light microscope such that visualizing these length scales in intact neurons is now possible. These super-resolution microscopy methods were recognized by the Nobel Prize in Chemistry in 2008. This project will use these cutting-edge super-resolution microscopy methods to visualize the early steps in tau aggregation at disease onset. These studies have the potential to revolutionize the way we study tau aggregation and can help develop new therapies for the early stages of disease.

PSYCHIATRY

Rebecca Ashare

Project 1: The Role of Cognitive Dysfunction in Smoking Relapse among HIV-infected Smokers

Medical advances in the treatment of HIV/AIDS have significantly improved the life expectancy and quality of life of HIV-infected individuals. However, complications arising from HIV-1 infection, including HIV-associated neurocognitive disorder (HAND), can reduce the efficacy of anti-retroviral medications (ART) and decrease quality of life among HIV-infected individuals. Therefore, addressing modifiable risk factors, such as tobacco use, has become a critical priority. Unfortunately, HIV-infected individuals are three times more likely to use tobacco than those in the general population, but little is known about the mechanisms that underlie these high smoking rates. One hypothesis is that the cognitive enhancing effects of nicotine reduce neurocognitive deficits associated with HIV-1 infection. The goal of this study is to test whether

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the neurocognitive impairments associated with HIV-1 infection are exacerbated when smokers quit smoking and make it more difficult for HIV-infected smokers (HIV+) to quit, compared to HIV-uninfected smokers (HIV-). Over the next three years, this study will contribute to a larger research program with the long-term goal of identifying risk factors for smoking relapse among vulnerable populations, including people living with HIV. We believe this study will provide important guidance toward developing population-specific smoking cessation treatments that target cognitive function in the hopes of improving smoking cessation outcomes to help sustain the health benefits of ART.

Students who participate will be mentored by Dr. Rebecca Ashare and be part of a collaborative research team. Students will become proficient in their understanding of: (1) study methods to examine the impact of HIV on tobacco use and cognitive function; (2) participant recruitment methods, including conducting phone interviews and may have the opportunity to accompany members of the research team on visits to HIV clinics throughout the city of Philadelphia; (3) participant assessments including collecting questionnaire data and administering neurocognitive task batteries to participants; and (4) general research methods and ethics including obtaining informed consent. No prerequisites are required. However, successful students will have a strong interest in human research in general and in the areas of psychopharmacology, addiction, and cognitive neuroscience.

Project 2: Targeting Cholinergic Function in HIV-Associated Inflammation and Cognition
Rising Juniors only

Although anti-retroviral therapy (ART) enhances life expectancy and overall quality of life (QoL), HIV-infected individuals are increasingly vulnerable to non-AIDS-related diseases including HIV-associated neurocognitive disorder (HAND). Inflammation is considered to be a primary mechanism in the pathogenesis of HAND. Tobacco use may further exacerbate inflammation and thus increase the incidence and severity of HAND. Conversely, nicotine alone has anti-inflammatory effects, mainly through activation of the nicotinic receptors (nAChRs) suggesting that stimulating the cholinergic pathway may be a novel therapeutic target to suppress inflammation and reverse or prevent neurocognitive deficits in HIV-1 infection. Over the next frive years, the goal of this study is to evaluate a pharmacological treatment that targets cholinergic function, improves neurocognition, and attenuates inflammation, to probe the interaction between inflammation, nicotinic receptors and smoking in people living with HIV, and potentially reduce HIV-associated adverse health consequences, including HAND. The broader goal of this study is to provide insight into the interactions among nAChR activation, HIV immune activation and pathogenesis, and tobacco use and has translational and therapeutic implications that could improve health outcomes and QoL among HIV-infected individuals.

Students who participate will be mentored by Dr. Rebecca Ashare and be part of a collaborative research team. Students will become proficient in their understanding of: (1) study methods to examine the impact of tobacco and nicotine on cognitive function among people living with

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HIV; (2) participant recruitment methods, including conducting phone interviews and may have the opportunity to accompany members of the research team on visits to HIV clinics throughout the city of Philadelphia; (3) participant assessments including collecting questionnaire data and administering neurocognitive task batteries to participants; and (4) general research methods and ethics including obtaining informed consent. No prerequisites are required. However, successful students will have a strong interest in human research in general and in the areas of neuropsychology, psychopharmacology, and addiction.

Rinad Beidas

Project 1: The Philadelphia Alliance for Child Trauma Services II (PACTS II): Reaching the Most Vulnerable Youth

Traumatic stress in children and adolescents arises from many different experiences (e.g., neighborhood violence; physical, emotional, and sexual abuse; natural disasters) and has varied effects on the individuals it impacts. The Philadelphia Alliance for Child Trauma Services (PACTS) is a system-wide trauma universal screening, education, prevention, and intervention program throughout the city. For the past four years, Dr. Beidas' team at the Center for Mental Health Policy and Services Research (CMHPSR) has investigated the effectiveness of providing trauma-focused cognitive-behavioral therapy (TF-CBT) in community mental health centers and has completed evaluations of 113 clients. Over the course of the next five years, Dr. Beidas' team will begin the second phase of this project with a special focus on groups particularly vulnerable to trauma: lesbian, gay, bisexual, transgender, and questioning (LGBTQ) children and commercially sexually exploited children. Findings from this research have and will continue to inform both City-wide and national roll-outs of trauma-informed care and provide information on whether the implementation of this evidence-based practice improves youth outcomes in the community.

Interested undergraduates will have the opportunity to work on a complex, multifaceted study by assisting with tasks like preparing folders and entering data from completed evaluations. There also may be opportunities for RAs to assist the team with scheduling appointments with families and therapists, transcribing and coding qualitative data from semi-structured interviews, and attending PACTS-related meetings with key public health stakeholders at Community Behavioral Health. Students will receive mentorship from Dr. Rinad Beidas, who has experience mentoring previous PURM students. Dr. Beidas has mentored a number of PURM students who have gone on to stay in our lab and do additional individual mentored research projects through other CURF opportunities (e.g., UScholars).

Project 2: Fidelity Accuracy: Comparing Three Strategies (FACTS)

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What do therapists in community mental health agencies do in sessions with their youth clients? How can we measure the extent to which therapists deliver cognitive behavioral therapy (CBT), an evidence-based practice, as it is intended to be delivered – in other words, how do we measure fidelity? Project FACTS looks to answer these questions by studying three different methods used to measure therapist fidelity to CBT and assessing which is the most accurate and cost effective. Successful completion of this project will identify accurate fidelity measurement methods as well as factors that can increase their uptake in community mental health settings. This multifaceted study provides those working on it opportunities to learn about a number of topics with cross-cutting relevance, like implementation science, cost effectiveness, community-academic partnerships, and approaching complex topics like therapist-client interaction with both sensitivity and scientific rigor.

The undergraduate research assistant work within a dynamic, collaborative research lab and help to prepare for agency visits and process data. They may also have the opportunity to accompany researchers on visits to community mental health centers—a rare and valuable experience for undergraduate students. Students will receive mentorship from Dr. Rinad Beidas, who has experience mentoring previous PURM students. Dr. Beidas has mentored a number of PURM students who have gone on to stay in our lab and do additional individual mentored research projects through other CURF opportunities (e.g., UScholars).

Project 3: Motivating Organizations to Implement by Valuing All Therapists' Efforts (MOTIVATE)

Over the last 5 years, Dr. Beidas' team at the Center for Mental Health Policy and Services Research (CMHPSR) has worked with therapists in community mental health centers to understand their experiences using evidence-based practices (EBP). One notable finding is that clinicians say they do not feel rewarded or recognized to implement EBP by their organizations. So, how can organizations use financial and non-financial incentives to encourage therapists' use of EBP? Project MOTIVATE looks to answer this question by crowdsourcing ideas directly from therapists and using insights from behavioral economics to optimize the impact of these ideas. Behavioral economics combines insights from psychology and economics to explain people's behavior and could contribute valuable information about the best ways to incentivize therapists to change their behavior. The goal of this project is to develop several strategies that are acceptable to a range of relevant stakeholders including clinicians, agency leaders, policy-makers and payers.

Undergraduate applicants will participate in novel research on a pressing public health issue. This project is well-suited for those interested in psychology, community mental health, and implementation science research. Students will receive mentorship from Dr. Rinad Beidas, who has experience mentoring previous PURM students. Dr. Beidas has mentored a number of PURM students who have gone on to stay in our lab and do additional individual mentored research projects through other CURF opportunities (e.g., UScholars).

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Michael Blank

Project 1: Mentorship Opportunity for a Student to Participate in Research Linking HIV+ Individuals with Mental Illness and Substance Use Disorders to Community Care

PATH for Triples (PFT) is an effectiveness trial using a nurse health navigator model (NHN) for people living with HIV/AIDs (PLWHA) as well as mental illness and substance use disorders (i.e., triply diagnosed). Eligible PLWHA with a detectable viral load are randomized to either 6 months of the NHN intervention or enhanced treatment as usual (eTAU) and are followed-up at 3, 6 and 9 months. The NHN provides psychoeducation, monitors medication adherence and facilitates linkage to mental health, substance abuse, and infectious disease care in Philadelphia. The intervention is set up as a cascade where non-adherent participants receive additional visits from the NHN based on the participants' level of medication adherence.

The student would be trained to screen potential candidates and evaluate them for eligibility on psychiatric inpatient units or at community-based clinics. He/she would accompany our research coordinator (Ms. Jackson) as she performs outreach in the community and would be trained in our research assessments, perform data entry and compile statistics and reports. The student will be trained by our preceptors (Drs. Blank and Coviello) and nurse (Ms. Plano) in administering the manual-based cascade intervention. The student will shadow our nurse during her home visits and observe her provide education, accompany participants to doctor appointments, and interact with family members. Under the supervision of our nurse, the student would conduct nursing assessments (pill counts, evaluate side effects) and complete nursing logs. This opportunity is beneficial for nursing students or anyone interested in community-based participatory research.

Lily Brown

Project 1: Reducing suicide risk in individuals with a trauma history

Suicide is a major public health concern and is an important clinical correlate of posttraumatic stress disorder (PTSD). While empirically supported treatments like Prolonged Exposure (PE), developed by Dr. Edna Foa at the Center for the Treatment and Study of Anxiety at the University of Pennsylvania, significantly reduce PTSD and related functional impairment, little is known about how suicide risk is altered throughout treatment. Furthermore, most published randomized controlled trials (RCT) explicitly exclude those at high SA risk. Therefore, very effective treatments are available for PTSD, but little is known about how those treatments

operate in individuals with high suicide risk. There is a clear need for the development of efficient and effective integrated treatments that target both PTSD symptoms and SI/SA in this complex population.

In this project, we will be conducting a pilot test of the first integrated treatment program for individuals with PTSD and suicide risk. Student duties will include data entry and database management, management of institutional review board materials related to the study, collaboration with community mental health organizations for the collection of data for the project, and observation of consultation in the treatment. Students will receive didactics and informal presentations on suicidal ideation and PTSD. Students will be required to be professional and interpersonally mature in the event that they will serve as a liaison between study staff and community clinicians and participants.

Project 2: PTSD, Substance Use, Sleep Disorders, and Suicide Risk in Persons Living with HIV

Rates of posttraumatic stress disorder (PTSD), substance use, sleep disorders and suicide are disproportionately higher in persons living with HIV (PLWH). The Syndemic Model of Substance Abuse, Intimate Partner Violence, and HIV (SAVA Syndemic), refers to the frequent co-occurrence and mutual influence between these conditions. The SAVA Syndemic has not been directly associated with suicide risk. The pathway to developing suicidal ideation and to transitioning from thinking about suicide to engaging in suicidal behaviors in PLWH is unclear. An analysis of demographic and clinical variables associated with increased risk for suicide in PLWH is essential to formulate testable hypotheses and elucidate pathways to suicide within the context of the SAVA Syndemic. We have identified the following specific aims:

Aim 1: To determine variables associated with the presence of suicidal ideation in PLWH. Aim 2: To determine variables associated with the emergence of suicidal ideation. Aim 3: To variables associated with the transition from suicidal ideation to suicidal behavior in PLWH.

In Phase I, we will conduct a comprehensive chart review of PLWH within the CFAR longitudinal database and link this database with medical records to determine the associations among PTSD, substance use, sleep disorders, and suicide risk. In Phase II, we will follow a small sample (n = 10-20) of participants who have HIV for one month. We will use ecological momentary assessment, FitBit®, and sleep diaries to inform the associations among PTSD, substance use, sleep disorders, and suicide risk.

Student duties will include conducting comprehensive chart reviews, data-base management, interacting with community partners at recruitment agencies, directly interacting with potential participants for preliminary screening. Students will be supported in the generation of independent projects that are related to this project. They will receive formal and informal didactics in the assessment of suicidal ideation, PTSD, sleep disorders, and substance use in persons living with HIV.

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Project 3: Physical Health Outcomes in Anxiety Disorder Treatment

Anxiety-related disorders are associated with poor physical health, including cardiovascular disease, insomnia, and metabolic syndrome. Poor physical health in turn contributes to psychological suffering and substantial economic burden in individuals with anxiety disorders. Despite the association between poor physical health and anxiety, physical health is rarely addressed in anxiety treatment studies.

Cognitive behavioral therapies (CBT) are the most empirically supported treatments for anxiety. However, relatively few studies examine whether these treatments that reduce anxiety symptoms also improve physical health. Further, while emerging research suggests that incorporating mobile technologies into treatment improve clinical assessment, no research has yet used mobile technologies to intensively assess physical health, anxiety, and related conditions in anxiety treatment.

This study will to assess patients' and clinicians' perceptions of the acceptability, feasibility, and utility of a comprehensive assessment of physical and psychological health in anxiety treatment. Participants will be randomized to enhanced assessment or assessment as usual. Assessment as usual includes only self-report indices, as per usual clinical practice in anxiety clinics. Enhanced assessment includes both objective and subjective indicators of physical and psychological health in addition to the assessment as usual self-report measures. Objective indicators of physical health will include data from a wearable Fitbit device to measure physical activity, sleep, and heart rate, as well as nursing assessments. Subjective indicators of physical health will include data collected through ecological momentary assessment (EMA, i.e., text message real-time assessment) about physical health, sleep, physical activity, anxiety, depression, and social functioning. Purported mechanisms of interest, namely distress tolerance, cognitive bias, and emotion regulation, will be measured in a laboratory assessment.

Students will directly interact with study participants for the collection of data. They will learn to analyze physiological and cognitive data resulting from laboratory tasks. They will be oriented to the Way to Health program and learn how to extract data from the platform. They will be trained in data analysis and in the preparation of scientific manuscripts resulting from the project. They will receive formal and informal didactics in the association between physical health and anxiety disorder treatment outcome.

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Monica Calkins

Project 1: A novel physical activity-based intervention for individuals with early stage psychosis

Schizophrenia is a leading cause of disability worldwide, and also confers a 20-year loss of life expectancy. Exercise has been shown to improve mental and physical health outcomes, but implementation can be challenging. Early stage psychosis presents a critical opportunity to intervene. We will be conducting a study using the Fitbit to support an exercise intervention in patients with recent-onset psychotic disorders. The student will aid in collection of neuropsychiatric phenotyping data (e.g., administering questionnaires, cognitive batteries), measures of fitness, and basic data entry and analysis. Training will be provided for these responsibilities. Students will also have the opportunity to observe intervention services within the Penn Psychosis Evaluation and Recovery Center (PERC; https://www.med.upenn.edu/bbl/penn-perc.html). Participation in preparation of scientific conference abstracts and/or manuscripts is available for motivated students. Sunny Tang, M.D., Psychiatry Resident, will be involved in mentoring the student.

Brenda Curtis

Project 1: Can Twitter Be Used To Predict Opioid Overdoses and Treatment Seeking Rates at the County Level?

This project will analyze Twitter data at the county level to determine whether we can predict opioid overdoses and opioid treatment rates by the words people post on Twitter. We will use data from over 138 million county-level tweets to develop predictive models and conduct differential language analysis.

Duties: Students will work in a collaborative environment to understand design, code, and test machine learning, natural language processing, and computational linguistics. Students will search social media data, extract data, and classify data. Students will assist in implementing, testing, and improving algorithms. The goal is for students to be able to present their results at a conference and co-author a manuscript with the investigators.

Prerequisites: CIS 121 (Preferably CIS 419/519)

My lab works with Lyle Ungar in CIS. He is a co-investigator on the project and will play a small mentoring role with the student.

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Liisa Hantsoo

Project 1: The role of hormones in premenstrual dysphoric disorder

This clinical study seeks to understand the role of neuroactive steroid hormones, such as progesterone, in premenstrual dysphoric disorder (PMDD), a severe form of premenstrual syndrome (PMS). PMDD is a prototypical psychoneuroendocrine disorder, and its study may shed light on how hormones interact with the central nervous system (CNS) to influence mood and stress response. This study uses psychophysiology techniques to measure stress response in women with and without PMDD at different points in the menstrual cycle. PURM students will assist in participant recruitment and screening, prepare materials for participant laboratory visits, enter and manage data in REDCap, assist with laboratory visits including psychological measures and psychophysiology assessments, work with psychophysiology (acoustic startle response) data, and prepare blood samples for hormone assays. PURM students also have the opportunity to participate in educational activities within the Penn Center for Women's Behavioral Wellness (PCWBW), including weekly educational and career development didactics geared toward summer students (past topics included introduction to hormones and behavior, basic statistics and study design, creating scientific posters, career paths, writing an effective resume), journal club, and lab meetings. Critical thinking skills are emphasized, and students are asked to think actively about the study on which they work, e.g. how a particular design might address a given research hypothesis. Students should have an interest in psychology/ psychiatry, women's health, and clinical research. Students will receive research mentorship from Dr. Liisa Hantsoo, and individualized feedback and coaching from the PCWBW program manager and staff.

Matthew Kayser

Project 1: A fruit fly model for social behavioral dysfunction in autism

My laboratory uses the fruit fly to explore the molecular and neural circuit basis of social behavioral dysfunction in autism spectrum disorders (ASDs). Because of complex underlying genetics in ASDs, monogenetic neurodevelopmental disorders (NDDs) with autistic features have served to provide critical insights into the basic pathophysiology in autism. As in ASDs, dysregulated social behaviors represent one of the most significant sources of disease burden in NDDs such as neurofibromatosis type 1 (NF1). NF1 is a genetic disorder caused by loss of function mutations in the protein neurofibromin (Nf1). Currently, no treatments for NF1 or ASDs effectively address social behavioral deficits. Remarkably, we have recently found in a Drosophila model of NF1 that mutant males display impairments in social behavioral decisions.

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We are using this model to examine where, when, and how social behavioral dysregulation arises in NF1.

PURM students will (1) learn how to conduct and analyze social behavioral assays in Drosophila, (2) become familiar with a wide range of genetic approaches in the fly, including manipulation of neural circuit activity, and (3) gain expertise with a technique that allows us to monitor brain activity in an awake, behaving fly as it engages in social interactions. These approaches present a unique opportunity to determine the neurobiological mechanisms of social behavioral dysfunction in NF1, and, we hope, pave the way for new therapeutic targets in ASDs.

Project 2: Building brains in our sleep: A Drosophila larval platform for examining sleep and neurogenesis

My laboratory studies the function and regulation of sleep during development. Sleep during critical developmental windows is thought to be important for brain maturation. However, examination of a function for sleep in the earliest periods of nervous system development, when neurons are being born, has been limited by the lack of a tractable experimental system. The adult fruit fly is a widely studied model organism for sleep, but the major wave of neurogenesis in Drosophila begins during larval life and ends prior to adulthood. It has remained unknown whether larvae sleep. My lab has established Drosophila larvae as a new system for studying sleep in the developing brain, with a particular goal of understanding how sleep controls the birth of new neurons.

PURM students will (1) learn how to conduct and analyze sleep assays in a novel larval system; (2) become familiar with a broad range of neurogenetic approaches in the fruit fly; and (3) help identify the region of the larval brain that promotes sleep, which is currently unknown. Collectively, this work will generate novel tools and approaches for studying the role of sleep in the developing nervous system.

Sara Kornfield

Project 1: Stress and Pregnancy Study

The Stress and Pregnancy study examines physiologic arousal and stress response to an acute laboratory stressor in pregnant women with symptoms of post traumatic stress disorder (PTSD), those who have been exposed to a traumatic stressor and have no symptoms, and in healthy control subjects. Pregnant women with PTSD symptoms are also invited to take part in a four-session psychotherapy treatment to determine whether this novel brief intervention can diminish arousal through cognitive behavior strategies and mindfulness.

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The student intern's responsibilities as a member of the study staff would be to assist in recruitment of study participants from two obstetrics clinics on Penn's campuses; learn how to conduct telephone interviews and obtain consent from interested and eligible participants; observe and become trained in the administration of the acoustic startle procedure (laboratory stressor); enter data into the study database; work with the electronic medical record to learn how to extract relevant participant information. In addition, there are opportunities for shadowing the study PI during research and/or clinical therapy sessions, and other center faculty in psychiatric medication consultations. This opportunity will provide exposure to both an intervention based clinical trial and integrated mental health-medical care (prenatal/gyn) settings for those interested in interdisciplinary work. As part of this internships, the PCWBW offers a 10-week didactic curriculum to introduce students to introductory concepts in women's mental health across the lifespan. Students are invited to participate in all center-wide meetings, lectures, and research presentations.

David Mandell

Project 1: Autism Intervention Research: Building Better Bridges to improve school transition

David Mandell, ScD is Professor of Psychiatry & Pediatrics, the Director of the Center for Mental Health Policy and Services Research, and Associate Director of the Center for Autism Research at the Children's Hospital of Philadelphia. Dr. Mandell's lab conducts federally-funded research related to the healthcare and education of children diagnosed with autism spectrum disorder (ASD). One such initiative is the Autism Intervention Research Network for Behavioral Health (AIR-B).

AIR-B is a multisite team of researchers across 5 Universities (UCLA, Drexel University, UC Davis, U Penn, and U Rochester). Across all sites and studies, the ultimate objective of the AIR-B is to deploy effective and sustainable evidence-based practices that will serve a broad community base and to improve outcomes for all children with ASD. Using a Community Based Participatory Research (CBPR) approach that equitably involves community stakeholders and researchers in all aspects of this research process, all partners contribute expertise and share decision making and ownership. A particular emphasis of AIR-B is on improving care for traditionally under-resourced communities.

Building Better Bridges (BBB) is one intervention developed within the AIR-B network using the CBPR approach. The BBB study has been designed to identify the barriers to successful transitions between educational systems for children with ASD. Focus groups and interviews have been conducted with parents of children with ASD across different sites (UCLA, UC Davis,

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U Penn, and U Rochester) as means to identify transition barriers that have been used to inform an intervention to improve transition outcomes for children with ASD and their families. The network, in conjunction with their community partners, is currently recruiting participants for a randomized controlled trial (RCT) of the BBB intervention. We are looking for exceptional student research assistants to join our team during this 2-year RCT phase.

The research assistant working on this project will gain experience working with a seasoned team of research faculty within the School of Medicine, and across all partner sites. S/he will gain experience with human subject research in a community setting, including the following: participant recruitment, informed consent, primary data collection, data base management, literature reviews, project management, & working with large research teams. We are looking for exceptional students with outstanding communication skills and a proven ability to work independently & with a team.

Dr. Mandell serves at the primary mentor for this experience. Two other leaders on the AIR-B project will also provide mentorship: Melanie Pellecchia, Ph.D., BCBA, NCSP, Assistant Professor and Heather Nuske, Ph.D., Postdoctoral Fellow.

Rebecca Pearl

Project 1: Psychosocial Aspects of Obesity: Weight Bias and Weight Loss

The Center for Weight and Eating Disorders is seeking summer students to work on studies relating to psychosocial aspects of obesity and weight loss. The students will primarily work on a weight loss clinical trial testing a psychological intervention to help patients with obesity cope with weight bias and stigma. Students may also have the opportunity to work on a project examining weight bias and other psychosocial factors in patients undergoing bariatric surgery.

This position will provide an excellent introduction to clinical research if students are interested in pursuing careers in medicine, psychology, public health, nursing, social work, or related fields. Students will also gain experience working in an interdisciplinary environment that includes physicians, psychologists, nurses, dietitians, and other research staff.

Students' duties may include: recruitment efforts (e.g., flyers); conducting phone screening interviews with potential study participants; data entry and verification; data management; organization of study materials and documents; interacting with patients; and other tasks as assigned by the faculty member.

Qualifications:

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Experience in clinical or social science research is preferred. Coursework in psychology, social work, public health, medicine, nursing, or similar fields is a bonus. Experience with Redcap, EPIC, and/or data management is also helpful but not required. Most importantly, the ideal candidate is self-motivated, able to work and problem-solve independently, flexible, and professional.

Melanie Pellecchia

Project 1: Parent Empowerment and Coaching in Early Intervention

Early intervention for children with or at risk for autism spectrum disorder (ASD) is a critical step in improving their long-term outcomes. University-based randomized trials demonstrate that parent-mediated early intervention for children with ASD results in improved child outcomes across a range of developmental domains, as well as improved parental self-efficacy and treatment engagement. The common component to all efficacious parent-mediated early interventions for ASD is therapist implementation of parent coaching: which comprises providing the parent the needed supports to improve their child's skills and abilities through a structured system of jointly planning learning goals, modeling effective practices, and engaging in feedback. Therapist implementation of evidence-based parent coaching results in parent behavior change which leads to improved child outcomes. Early intervention for young children with ASD is typically provided through Part C-funded early intervention (EI) providers. These services often result in poorer outcomes than those observed in research clinics. Preliminary evidence suggests that Part C providers rarely use parent coaching when working with parents of young children with ASD. The lack of implementation of parent coaching may be the critical element that makes community-based intervention less effective than what is observed in randomized trials.

The current pilot study will address two specific aims: (1) Examine EI providers' current use of parent coaching when working with parents of young children with ASD; and (2) Identify barriers and facilitators to using parent coaching in Part C service systems. The information gathered through this pilot study will inform the development of a larger proposal to develop and test an implementation toolkit to improve the implementation of parent coaching by EI providers.

Aim 1: Examine EI providers' current use of parent coaching when working with parents of young children with ASD. We will examine EI providers' implementation of parent coaching during sessions with parents of children with or at risk for ASD. These observations will provide evidence of whether EI providers implement parent coaching, their overall fidelity to various parent coaching techniques, and a broad description of EI providers' activities during sessions.

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This will inform whether there is a need to develop interventions to improve the implementation of parent coaching within Philadelphia's early intervention system.

Aim 2: Identify barriers and facilitators to using parent coaching in Part C service systems. We will interview agency leaders, EI providers, and parents to learn about their perspectives toward parent coaching. We will also survey the EI providers to learn about their attitudes, perceived norms, self-efficacy, and intentions to implement parent coaching.

Student Responsibilities: Transcription of qualitative interviews and coding of qualitative data. After all of the interviews have been transcribed, students will work with Dr. Pellecchia to develop a qualitative code book and will use the code book to code the transcripts.

R. Christopher Pierce

Project 1: Effect of optogenetic stimulation of nucleus accumbens D1-containing vs. D2-containing neurons on reinstatement of cocaine-seeking

The nucleus accumbens is brain region that is highly implicated in cocaine self-administration and reinstatement of cocaine-seeking behavior. Medium spiny neurons in the nucleus accumbens can be differentiated by the expression of dopamine D1 receptors vs. D2 receptors which send projections via the direct vs. indirect pathway, respectively. This project utilizes newly developed transgenic rat lines which express Cre recombinase in D1-containing or D2-containing neurons. Light-sensitive ion channels (channelrhodopsins) can be delivered to specific neuron populations by Cre-dependent viral vectors, which allows us to drive optogenetic stimulation selectively to those neurons. Our preliminary data suggests high frequency optogenetic stimulation of D2-containing neurons in the nucleus accumbens attenuates the reinstatement of cocaine-seeking behavior. This project will aim to expand upon these preliminary data and combine optogenetic tools with transgenic rat lines to test the hypothesis that high frequency stimulation of D2- vs. D1-containing neurons will differentially modulate cocaine-seeking behavior. A mentee will perform cocaine self-administration, extinction and reinstatement behavioral assays as well as construct optogenetic equipment and deliver optogenetic stimulation during the reinstatement session. Students will have the opportunity to design and perform experiments under the mentorship of postdoctoral fellow Dr. Sarah Swinford-Jackson and Dr. Chris Pierce. Students will be engaged in reading literature and leading a journal club discussion, designing and performing experiments, analyzing data, and presenting their research in lab meeting. Mentees are highly encouraged to expand upon the PURM project to pursue independent research credit in the lab.

Project 2: Epigenetic changes in sperm of cocaine-experienced sires confer cocaine resistance in male offspring ***Rising Juniors only***

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Recent preclinical evidence indicates parental exposure to drugs of abuse to alter behavior and physiology of offspring. For example, when male rats self-administered cocaine, their male, but not female, progeny displayed reduced cocaine self-administration (Vassoler et al., 2013). However, the heritable epigenetic marks that mediate differences in the reinforcing efficacy of cocaine in offspring are not fully understood. DNA methylation is a conserved and stable epigenetic modification which may be involved in transgenerational epigenetic inheritance. We identified two hypomethylated regions upstream of the cyclin-dependent kinase inhibitor 1a (Cdkn1a or p21) gene in the sperm of cocaine-experienced sires vs. saline-experienced sires. In the nucleus accumbens, expression of Cdkn1a mRNA was upregulated in cocaine- vs. saline-sired male offspring, but not female offspring. The goal of this project is to functionally validate higher Cdkn1a expression in the nucleus accumbens as a mediator of reduced cocaine self-administration by using viral vectors to overexpress Cdkn1a in the nucleus accumbens of naïve rats. A mentee will perform cocaine self-administration in rats that overexpress Cdkn1a and controls as well as validate Cdkn1a overexpression using qPCR and Western blotting. Students will have the opportunity to design and perform experiments under the mentorship of postdoctoral fellow Dr. Sarah Swinford-Jackson and Dr. Chris Pierce. Students will be engaged in reading literature and leading a journal club discussion, designing and performing experiments, analyzing data, and presenting their research in lab meeting. Mentees are highly encouraged to expand upon the PURM project to pursue independent research credit in the lab.

Catherine Alix Timko

Project 1: A Systematic Review of Reward Circuitry Dysfunction in Anorexia Nervosa

While long considered a socially driven disease, Anorexia Nervosa (AN) is a biologically based eating disorder with a neurobiological component. It is hypothesized that the reward circuitry of the brain of individuals with AN is disrupted such that normal rewards (i.e., palatable foods) becomes punishing and avoided while unpleasant physical states and behaviors - such as restriction of intake - become rewarding. This disruption of reward and behavior is believed to maintain the symptoms of AN. However, as it stands, there is no clear consensus of the exact disruptions of the reward circuitry. Many of the existing studies have used different stimuli and tasks among adults and adolescents, leading to an array of results. PURM students working on this project will learn how to conduct a hypothesis-driven systematic literature review analyzing the existing studies of reward circuitry dysfunctions among AN individuals. Additionally, students will aid with an ongoing study of conducting fMRI scans of adolescents with AN to understand adolescents with AN's response to social reward and punishment. Responsibilities will include conducting an in-depth literature review, writing a review paper consolidating the findings, partaking in recruitment and data entry of the fMRI study, and gaining invaluable clinical research experience. Two students can be involved in this project and will work with Dr.

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C. Alix Timko, PhD and her research team. All research will take place at Children's Hospital of Philadelphia and the Roberts Center for Pediatric Research. As such, students are required to undergo FBI background and child abuse clearance as well as IRB and human subjects training.

Project 2: Psychological Distress and Burden in Parents of Adolescents with Anorexia Nervosa

Anorexia Nervosa (AN) is a serious eating disorder characterized by restriction of food intake and reduction of body weight below what is healthy or expected for someone of the same age and height. AN has the highest mortality rate of all psychiatric disorders and is associated with significant morbidity. Caregiver burden is high. Research has investigated the link between burden, distress, and communication style in caregivers of adults with anorexia. More research is needed to understand caregiver burden in the parents of adolescents with anorexia. PURM students will explore the relationship between caregiver experiences of adolescents with AN to psychological distress, expressed emotion, and effectiveness of treatment. Responsibilities include conducting a comprehensive literature review, data entry and management of database as well as statistical analysis of the data collected. Knowledge of SPSS is preferred but not required and can be taught during the internship. The student will, in return, gain valuable experience conducting clinical research and join a dynamic lab. Students will be supervised by Dr. C. Alix Timko, PhD and will work closely with the research team. All research will take place at Children's Hospital of Philadelphia and the Roberts Center for Pediatric Research. As such, students are required to undergo FBI background and child abuse clearance as well as IRB and human subjects training.

Daniel Wolf

Project 1: Clinical and Behavioral Assessment of Intrinsic Motivation in Adolescents at Risk for Psychosis

The summer student will play an active role in this exciting new study led by Dr. Wolf. The study integrates clinical, behavioral, and functional imaging (fMRI) measures to investigate motivational impairment during cognitive task performance in youth at risk for psychotic disorders, a clinically important and understudied area. Specifically, we will test the hypothesis that clinical "real world" motivation impairments are associated with reductions of internally-generated reward responses to correct responses assessed trial-by-trial in a visual memory task. Student responsibilities will include helping to: screen and schedule study participants, administer behavioral tasks and questionnaires, manage and analyze data, review and summarize relevant literature. Students will be exposed to all aspects of the study including fMRI data acquisition and analysis, patient interviews, and will have the opportunity to shadow advisor in

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outpatient psychiatry clinic. As the project progresses, students will have the opportunity to relate their analysis of clinical and behavioral measures to functional imaging data collected from the same study participants. Students will be encouraged to: explore their own ideas for analysis, attend lab and departmental seminars; present their results at local and/or national conferences, and contribute as co-authors on abstracts or manuscripts. Students will benefit from the exposure to cutting-edge translational neuropsychiatric research, close mentorship from a physician scientist, and the opportunities to build skills in interpreting literature and data and creating written and oral presentations. This project is best suited to highly motivated students interested in cognitive-affective neuroscience, psychology, psychiatry, and/or behavioral neurology.

Project 2: Quantitative Neuroeconomic Modeling of Intrinsic Motivation during Memory Performance in Adolescents at Risk for Psychosis

The summer student will play an active role in this exciting new study led by Dr. Wolf. The study integrates clinical, behavioral, and functional imaging (fMRI) measures to investigate motivational impairment during cognitive task performance in youth at risk for psychotic disorders, a clinically important and understudied area. Specifically, we will test the hypothesis that clinical "real world" motivation impairments are associated with reductions of internally-generated reward responses to correct responses in a visual memory task. Student responsibilities will include writing and applying computer programs to analyze trial-by-trial behavioral responses including confidence ratings and old/new memory judgments in the context of a reward prediction error model. These quantitative models will also be applied to the analysis of trial-by-trial fMRI measures of brain activation in brain regions involved in motivation. Students will be exposed to all aspects of the study including fMRI data acquisition and analysis, patient interviews, and may shadow advisor in outpatient psychiatry clinic. Students will be encouraged to: explore their own ideas for analysis, attend lab and departmental seminars; present their results at local and/or national conferences, and contribute as co-authors on abstracts or manuscripts. Students will benefit from the exposure to cutting-edge translational neuropsychiatric research, close mentorship from a physician scientist, and the opportunities to build skills in interpreting literature and data and creating written and oral presentations. This project is best suited to highly motivated students with a strong background in math and computer science who are also interested in cognitive-affective neuroscience, psychology, psychiatry, and/or behavioral neurology.

Project 3: Approach and Avoidance Tendencies: Inter-relating Clinical, Personality, Cognitive, and Imaging Measures

The summer student will focus on analyzing and integrating data collected in previous studies led by Dr. Wolf and his collaborators. These studies include various measures related to approach and avoidance tendencies, including clinical measures of depression and anxiety, self-reported personality tendencies toward approach and avoidance motivation, functional brain

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imaging responses to positive and negative monetary or facial affective outcomes, and cognitive measures of bias towards correct responses versus avoidance of incorrect responses. Specifically, we will test the hypothesis that a self-reported bias towards avoiding negative events versus approaching positive events will be associated with related abnormalities in cognitive and brain imaging phenotypes. Student responsibilities will include organizing, integrating, and analyzing these diverse datasets. Students will be exposed to other aspects of translational psychiatric research in ongoing studies including fMRI data acquisition and analysis, patient interviews, and may shadow advisor in outpatient psychiatry clinic. Students will be encouraged to: explore their own ideas for analysis, attend lab and departmental seminars; present their results at local and/or national conferences, and contribute as co-authors on abstracts or manuscripts. Students will benefit from the exposure to cutting-edge translational neuropsychiatric research, close mentorship from a physician scientist, and the opportunities to build skills in interpreting literature and data and creating written and oral presentations. This project is best suited to highly motivated students with a strong background in math/statistics, who are also interested in cognitive-affective neuroscience, psychology, psychiatry, and/or behavioral neurology.

Benjamin Yerys

Project 1: Challenging Behaviors in Autism: Parent, Child, and Therapist Perspectives

Many school age children with autism who have average intelligence struggle with tantrums, arguing, yelling, and other challenging behaviors. There are behavior therapies to address these challenging behaviors, but very little is known about how key stakeholders perceive the effectiveness of the available treatments. The goal of this project is to interview children and young adults with autism, parents, and therapists who treat aggression in autism to learn about their perspective on these treatments. We will conduct a qualitative analysis of the interviews to determine key themes from each of the three stakeholder groups, and themes that cut-across all groups. We expect to identify an array of positive and negative perspectives about the current set of treatments. We anticipate submitting our findings for a conference presentation and an empirical paper. The student would play a pivotal role in working with a team of clinical psychologists who specialize in working with individuals with autism. The student would be able to assist in developing the project (Interview guides, IRB submission), conduct the interviews, support the qualitative analysis, and participate in the write-up of results. The student would have a unique opportunity to learn about autism, gain an introductory experience in working directly with families and providers, foundational skills in qualitative interviewing, and a community-based research approach. Dr. Kuschner and Dr. Maddox will mentor qualitative methods, Dr. Miller and Dr. Yerys will mentor theoretical and clinical foundations of autism and challenging behaviors. Student prerequisites include Intro to Exp Psych and/or Intro Developmental Psyc.

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PULMONARY AND CRITICAL CARE MEDICINE

Mary Porteous

Project 1: Risk factors associated with progression of Interstitial Lung Disease

This is a great opportunity for students interested in clinical research. Students will obtain a better understanding of interstitial lung disease, a rare lung disease associated with significant morbidity and mortality and that often requires lung transplantation. This project focuses on classifying different subtypes of interstitial lung disease and identifying clinical and molecular risk factors associated with disease progression. Students will collect clinical information for patients enrolled in the Interstitial Lung Disease Clinical Registry and Biorepository. Students will work with the ILD study coordinator Carly D'Errico and will be taught to extract information related to environmental exposures, medical history, pulmonary function, and response to medication from the electronic medical record and to record this information in an online database. Students will also participate in a weekly multidisciplinary review in which pulmonologists, radiologists, pathologists, and rheumatologists discuss the clinical and radiographic information collected by the students in order to classify the patient's specific subtype of interstitial lung disease. Identifying a patient's specific type of interstitial lung disease has important treatment and prognostic implications. Students will also have an opportunity to discuss ongoing research projects, analyses, and manuscripts in progress. Students will interact with chronically ill patients and their families and should be professional and adherent to patient privacy standards.

Project 2: Risk factors associated with the development of lung cancer in interstitial lung disease

Lung cancer among those with interstitial lung disease can be difficult to diagnosis and to treat due to the lung toxicity associated with surgery, radiation, and chemotherapy. It is currently unknown as to whether lung cancer in patients with interstitial lung disease should be treated differently than in patients without underlying lung disease. This project will involve identifying clinical risk factors for lung cancer among those with interstitial lung disease and understanding the impact of lung cancer treatment (surgery, radiation, and chemotherapy) on lung function and survival in this group of patients. Students will work with the ILD study coordinator Carly D'Errico and will be taught to extract information about clinical and molecular characteristics of the patient's lung cancer, treatment regimen, lung function, and survival from the electronic medical record and record them into an online database. Students will have the opportunity to participate in research meetings to discuss ongoing findings with pulmonologists, oncologists, and radiation oncologists.

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Project 3: Clinical and molecular characteristics of acute exacerbations of interstitial lung disease

Interstitial lung disease is a progressive type of lung disease associated with significant morbidity and mortality. Acute worsening or exacerbations of interstitial lung disease can be due to infection, aspiration, or acceleration of underlying lung inflammation and fibrosis, often require hospitalization, and are associated with over 50% mortality. Among those that survive the acute exacerbation, many experience a significant decline in their lung function after the exacerbation. Currently, the treatment of these exacerbations involves empiric antibiotics, steroids, and supportive care. The pathways responsible for these exacerbations are unknown. This project would involve the identification of molecular pathways that mediate acute exacerbations so that more tailored treatments can be identified including longer use of anti-inflammatory medications or early initiation of anti-fibrotic agents. Students will work with the ILD study coordinator Carly D'Errico and will be taught to collect clinical information regarding infection, treatment, lung function, and survival from the electronic medical record and enter this information into an online database. If time allows, students may also learn laboratory techniques to process blood samples collected from these patients. Students will also have the opportunity to participate in weekly research meetings to discuss ongoing projects and data quality. Students will interact with critically ill patients and their families in the hospital.

RADIOLOGY

David Mankoff

Project 1: PET (positron emission tomography) study of glutamine metabolism in breast cancer

PURM Research assistant will participate in the development of molecular imaging markers (positron emission tomography-PET) to study how blocking glutamine utilization can choke the growth of aggressive breast cancer. Work includes assistance in 1) the PET imaging studies of small animal models (mouse); 2) the analysis of dynamic PET images (including mathematic modeling of image-derived data if capable). 3) keeping the tumor growth, imaging and treatment records for the project. The student will be mentored by Drs. David Mankoff, Rong Zhou and Austin Pantel and directly supervised by Dr. Zhou. Students will be exposed to the state-of-art in vivo imaging techniques and instruments at the Small Animal Imaging Facility at JMB-100.

Prerequisites: Students majored in bioengineering, biochemistry or premed are encouraged to apply. Training for working with mice will be provided once the student is accepted and is needed.

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Project 2: Developing multiple imaging modality approach for optimal assessment of pancreatic cancer responses to novel therapies

PURM Research assistant will participate in the development of precision molecular imaging markers using the two most powerful diagnostic imaging modalities (positron emission tomography-PET and magnetic resonance imaging-MRI). The multimodality imaging aims to gaining an insight of pancreatic cancer to novel therapies (e.g., stromal targeted therapy). Work includes assistance in 1) design and setting up of the combined MRI and PET imaging protocols in mouse models of pancreatic cancer; 2) the analysis of PET and MR images. The student will be mentored by Drs. David Mankoff, Rong Zhou and Austin Pantel. Most of the work will be done in Dr. Zhou's lab in John Morgan 198 and the Small Animal Imaging Facility (SAIF) at JMB-100. Students will be exposed to the state-of-art in vivo imaging techniques and instruments at the SAIF, Radiology at PENN.

Prerequisites: Students majored in bioengineering, biochemistry or premed are encouraged to apply. Training for working with mice will be provided once the student is accepted and is needed.

Chamith Rajapakse

Project 1: Musculoskeletal MRI and Orthopaedic Biomechanics

We are developing methods to non-invasively predict bone fracture risk in patients using MRI or CT guided personalized biomechanical simulations. This project involves imaging of human subjects as well as validation studies in cadaveric bone. This project involves MRI/CT scanning, image analysis, computer modeling, mechanical testing of bone samples in the orthopaedic lab, and writing abstracts/papers. No experience is needed and training will be provided. Preference will be given to students intending to apply for medical school and/or academic careers and who are interested in continuing the research beyond summer.

Project 2: Personalized 3D printing of Biological Tissue

We are investigating the feasibility of personalized 3D printing of bone, cartilage, muscle using biocompatible material guided via images obtained from high-resolution MRI or CT in human subjects and mesenchymal stem cell (hMSC) engraftment onto the same 3D-printed surfaces as a mean to further improve post-implant outcomes. This project involves MRI/CT/SEM/Microscopy imaging, image analysis, bio-fabrication, cell culturing, computer programming, and biological/mechanical testing of printed models, publication of abstracts/papers. No experience is needed and training will be provided. Preference will be given

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to students intending to apply for medical school and/or academic careers and who are interested in continuing the research beyond summer.

Project 3: Molecular Imaging of Cancer, Heart, and Bone Disease using PET/CT/MRI

This relatively new project involves development of novel PET/CT/MRI methods for applications in cancer, heart, and bone disease. Responsibilities could include the generation, analysis of imaging data and publication of results. No experience is needed and training will be provided. Preference will be given to students intending to apply for medical school and/or academic careers and who are interested in continuing the research beyond summer.

Ronnie Sebro

Project 1: Artificial Intelligence and Machine Learning for evaluation of pediatric bone and soft tissue tumors

"A picture is worth a thousand words". Most radiology studies are made of several pictures, but most radiology reports are only a few sentences long. Each image contains a tremendous amount of information that is often (partially) summarized by the radiologist. Here, we plan to harvest the tremendous advances in computing power and machine learning to better understand bone and soft tissue tumors. Bone and soft tissue tumors are very rare mesenchymal tumors with a very poor prognosis. We hypothesize that key imaging features of these tumors will be associated with tumor grade, and prognosis. We will perform a retrospective chart review case-control study evaluating how tumor heterogeneity predicts clinical outcomes. Student responsibilities will include data extraction from the medical record, statistical analysis of the data and preparation of a manuscript for publication.

This project will require: Excel skills, interest in radiology and willingness to learn imaging techniques. The student will learn: research techniques, how to write a paper, biostatistics, computing skills, and learn about bone and soft tissue sarcomas. Students can learn of the role of the radiologist at the weekly Sarcoma Tumor Board and get to interact with patients at the annual Sarcoma Steps to Cure Sarcoma. This will be a great project for a student interested in medicine (Radiology, Orthopedics, Pediatrics or Oncology) or computational sciences and image recognition.

Project 2: Genetics of musculoskeletal tumors and conditions

The human genome project has provided us insight into how genes affect diseases. Here, we seek to identify genes that are overexpressed/upregulated in musculoskeletal tumors and conditions. Identifying these genes will help scientists identify potential drugs that could be used to treat these diseases. Student responsibilities will include collecting data, statistical analysis of the data

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in conjunction with the mentor. The student should be motivated and responsible with an interest in clinical biomedical research but need not have formal research experience or statistical training. The student will learn: research techniques, how to write a paper, genetics, computing skills, and learn about bone and soft tissue sarcomas. Students can learn of the role of the radiologist at the weekly Sarcoma Tumor Board and get to interact with patients at the annual Sarcoma Steps to Cure Sarcoma. This will be an ideal project for a student interested in medicine (Genetics, Radiology, Orthopedics, Pediatrics or Oncology).

Project 3: Health disparities, diversity and inclusion

Eliminating health disparities has been a major focus of the American Medical Association, and Association of American Medical Colleges (AAMC). Health disparities are already apparent at birth (pre-term birth, low birthweight, perinatal complications). The goal of this research is to evaluate diversity and inclusion across different professions and to assess overall progress over the past few years and to identify potential solutions to increase diversity and inclusion. Student responsibilities will include data extraction, statistical analysis of the data and preparation of a manuscript for publication in conjunction with the mentor. The student should be motivated and responsible with an interest in clinical biomedical research but need not have formal research experience or statistical training. This would be a wonderful project for a student interested in studying how health is affected by society and human behavior.

Spyros William Stavropoulos

Project 1: Improving image guided kidney cancer management via deep learning

The focuses of the project for selected student are machine learning/deep learning and their application to the care of patients with renal cell carcinoma. The student will also be exposed to clinical medicine and research in radiology and interventional radiology through this project. Specifically, the student will be involved in developing/refining a radiomic pipeline that uses medical imaging (MRI, CT, etc) to predict outcomes for patients with small renal tumors who are potential candidates for ablation therapy by interventional radiologists. The student will be trained and involved in all aspects of the project including conception and design, data collection, algorithm development, interpretation of results and potentially manuscript writing. Professors from the radiology, pathology and engineering department will oversee the project and mentor the students from a high level. Students will work on a daily basis with an interventional radiology fellow (PGY-6, Dr. Harrison Bai) who is devoted to research and has mentored Penn undergraduates and medical students, helping them be published co-authors in journals in machine learning/deep learning (e.g., PMID 28339588 and 29167275). The student will work collaboratively with and have access to resources at the Center for Biomedical Image

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Computing and Analytics (CBICA) from our department which features high throughput computing resources designed for machine learning/deep learning. The students should have a basic understanding of computer science and programming experience (e.g., Python, matlab), ideally from CIS or other departments in SEAS, but we will consider all highly-motivated candidates.

Joel Stein

Project 1: Quantification of hippocampal digitations in temporal lobe epilepsy using high resolution MRI

The hippocampus is a brain structure that subserves learning and memory function and is also a common site of seizures in patients with epilepsy. Hippocampal digitations are undulations along the surface of the hippocampus. Loss of this morphologic feature is one marker of mesial temporal sclerosis (MTS), a common and treatable cause of temporal lobe epilepsy. Magnetic resonance imaging (MRI) at higher magnetic field strength permits better visualization of hippocampal digitations. The goal of this project is to develop an automated method to determine the number and thickness of hippocampal digitations from high resolution MRI. The approach will be validated against expert manual determination in an existing 7 Tesla brain MRI dataset of epilepsy and control patients. A validated automatic method for measuring digitations could be used in larger datasets to determine whether the number of digitations is correlated with MTS, hippocampal atrophy, behavioral factors or genetic features.

This project offers the opportunity to work with state-of-the-art neuroimaging data on a problem of high clinical relevance. Successful implementation should lead to a conference abstract and manuscript submission. The project will be co-mentored by Dr. Joel Stein (Radiology) along with Dr. Kathryn Davis and Dr. Sandhitsu Das (Neurology). Familiarity with basic statistical methods is recommended. Programming experience such as in Matlab, C++, or Python would be helpful.

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SURGERY

Pavan Atluri

Project 1: Molecular mechanisms of mechanical unloading-induced recovery

Heart failure therapies have undergone massive changes in recent times, one of the most significant of which is the use of mechanical circulatory support as a means of inducing cardiac recovery. Left ventricular assist devices take blood from the left ventricle and transmit it to the ascending aorta, relieving the workload of the left heart and supporting the circulation. It was discovered that in selected patients, these devices can be used to recover cardiac function. The mechanisms of how this happens could lead to new therapeutic targets. We have an animal model of cardiac recovery in mechanical unloading and will be examining protein expression of key calcium handling proteins and proteins which regulate cell structure, to correlate with physiological changes at the organ level. Specifically, the student would be involved in a project examining protein expression changes related to calcium handling in a model of mechanical unloading and recovery. Some experience with basic lab techniques, especially western blotting, would be ideal but is not required. Preference will be given to students who wish to continue this work into the academic year.

Ronald DeMatteo

Project 1: Role of PDGFRA signaling in Gastrointestinal stromal tumor

Gastrointestinal stromal tumor (GIST) is the most common sarcoma of the intestinal tract, caused in the majority of cases by a genetic mutation in Kit, a growth factor receptor tyrosine kinase that is sensitive to the targeted therapy Imatinib (Gleevac). However, 10-15% of GIST patients harbor an activating mutation in platelet derived growth factor receptor alpha (PDGFRA). The biology of these PDGFRA tumors is not as well understood and they are largely resistant to Imatinib therapy. Our summer student will study how the non-mutated and mutated PDGFRA receptors contribute to GIST proliferation and downstream kinase signaling, as well as test novel therapies against PDGFRA in vitro with cell lines and in vivo with mouse models. By the end of the summer, the student will develop a better understanding of the role of growth receptor signaling in cancer biology. Towards this end, the student will learn the basic techniques of cell culture, western blot, ELISA and immunohistochemistry. The student will be expected to present his/her findings bimonthly at lab meetings and will be responsible for maintaining and treating GIST cell lines. Additionally, the student will work in a collaborative atmosphere, closely mentored by senior scientist (Ferdinando Rossi, PhD) and Surgery fellow (Marion Liu, MD), and

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witness how bench science is translated to targeted therapies. As pre-requisite, the student will need BIOL 101, 121 or 123.

Shariq Raza

Project 1: Trauma Surgery - The utility of 3D printed heart models for surgical education and training in echocardiography for guided resuscitation in critical care.

Help design a 3D heart model for various cardiac disease states (shock, traumatic injury, valve disease) and incorporate them in an ultrasound course already taught to medical students and residents rotating in Trauma Surgery and Surgical ICU. The project can be started and implemented without difficulty during summer months. Outcomes studied shall be higher understanding /earlier adoption of ultrasound to guide resuscitation in critical care. Long-term retention and sustained use of ultrasound modality will be tracked. Findings will be presented (by the student, if feasible) at national /international surgical meetings and published in surgical journals.

The exposure will provide mentoring and education from a trauma surgery attending with clinical and research interest. This shall help students tremendously as they embark on choosing an area of study for their ultimate career track. The student will develop skills in conceptualizing and designing complex cardiac disease conditions in 3D; planning, implementing and conducting a clinical trial; and learn manuscript writing. They will receive authorship /contributor credit in the manuscript and present findings at national meetings. The student will work closely with myself, and the 3D printing lab at Penn, and help conduct educational sessions with medical students, surgery /anesthesia /emergency medicine residents and fellows, and allied healthcare providers in surgical ICU.

Prerequisites: Ability to visualize concepts in 3D is a must. CAD and/or 3D design experience is a plus but certainly not required. An interest in medical disciplines in general and (trauma) surgery in particular would be a delightful benefit.

Project 2: Trauma Surgery - Patterns of Usage of Smartphone Emergency Medical ID Apps among Patients presenting in Extremis to a Level-1 Trauma Center

Help study patterns of usage of iPhone and Android smartphones' Emergency Medical-ID information features in trauma patients presenting to Penn Trauma Center. Help design and implement an ED performance improvement project to train staff to routinely query smartphones' Emergency Medical-ID information for patients that present in extremis. Study effects of earlier patient identification, availability of medical information and family notification on clinical outcomes and patient and family satisfaction.

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The project can be started and implemented without difficulty during summer months. Findings will be presented (by the student, if feasible) at national /international surgical meetings and published in surgical journals. The exposure will provide mentoring and education from a trauma surgery attending with clinical and research interest. This shall help students tremendously as they embark on choosing an area of study for their ultimate career track. The student will develop skills in conceptualizing, implementing and conducting a clinical trial; and learn manuscript writing. They will receive authorship /contributor credit in the manuscript and present findings at national meetings. The student will work closely with myself, and the Trauma Surgery and Emergency Medicine staff in the ED, and medical students, surgery /anesthesia /emergency medicine residents and fellows, and allied healthcare providers.

Prerequisites: RedCap /database design experience is a plus but certainly not required. An interest in medical disciplines in general and (trauma) surgery in particular would be a delightful benefit.

Project 3: Trauma Surgery - Determining the minimum required volume and optimum location for the detection of pneumothorax using eFast Ultrasound Assessment

Help determine the minimum volume of air required to detect a pneumothorax (air outside the lung) using eFast ultrasound, and the optimum location on the chest for this assessment. Study would involve calculating volumes of pneumothorax on the chest CT scans of patients presenting to Penn Trauma Center, and help perform repeat eFast ultrasounds on these patients to determine ultrasound sensitivity and optimum location on the chest.

The project can be started and implemented without difficulty during summer months. Findings will be presented (by the student, if feasible) at national /international surgical meetings and published in surgical journals. The exposure will provide mentoring and education from a trauma surgery attending with clinical and research interest. This shall help students tremendously as they embark on choosing an area of study for their ultimate career track. The student will develop skills in conceptualizing, implementing and conducting a clinical trial; and learn manuscript writing. They will receive authorship /contributor credit in the manuscript and present findings at national meetings. The student will work closely with myself, and the Trauma Surgery and Emergency Medicine staff in the ED, and medical students, surgery /anesthesia /emergency medicine residents and fellows, and allied healthcare providers.

Prerequisites: RedCap /database design experience is a plus but certainly not required. An interest in medical disciplines in general and (trauma) surgery in particular would be a delightful benefit.

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Mark Seamon

Project 1: Assessment of Long-Term Outcomes in Gunshot Wound Victims

The purpose of the study is to evaluate the long term functional and behavioral outcomes in patients who sustained gun shot wounds and were treated at Upenn over the last 10 years. Subjects will be identified using the Upenn trauma registry and will be contacted by phone. Subjects will be asked to complete a series of validated surveys, and subjects who sustained minor injuries will be compared to those who sustained major injuries and with matched controls from the general population. Undergraduate students will be calling prior gunshot wound victims and filling in survey answers. Undergrads will work with myself (Mark Seamon, PI), Michael Vella (Trauma Fellow) and Alexander Warshauer (Medical Student) and will have plenty of supervision for the project.

Justin Ziemba

Project 1: Assessing Quality of Life in Patients with Kidney Stones

Kidney stone disease is very common, and it is characterized by multiple painful episodes. How this pain interrupts or interferes with patients' daily lives is not well known. To better understand how patients' feel about their disease, we are having them complete surveys in the office, operating room, and emergency department. They then complete follow up surveys at home. Hopefully, we will be able to use this information to better treat and counsel patients with kidney stone disease.

As a summer research assistant, you would help to enroll patients in this study (talk with them, have them sign documentation, etc.) and also help to collect data about their treatments. This project will allow you to improve your communication skills, build your time management and organizational skills, and understand how data management is important in the medical field. Plus, you will have the opportunity to shadow the team of physicians in the office and operating room. This project will require full time commitment Monday through Friday during normal business hours.

The lead on this project will be Dr. Justin Ziemba, MD in the Division of Urology at the Hospital of the University of Pennsylvania. However, you will also have the opportunity to work with Dr. Phillip Mucksavage, MD in the Division of Urology at Pennsylvania Hospital as well as numerous other medical students and residents. This is great opportunity to build a mentoring relationship if you are interested in entering a health-related profession after your undergraduate career.

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Project 2: Assessing Injury after Kidney Stone Surgery

There are several methods to surgically remove a kidney stone. One way is using a small camera placed through the ureter (tube that drains urine from the kidney to the bladder). We think that injury of the ureter after performance of this procedure is rare, although we are not sure. To determine if injury happens more often, we are planning to perform a post-surgery x-ray to look for injury or damage to the ureter.

As a summer research assistant, you would help to enroll patients in this study (talk with them, have them sign documentation, etc.) and also help to collect data after performance of the x-ray. This project will allow you to improve your communication skills, build your time management and organizational skills, and understand how data management is important in the medical field. Plus, you will have the opportunity to shadow the team of physicians in the office and operating room.

The lead on this project will be Dr. Phillip Mucksavage, MD in the Division of Urology at Pennsylvania Hospital. However, you will also have the opportunity to work with Dr. Justin Ziemba, MD in the Division of Urology at the Hospital of the University of Pennsylvania as well as numerous other medical students and residents. This is great opportunity to build a mentoring relationship if you are interested in entering a health-related profession after your undergraduate career.

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Nursing

BIOBEHAVIORAL HEALTH SCIENCES

Charlene Compher

Project 1: EFFORT Trial

Learn about clinical trials in nutrition by participating as part of the HUP nutrition team. Your role would be to assist the dietitian with data retrieval from patient records and entry into a password-protected database. You would be trained for this role by Jennifer Dolan, a dietitian specialist. Dr. Compher would also mentor you in this role and meet with you at least every other week. Only nursing students will be considered. They must have current and up-to-date immunization and criminal background checks.

Mary Ersek

Project 1: Palliative Care Consultations for Persons with Advanced Dementia

Palliative care is a patient and family-centered approach to care that is recommended for persons with advanced dementia (PWAD). Key components of this approach are:1) open discussion of the course of illness; 2) establishment and communication of patient- and family- directed goals that guide health care; 3) aggressive prevention, early identification and treatment of illness-related symptoms; and 4) identification of psycho-spiritual needs and approaches to mitigating suffering. Unfortunately, many PWAD, especially those who are cared for in nursing homes, lack access to palliative care. This is particularly concerning in post-acute (i.e., following hospitalization) nursing home care, where PWAD are likely to receive intensive physical rehabilitation services and treatments that are burdensome rather than beneficial for the person's well-being. Our project's goal is to refine and test a palliative care consultation intervention for PWADs who are receiving post-acute care in nursing homes.

Note: we will be finishing this project this coming summer and will be in the midst of analyzing data, writing up the results, and preparing a larger grant application. Student duties and learning opportunities include: cleaning the database in preparation for analysis, assisting in preparing a manuscript, assisting with preparing presentations using PowerPoint, and reviewing NIH grant application materials to assist in grant preparation.

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My co-investigator on this grant is a postdoctoral fellow, Dr. Joan Carpenter, who will also be mentoring all student helpers

Nancy Hodgson

Project 1: The Role of Palliative Care Interventions to Reduce Circadian Rhythm Disorders in Persons with Dementia: The Healthy Patterns Study

This Phase III efficacy trial of the Healthy Patterns intervention, a home-based activity intervention, is designed to improve symptoms of circadian rhythm disorders (CRD) and quality of life (QOL) in home dwelling person with dementia. We will use a randomized two group parallel design of 200 people with dementia and their caregivers assigned to intervention or attention control intervention. Outcomes include measures of QOL as well as actigraphic and proxy reported measures of CRDs.

Position Duties will include:

Administrative: Prep paper files; Collect and enter data into REDCap; Mail study correspondence; Arrange study supplies; Conduct literature reviews; Maintain accurate records of interviews; Manage and respond to project related email; Update and maintain Google calendar

Recruitment: Post pamphlets/flyers in the community; participate in direct mail campaign, which includes cold calling potential participants

Communication: Conduct screening calls with potential participants; Arrange study visits in collaboration with Research Nurse

Home Visits: Conduct visits with caregiver; Conduct end of life study visit; Retrieve actigraph from participant's home; Retrieve saliva specimens from participant's home

Other: Check actigraphs for battery power; Attend project meetings; Attend seminars, training and other meetings as necessary

Other mentors: Laurel Caffeé - Research Project Manager; Anjali Rajpara - Research Nurse

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Sarah Kagan

Project 1: Developing an App for Clinical Decision Making in Head and Neck Cancer: The Challenge of Prophylactic Gastrostomy Tube Placement

Significance: Evidence supports use of prophylactic percutaneous gastrostomy tubes (pPEGt) to improve clinical outcomes among head and neck cancer patients. However, few tools are available to guide clinical decisions to appraise risk and select patients for whom placement of these devices is appropriate. Moreover, tools and decisions guides currently available are cumbersome to use in clinical care and limit opportunities to collect data to ensure high quality evidence-based care over time.

Objective: To develop an app making a clinical decisions support tool for pPEGt placement in head and neck cancer care.

Design and Methods: Build a pilot app using available scientific and clinical best practices for clinical feasibility study in concert with the clinicians and patients at the Center for Head and Neck Cancer at the Abramson Cancer Center, Pennsylvania Hospital. The student will work with speech language pathologists, nutritionists, nurses, and surgeons to design and test the app, carrying out activities including app development, Institutional Review Board application, patient recruitment and enrollment, and data collection and analysis.

Student Skill Sets: Experience in app development, basic statistics knowledge, and current patient oriented research certification are required. Interest in biomedical and health research as well as careers in healthcare are encouraged.

Project 2: Comparing access to and utilization of supportive care for head and neck cancer patients in an interdisciplinary care model versus usual care.

Significance: Evidence suggests timely access to and utilization of supportive care improves clinical and patient-reported outcomes as well as enhancing care experience and satisfaction. Effective mechanisms to ensure access and timely referral and scheduling for nurse navigation (NN), speech language pathology (SLP), clinical nutrition (CN), and physical therapy (PT) services as integrated interdisciplinary supportive care for patients treated for head and neck cancer are less well established.

Objective: To develop and implement an observational descriptive survey study of patient-reported and clinical outcomes of an interdisciplinary supportive care model during head and neck cancer treatment. Patients who receive NN/SLP/CN/PT in the interdisciplinary CARE Clinic at the Center for Head and Neck Cancer at the Abramson Cancer Center, Pennsylvania Hospital will be compared with patients who receive their medical and surgical care in the Center but receive some or all of their supportive care at agencies outside Penn Medicine as usual care.

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Design and Methods: Develop an observational descriptive survey administered during telephone contact with patients treated in the Center for Head and Neck Cancer at the Abramson Cancer Center, Pennsylvania Hospital. The student will work with speech language pathologists, nutritionists, nurses, and surgeons to design the study, write the study protocol and carry out activities including Institutional Review Board application, patient recruitment and enrollment, and data collection and analysis.

Student Skill Sets: Basic statistics knowledge and current patient oriented research certification are required. Interest in survey research, other biomedical and health research, as well as careers in healthcare are encouraged.

Eileen Lake

Project 1: NICU Performance: Missed Nursing Care and Infant Outcomes

This project has three aims:

Aim 1. Determine associations between missed nursing care and NICU patient outcomes for VLBW infants.

Aim 2. Determine the association between missed nursing care and parent satisfaction with care in the NICU.

Aim 3. Identify nurse and NICU organizational factors associated with missed nursing care.

This summer we are conducting Aim 2 in 24 NICUs around the country.

The student would monitor the recruitment of parents and survey completion in the 24 NICUs, perhaps do some data entry from the parent survey, as well as other research assistant duties such as literature search, preparation of tables for manuscripts from analytic output, preparation of powerpoint slides for presentations.

Salimah Meghani

Project 1: Clinical Disparities in Cancer Pain and Symptom Outcomes and Converting Findings into Workable Interventions

This study provides an important opportunity for a student interested in clinical research and generating interventions to reduce health disparities. Abundant research suggests that cancer pain

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is undermanaged in African Americans although very few interventions exist to close the gap in pain and symptom management. This is partly because the mechanisms 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 in-depth individual interviews with 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 explicates what is important to patients and family caregivers in the context of patients’ cancer and symptom management experience and to determine if the salient concerns and considerations differ for patients vs. families or between racial subgroups. In addition, the study elicits patients-family generated concerns and ideas to improve illness and pain management and to convert ideas to actionable interventions specific to decreasing disparities.

The PURM fellow will learn the following skills: 1) completing training in human subjects research and learning to navigate Institutional Review Board; 2) learn principles of clinical research; 3) analyze and code qualitative data; 4) learn to use data analysis software [Atlas ti. for qualitative and SPSS for quantitative data); 5) generate and interpret data outputs; 6) learn to triangulate mixed-methods data; 7) contribute to grants and publications stemming from the data analysis and interpretation. The mentee(s) will have opportunities to develop scientific posters and papers from the data.

FAMILY & COMMUNITY HEALTH

Pamela Cacchione

Project 1: Heart Failure Montitoring Socks "Smart Socks"

This past year I have been working with an Engineering Senior Design team to develop a proof of concept on "Smart Socks" to monitor peripheral edema related to heart failure. We are also interested in adding additional monitoring such as actigraphy and heart rate. As people with heart failure have an exacerbation typically their physical activity will decrease and their heart rate may increase. We are trying to ultimately develop a wearable sock that can identify when a person with heart failures needs to see their primary care provider in order to avoid a hospitalization and have a better quality of Life. At this part of the project I anticipate we will be working with designing and testing socks on a model developed by the Senior design students.

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Peggy Compton

Project 1: Sensory Modulation in Opioid Abusers With Chronic Pain

Exposure to opioids in and of themselves plays a role in altered pain perception; well-demonstrated in animals and inferred in patients, ongoing opioid use results in increased sensitivity to experimental pain, a phenomenon known as opioid-induced hyperalgesia (OIH). Both patients with chronic pain and patients with opioid addiction use opioids on a regular basis, however it is unknown if OIH is expressed similarly in both populations. This study will compare experimental pain perception in patients with chronic pain with and without opioid addiction to better understand how the interaction of these patient conditions affects the expression of OIH. Students will receive training in administering experimental pain (cold pressor, quantitative sensory testing) and assist with the collection of these data on human subjects. Students will work closely with the project director to recruit and screen potential research subjects, schedule study visits, and prepare lab and equipment for pain testing sessions. In addition, students will assist with data entry and formatting of references for research publications. Applicants must be proficient in WORD and EXCEL, with excellent attention to detail. Due to interaction with human subjects, applicants must be professional, a good communicator and highly responsible. Coursework in human physiology and/or neuroscience preferred, but not required.

Project 2: Post-Operative Pain Responses in Dental Patients on Chronic Opioid Therapy

Exposure to opioids in and of themselves plays a role in altered pain perception; well-demonstrated in animals and inferred in patients, ongoing opioid use results in increased sensitivity to experimental pain, a phenomenon known as opioid-induced hyperalgesia (OIH). The degree to which OIH worsens the pain experience of patients with chronic pain remains undescribed, however has significant implications for clinical management. The specific aim of this study is to determine the effect of chronic opioid use on pain perception in patients undergoing a standardized dental surgical procedure. Specifically, in a well-characterized sample of chronic pain patients receiving daily opioid therapy, experimental and subjective pain responses will be prospectively described prior to and immediately following a planned dental surgery, and compared to patients matched on gender, ethnicity, age and expected surgical trauma who are not on opioid therapy. Students will receive training in administering experimental pain (cold pressor, quantitative sensory testing) and assist with the collection of these data on human subjects. Students will work closely with the project director to recruit and screen potential research subjects, schedule study visits, and prepare equipment for pain testing sessions. In addition, students will assist with data entry and formatting of references for research publications. Applicants must be proficient in WORD and EXCEL, with excellent attention to detail. Due to interaction with human subjects, applicants must be professional, a good communicator and highly responsible. Coursework in human physiology and/or neuroscience preferred, but not required.

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Jianghong Liu

Project 1: Data Collection and Management for Longitudinal Healthy Brain and Behavior Study (HBBS)

We are currently in the process of performing a follow-up study on a 450-children cohort from West Philadelphia that participated in a previous research study on early health factors and behavior in 2011-2012. We are piloting a study that is attempting to track this original cohort and examine long-term health outcomes. The student will be involved with survey administration to subjects, data collection, data entry and data cleaning. The ideal candidate is highly organized and motivated with an interest in behavioral health, children and adolescents, mental health and environmental health.

Project 2: Early health factors on adolescents' positive psychology

We know very little about what are the early health factors associated with adolescents' emotional well-beings (e.g. happiness, and grit, and 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 interpreting 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. Students with a psychology background are especially welcome.

Project 3: Nutritional Factors and Sleep

It is well known that sleep is critical for child growth and development and that it can be affected by a variety of a health factors. However, we are only beginning to understand the role of nutrition and diet on sleep quality. Nutrition factors that could possibly affect sleep include micronutrient intake, omega-3 fatty acid intake, etc. The student will build experience in literature search, synthesis, and interpreting 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. Students with a nutrition background are especially welcome.

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Adriana Perez

Project 1: Meaningful Activity and Quality of Life in older Latinos with Alzheimer's or Dementia

The purpose of this study is to culturally adapt a timed activity protocol designed to promote quality of life and and reduce behavioral symptoms in high risk older Latinos and their caregivers. The study uses a mixed methods approach to refine the timed activity protocol ("Healthy Patterns") with input from Latino elders with dementia and their caregivers (Phase I), and to evaluate the feasibility and proof of concept of the tailored activities on outcomes related to quality of life, behavioral symptoms (Phase II).

Student Duties & Responsibilities (under the guidance of Principal Investigator):*

- Recruitment, including research participant follow up prior to enrolling in research intervention
- Data Collection, including participant demographic data, quality of life scale, and Neuropsychatric Inventory Scale
- Data entry and data management
- Assistance with preliminary data analysis and research report preparation
- Participant home visits for intervention education
- Participant retention, including phone call reminders
- Opportunity to publish and present findings in peer-reviewed conference proceedings (with research team)

* Ultimately, students will obtain hands on research experience with mixed methods research, including qualitative focus group conduction, as well as intervention design, implementation and analysis. This research offers a unique opportunity to work with a diverse and understudied population: Spanish speaking, Latinos with Alzheimer's and their caregivers.

- Prerequisites:
- Bilingual (Spanish) since all participants will be Spanish speaking only.
- Must complete CITI; Training in ethics and regulatory practices.
- Must have dependable transportation, since study is conducted in participant homes throughout Philadelphia.

Mentorship:

Students will be directly mentored by Dr. Perez, and will attend weekly (or bi-weekly) research team meetings.

Students will also receive training for data collection and data entry from our current Research Project Manager, Laurel Caffeé.

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Anne Teitelman

Project 1: Women and HIV Prevention

Pilot testing an intervention to reduce HIV risk among women in Philadelphia. Activities would include data collection with study participants and data management. Also attending research team meetings. Good organizational skills needed as well as good interpersonal skills.

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Social Policy and Practice

BIOBEHAVIORAL HEALTH SCIENCES

Femida Handy

Project 1: Does being pro social make you a better date?

Prior research has found evidence that "beautiful is good:" more physically attractive people are seen to have more favorable attributes, are treated better by others, and even have some better behaviors and outcomes in many areas of life. Research has also found evidence in the opposite direction, that "good is beautiful:" people with more favorable attributes are rated as more physically attractive. Yet the prior research has only rarely examined links between physical attractiveness and prosocial behavior, such as helping others, donating money or volunteering. Furthermore, prior research has relied on convenience samples of college students, and are largely cross-sectional. In the current research, we propose to examine the relationships between physical attractiveness, sexual and dating behaviors and prosocial behaviors and traits in a nationally representative sample of older adults and a 54-year longitudinal study.

Students' duties, responsibilities, and/or prerequisites: Interest in the subject matter. Excellent writing skills, and ability and interest in doing a literature search. Students will be engaged in all aspects of the paper, including but not limited to searching the database of journal articles relevant to the topic, assisting with formulating the precise questions and writing the testable hypotheses. Assisting with the editing and writing of the paper. IF (but not necessary) interested students can help with the data analyses as well.

Project 2: Retention and Attrition among Sport Volunteers: The Case of Fencing USA

Volunteers are critical in the operation of many sports events and organizations, especially in non-professional sports. Many sports organizations are currently facing an erosion of their traditional volunteer base and have had to turn to paid staff. This has led to increased costs for their members and participants. This research examines the data from a national sports association related to fencing to understand the factors that promote retention and those factors that are associated with volunteers' quitting. Using 606 responses from individuals, this research examines the behaviors of USA fencing volunteers, and the challenges and barriers faced in the context of the different tasks undertaken. By examining the responses of those who had either volunteered (25%) or were currently volunteering (75%) for USA Fencing, the study aims to understand the causes of both volunteer retention and volunteer attrition, and thereby provides a more holistic look at a critical issue facing sports organizations of volunteer attrition.

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Students' duties, responsibilities, and/or prerequisites: Interest in the subject matter. Excellent writing skills, and ability and interest in doing a literature search. Students will be engaged in all aspects of the paper, including but not limited to searching the database of journal articles relevant to the topic, assisting with formulating the precise questions and writing the testable hypotheses. Assisting with the editing and writing of the paper. IF (but not necessary) interested students can help with the data analyses as well.

SOCIAL WORK

Jacqueline Corcoran

Project 1: Systematic Review of Treatment Effectiveness for Low-Income Women with Depression

Low-income women are at high risk for depression (Ertel, Rich-Edwards, & Koenen, 2011; Lennon, Blome, & English, 2001; McDaniel & Lowenstein, 2013). Because of the potential deleterious outcomes associated with depression in low-income women, it is important to know how to effectively treat depression in this population. To that end, a systematic review will be undertaken on the effectiveness of interventions to treat depression in low-income women. A systematic review aims to comprehensively locate and synthesize the research that bears on a particular question. It uses organized, transparent, and replicable procedures at each step in the process (Littel, Corcoran, & Pillai, 2008).

Student's Role: A student's role would involve the following tasks:

1) searching for studies in PubMed, Proquest, Psychinfo, and EBSCOE with the following criteria:
    a. women 18 years and older
    b. low income specified in the study or assessed as low income
    c. randomized controlled trials of depression interventions compared to either a comparison intervention or a no-treatment control group
    d. with a primary outcome measure of depression using a standardized instrument
2) screening titles, abstracts, and full-text articles of studies located through the search and organizing them in an Excel spreadsheet
3) extracting relevant methodological characteristics, demographic characteristics, and statistical findings from studies that meet the criteria.

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What Students Will Gain: Students will gain knowledge and skills associated with conducting systematic reviews, which are considered the highest level of research evidence in medicine and related fields. More specific skills for the student will involve library search and retrieval skills and a deep topic and methodological knowledge of the treatment outcome studies involved with depression in low-income women. Publication authorship is a possibility depending on the scope, duration, and quality of work.

Prerequisites: Logical and detail orientation; Interest in topic area; Interest in learning how to read and understand academic studies

Project 2: Women and Depression: A Meta-Synthesis

Qualitative research may illuminate women's experience of depression and provide insights into how women cope and recover, and discover what is helpful about treatment. Qualitative research may also empower women to give voice to their experience with depression (Stoppard, 1999). The results of several qualitative studies on a topic can be accumulated through meta-synthesis to advance knowledge-building.

Meta-synthesis is a methodology designed to systematically review and integrate results of primary qualitative studies that have been conducted on a particular topic using qualitative methods. According to the Joanna Briggs Institute (2014), meta-synthesis can be viewed as a necessary component of the evidence-based practice process (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1997). It can represent consumer voices on perspectives of sufferers and the types of strategies and approaches that they find helpful.

The purpose of this study is to conduct a meta-synthesis of studies of qualitative research on the lived experience of women suffering from depression. The inclusion criteria involves qualitative studies of U.S. women (age 18 and above, not elderly) suffering from non-pregnancy related depression.

Student's Role:

1) Completing a data extraction sheet for the descriptive characteristics and methodological features of each study using a form adapted from Paterson, Thorne, Canam, & Jillings (2001).
2) Using an Excel spreadsheet to track studies.
3) Tabulating ideas represented in studies in table and form and extracting quotes from participants in the studies identified. Studies analyzed for themes using the methodological framework provided by Noblit and Hare (1988) for meta-synthesis.

Prerequisites: Interest in topic area and learning about qualitative research.

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Allison Werner-Lin

Project 1: The LiFE Consortium: Understanding risk and resilience in young adults with hereditary cancer syndromes

This study examines the psychosocial, family, and health care challenges of living with Li-Fraumeni Syndrome (LFS), a rare and often inherited cancer predisposition syndrome. Individuals with mutations to the TP53 gene are at significantly increased lifetime risk of developing cancer, and at younger ages, than the general population. LFS impacts multiple generations in a family, often at the same time, impacts life cycle development, reproductive planning, family caregiving, and incites both prolonged grief and chronic engagement with medical systems.

The National Cancer Institute, in partnership with the international Li-Fraumeni Exploration Consortium, is collecting data on the emotional, social, and medical challenges of living with an identified TP53 mutation. Of particular interest are the experiences of emerging adults, aged approximately 18-29, who have the legal capacity to make informed decisions about their care yet often experience significant and normative (in the Western, industrialized world) educational, residential, and relational instability.

This summer the research team will examine data from individuals, couples, and families who participate in the National Cancer Institute's Li-Fraumeni Syndrome Study. Specifically, students will learn the fundamentals of qualitative data analysis, learn to use qualitative data management software, participate actively in coding interview data with the research team, and prepare papers for dissemination to an interdisciplinary audience. Students will attend regular meetings with the interdisciplinary team of researchers, which includes social work, genetic counseling, family science, medical genetics, and bioethics. Students will be exposed to the inner workings of the intramural research program at the NCI and will acquire basic proficiency in genetic terminology.

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Veterinary Medicine

BIOMEDICAL SCIENCES

Narayan Avadhani

Project 1: Role of mitochondria targeted CYP1 and Ahr in polycyclic aromatic in bone degeneration

We have three different NIH (RO1) projects dealing with the roles of CYP2D6, CYP2E1 and CYP1 on mitochondrial toxicity and tissue damage. The first project deals with the role of mitochondrial Cyp1 genes (CYP1A1, 1A2, 1B1) in cigarette smoke induced osteoclastogenesis and osteoporosis. All three projects employ enzyme assays with purified enzymes and subcellular organelles, analysis of metabolites, induction of osteoclastogenesis in vitro with bone marrow derived cells, immunoblot analysis of proteins, and neuronal toxicity in cultured neurons and transgenic mice, CT scanning of bone sections.

Project 2: Mechanism of alcohol liver disease involving mitopchondria targeted CYP2E1

We have generated transgenic mice expressing human CYP2E1 genes (WT, ER++ and Mito++) under the endogenous CYP2E1 null background. The project involves the cellular and biochemical characterization alcohol toxicity in cells and also livers of mice expressing these variant forms of the gene. We measure mitochondrial function, quantify acetaldehyde levels and also investigate tissue pathology in whole tissues. The trainees are required to grow cells and also handle hepatic and esophageal tissues extracted by an experienced Tech and analyze toxicity parameters.

Project 3: Role of mitochondria atrgeted CYP2D6 in monomethylamine neurotoxicity

This project is based on our published data showing the direct role of mitochondrial CYP2D6 in the metabolism of neurotoxic drug MPTP to reactive cationic metabolite MPP+. The current project is to investigate the role of endogenously generated monomethylamine toxins (beta-Carbolines, norharmons and isoquinolines in the production of cationic metabolites that bind to mitochondrial complex I. Trainees are required to handle neuronal cells that express variant forms of CYP2D6, isolate mitochondria from cells and mouse brain, extract metabolites for shipping to our collaborators at the NCI (NIH) for analysis. We also study mitochondrial function by assaying electron transfer complexes and respiration in whole cells as well as in isolated mitochondria. Behavioral studies are carried out in collaboration with researchers in University of Miami and UPENN.

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Serge Fuchs

Project 1: Mechanisms of development of the pre-metastatic niche

Metastatic disease is number one cause of death in cancer patients. Circulating cancer cells seek a receptive micro-environment in healthy tissues for colonization. Development of this receptive environment (i.e. pre-metastatic niche) involves factors produced by malignant cells (cytokines, membrane vesicles, etc) and their interaction with healthy tissues. This project is focused on the mechanisms by which tumor-derived factors act on normal cells to generate the pre-metastatic niche and stimulate metastatic disease. Students will have basic biomedical laboratory skills and will be responsible for help with conducting experiments.

Jennifer Punt

Project 1: The influence of canine IGF1 on immune function

We are interested in gaining a deeper understanding the immune system of dogs, which are susceptible to many of the same metabolic and neoplastic disorders that afflict humans. Dogs are also biologically unique in an intriguing respect: they display a remarkable intra-species size variation, which has been shown to be a consequence of variations in gene expression of the growth factor IGF1. Serum levels of IGF1 correlate directly with dog size and inversely with longevity.

Although IGF1 is likely to affect canine health in multiple ways, data in other species suggest that IGF1 inhibits immune cell activity. We will launch a new investigation to test the hypothesis that IGF1 enhances the activities of canine immune suppressor cells. The undergraduate involved in this project will be a full partner at the bench and a full participant in weekly lab meetings. Together, and in collaboration with Dr. Oliver Garden's vibrant Immune Regulation laboratory at Penn Vet, we will 1) determine the levels of IGF1 in dog blood samples, 2) identify which canine blood cells express the receptor for IGF1 and 3) determine how IGF1 influences canine immune cell activity in vitro.

We anticipate that the experiments will add important (and publishable) perspectives to our growing understanding of the canine immune system, but we also hope the experience will enhance our summer student's exposure to a wide range of research methods in immunology, and inspire an interest in a career of discovery.

In addition, our findings will become the foundations for the Fall semester of Penn's BIOL425 Investigative Biology course. Our summer student will be given the opportunity to TA this course, if interested.

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Andrew Vaughan

Project 1: Fibrosis Lineage Tracing

Lineage tracing is a set of techniques by which one can determine the cell of origin (stem cell) of any cell type of interest. While this technique is powerful for determining lineage hierarchies in development and after injury, it only allows for identification of cells themselves, not the protein products of those cells.

The need to determine the cellular origin of proteins is particularly relevant in cases of excess extracellular matrix deposition, especially fibrotic disease. In such cases, i.e. alcohol-induced liver fibrosis or smoking-induced lung fibrosis, there is rampant deposition of collagen, which dramatically impairs normal organ function. Identification of the cellular source of the collagen would allow for therapeutic targeting / ablation of those cells responsible for this pathological collagen deposition.

We believe we have a viable method using CRISPR/Cas9 in mouse embryonic stem cells to introduce a traceable tag into the collagen gene itself. Activation of this tag will be cell-type specific, allowing us to directly determine the cell-of-origin for collagen. This would represent a significant scientific discovery possibly empowering new therapies.

This project is well suited to an undergraduate student since it will largely involve in vitro cell culture work for much of the project. The student will gain experience in embryonic stem cell culture, differentiation of said cells to different mature lineages, and CRISPR editing of these cells. The student would receive additional mentoring by my postdoc Chetan Rane, and would have full access to the professional and scientific environments of the Penn Institute for Regenerative Medicine and Biomedical Sciences Department.

CLINICAL SCIENCES & ADVANCED MEDICINE

James Perry

Project 1: Molecular analysis and in vivo drug response prediction in feline mammary carcinoma: Improving adjuvant therapies in cats and modeling aggressive breast cancer in women

Feline mammary tumors (FMTs) are a common malignancy in cats, and this cancer shares many characteristics with breast cancer in women. Unfortunately, current prognostic criteria fail to completely discriminate aggressive from less aggressive tumors, and as such, we may be over-treating some, while under-treating others. Additionally, with the current dearth of molecular

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characterization of these tumors in cats, we are failing to take advantage of targeted and personalized treatment modalities as utilized in women with breast cancer.

The goal of the proposed study is first to molecularly characterize of FMTs, then, to design a panel of targeted therapeutics to be evaluated in cats with this disease. We hypothesize that combining molecular categorization with intra-tumoral drug screening will streamline therapies and improve outcomes in cats as well as provide a predictive model for translation to aggressive breast cancer in women. To achieve this goal, the student will work directly with their advisor to initiate this effort by creating a database of client owned cats with known clinical history, follow-up, and archived tumor tissues available, then help expand current immunohistochemical analysis and protein expression signatures using RNAseq. Once the molecular landscape has been characterized through phase 1 of this study, we will begin enrolling cats into a clinical study evaluating novel drugs and combinations using a validated device for streamlining the design of effective treatment protocols in a personalized fashion. Through this project, the student will participate in client communications, learn molecular techniques, perform data analysis, and partake in clinical study design.

Deborah Silverstein

Project 1: Comparison of dopamine versus norepinephrine for the treatment of hypotension in anesthetized dogs

This study will investigate the effectiveness of two different blood pressure medications, dopamine and norepinephrine, for the treatment of hypotension in anesthetized dogs. The student will determine the drug based on a randomization generator and will then go with selected patients into the operating room in order to obtain data that is collected by the anesthesia technician or student that is assigned to the case. The student will be taught how to measure blood pressure using a Doppler probe in order to ensure that proper time points are collected if the anesthesia technician is unable to measure the blood pressure as frequently as desired. The student will also be responsible for entering the data into a spreadsheet. Prerequisites are minimal and include only familiarity with excel spreadsheet data entry. Dr. Giacomo Gianotti will assist with supervision of the anesthesia service during the study.

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CLINICAL STUDIES NEW BOLTON

Laurel Redding

Project 1: The relationship between pet ownership and recurrent Clostridium difficile infection

Clostridium difficile has become the most common cause of health care–associated infections in U.S. hospitals. In recent decades, there has been a marked increase in the incidence and severity of Clostridium difficile infection in humans worldwide, and community-acquired C. difficile infections are now thought to account for one quarter of infections. The source of these community-acquired infections has not been definitively established. People asymptomatically colonized with C. difficile are potential reservoirs, but zoonotic, environmental and food-borne transmission to people have also been posited. Pets can be asymptomatically colonized with C. difficile and may therefore serve as a reservoir. The goals of this study are to 1) investigate the relationship between pet ownership and the recurrence of C. difficile infections in patients who have experienced C. difficile and 2) assess the colonization status of pets of patients who have experienced CDI. The student will be involved in interviewing patients and collecting and testing samples from pets for C. difficile and will acquire skills in epidemiologic research and molecular diagnostic techniques.

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Wharton

BUSINESS ECONOMICS & PUBLIC POLICY

Santosh Anagol

Project 1: Household Finance in India

The student will contribute to my research agenda on understanding the development of household financial markets in India, potentially including real estate, mutual funds, stocks, credit, insurance and payments (e.g. paytm). Across these sectors I am studying how recent regulatory reforms have improved the development of these markets, including changes in tax policies and government incentives. The types of household financial markets and reforms we focus on may change as the summer progresses, but likely topics to explore are impacts of demonetization, transparency initiatives in the real estate sector (Real Estate Regulation Act of 2016 and Benami Transactions Act), and policies to increase mutual fund investment in rural areas.

This position would be a great fit for students interested in emerging markets, looking to get exposure to the basic process of research in economics (collecting data, conducting literature reviews, formulating hypotheses, and acquiring programming skills). Students will build their practical knowledge of the household financial markets listed above, as well as sharpen their ability to use economics to understand policies and data.

Requirements include good general computer skills, basic knowledge of statistics, high attention to detail, and ability to work independently. Programming experience is a major plus (particularly in Stata), but not a requirement.

Project 2: Creating an Overview of Brazilian Household Finance

The student will create overview documents of the history and current practice of household finance in Brazil. The markets covered will be real estate, mutual funds, stocks, fixed deposits, credit (mortgages, auto-loans, student-loans, microfinance, etc.), insurance (life, health, auto etc.), and taxes. The overview will include discussions of how these markets have developed historically in terms of market size and regulation. The student may also organize publicly available data related to these topics in Brazil.

This position would be a great fit for students interested in Brazil, household finance, or both. The student will work mainly independently, but will also be required to have frequent meetings with me to update me on progress and discuss the direction of the research. Students will build

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their practical knowledge of the household financial markets listed above, as well as sharpen their ability to use economics to understand policies and data.

The main requirement for this position is the ability to fluently read, write and speak Portuguese, as I expect most of the research will be conducted reading Portuguese language resources. Other required skills are a basic knowledge of statistics, high attention to detail, and ability to work independently. Programming experience is a major plus (particularly in Stata), but not a requirement.

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 — varies dramatically across states, from above 80% in states like Alaska and Utah to below 20% in New York and Texas. This research project aims to better understanding the variation between states by systematically investigating how individuals are asked to register as donors in their state DMV and analyzing those strategies. The student would be researching policies at each state and gathering visual materials (e.g. PDFs of DMV forms that ask about organ donation), primarily by internet research but also by correspondence with DMV or organ donation contacts.

HEALTH CARE MANAGEMENT

Scott Harrington

Project 1: US Health Care System

The purpose of this project is to collect background academic literature, policy literature, and data in preparation for a book on the US health care system. The student will have an opportunity to develop skills in conducting literature reviews, synthesizing and summarizing papers, and organizing and summarizing data. Organizational skills, attention to detail, an interest in the topic, and writing skills are important. Students who have taken HCMG 101 Health Care Systems or a similar introductory course on the US health care system are preferred. This is joint work with Professor Genevieve Kanter at the Perelman School of Medicine, who will be the primary mentor and supervisor on the project.

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Project 2: FDA Approval of Medical Devices ***Rising Juniors only***

The purpose of this project is to examine conflicts of interest at the FDA in the approval of medical devices. In reviewing and approving medical devices, the FDA seeks the advice of outside experts, many of whom have financial relationships with the companies sponsoring devices that are under review. We examine how these financial ties might influence the device approval process. Students will have an opportunity to develop skills in working with data and conducting statistical analysis. Applicants should have had coursework in statistics or econometrics, as well as some programming experience, ideally with statistical packages (e.g. R, Stata). Organizational skills, attention to detail, and an interest in data analysis and programming are important. This is joint work with Professor Genevieve Kanter at the Perelman School of Medicine, who will be the primary mentor and supervisor on the project.

MANAGEMENT

Rachel Arnett

Project 1: Identities, Diversity, and Inclusion in Organizations

My research investigates the important role that identities and interpersonal interactions play in fostering inclusion in diverse workplaces. This research focuses on how individuals cultivate a sense of inclusion for themselves and others through the ways in which they navigate social identity differences – such as culture, race, and social class – in interpersonal interactions. Using experimental methods, I examine when, why, and how individuals express minority cultural identities or conceal relatively high status educational identities when interacting with their coworkers, and how these decisions affect their coworkers' inclusive behaviors in the workplace. I also investigate how people learn about and react to biases in the workplace, and whether there are ways to tackle bias in a manner that improves (rather than strains) intergroup relations in organizational settings. I am looking forward to getting students involved with idea development, research design (mostly in terms of experiments), background research and literature reviews, study creation and participant recruitment via online platforms, and data collection. Students should be familiar with or interested in research in topics relating to organizational behavior, psychology, and/or diversity/intergroup relations.

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Stephanie Creary

Project 1: Race and multiple identity management in workplace relationships

Despite a push to diversify the ranks of top management across the private and public sectors, managers from racial minority groups continue to be underrepresented in these positions. Scholars suggest that the underrepresentation of racial minority leaders in top management positions may be partially explained by the difficulty members from these groups have in having their leadership validated by others and a lack of appropriate developmental opportunities throughout their careers. In this study, we examine a potential alternative explanation for these leaders' underrepresentation in top management positions; that is, how they manage their multiple identities (i.e., cultural/racial/class/family and work identities) in key workplace relationships. The guiding research question for the present study is: "How does the management of multiple identities in workplace relationships shape individuals' leadership and promotion experiences?" This is an inductive, qualitative study. Our primary method of data collection includes semi-structured interviews with current and former US Army officers (Black/African American and White American). RAs' primary tasks will include assisting with data analysis (i.e., coding transcripts, distilling key themes related to cultural/racial/class/family and work identities) and conducting reviews of the relevant literature. RAs may also be asked to help with interview scheduling, other administrative tasks, early stage study design for a related quantitative study, and searching for related material to support a Wharton diversity course. This position is ideal for students interested in workforce diversity research, considering a PhD in organizational behavior/management, and needing more experience working on research projects focused on the experiences of working professionals. Strong written and oral communication, critical/analytical thinking, detail orientation, timeliness, and ability to work independently are critical prerequisite skills, which will also grow from working on this project.

Katherine Klein

Project 1: School Turnaround: Can Radical Organizational Change Succeed?

Students in schools in high-income communities in the US typically perform far better on standardized tests than do students in schools in low-income communities. This income-achievement gap reflects differences in school funding, in the quality of teaching and school leadership, and in students' school readiness, family engagement in education, and more.

A number of school districts in the US have recently implemented major organizational change efforts designed to "turnaround" their chronically under-performing schools. I am leading a

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qualitative study of the dynamics and effectiveness of a radical turnaround effort in four schools in "City School District" (CSD). In these schools, CSD:

1. Replaced the existing school principal with a new, highly respected principal;
2. Replaced 90% of the existing teachers with teachers hand-picked by the new principal;
3. Extended the school day by 1 hour to increase instruction time;
4. Motivated the new principals and teachers with an annual bonus of $8,000 - $15,000; and
5. Charged the principals and teachers with bringing students up to grade level within 3 years.

We have gathered survey and interview data from the principals and teachers in the four schools. We need your help in cleaning and analyzing our survey and interview data. Two schools are thriving. Two are struggling. But, why? You will gain experience in qualitative research analysis and new knowledge of organizational behavior and change. Applicants should have a deep interest in schools, organizational change, and management; attention to detail; strong conceptual and analytical skills; and self-discipline.

Samir Nurmohamed

Project 1: Commitment of Perceived Underdogs at the Workplace

The purpose of this project is to better understand whether employees who are perceived as underdogs are committed to their jobs and/or organizations. As part of this project, I have collected field experiment data examining the effects of being seen as an underdog on dedication to the job and commitment to the organization. My hope is that over the summer we can replicate these effects in the lab and better understand the mechanisms underlying these effects. Over the summer, the selected candidate would be responsible for helping design and conduct lab studies online, as well as analyzing data that is collected as part of this project. Experience with Qualtrics, Mechanical Turk and statistics (R or SPSS) are an asset.

Project 2: Business and/or Moral Case for Diversity

Traditional scholarship assumes that in organizations, the business case for social issues is more valuable than the moral case. The purpose of this research project is to better understand whether this applies or not to managers of different backgrounds, as well as the mechanisms for when and why this may not be the case. My hope is that over the summer we can replicate these effects that we have found in the lab in follow-up studies. Over the summer, the selected candidate would be responsible for helping design and conduct lab studies online, as well as analyzing data that is collected as part of this project. Experience with Qualtrics, Mechanical Turk and statistics (R or SPSS) are an asset.

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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.

Minyuan Zhao

Project 1: Innovation and Intellectual Property Strategies of Multinational Enterprises

Intellectual properties (IP) has been playing an increasingly important role in firms' globalization efforts. On the one hand, multinational enterprises are spreading their value chains across multiple countries—R&D being one of the most important links in the value chain—forcing them to come up with strategies to develop and defend IPs on a global basis. On the other hand, institutions in different countries are as diverse as ever, so the IP strategies have to consider the unique local environments. The three studies in this project examine the strategic choices that MNEs face in market entry, patent portfolios, and IP litigation.

Applicants should have necessary skills and experience working with large datasets, be detail oriented, and demonstrate responsibility and accountability. You will be asked to clean and verify data, search for literature, and/or conduct simple data analysis. Interest in intellectual property law and global innovation strategies is a big plus.

Project 2: Cross-border acquisitions by emerging-market multinational enterprises

Recent years have seen a surge of cross-border acquisitions by emerging-market multinational enterprises (EMNEs). These acquirers tend to leave the top management team of the target firms intact and implement very limited integration, which contradicts the conventional view that integration is crucial for realizing value from M&As. In this study, we disentangle the multiple factors behind the observations, and try to gain better understanding of EMNEs in particular and post-acquisition integration strategies in general.

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Applicants should have necessary skills and experience working with datasets, be detail oriented, and demonstrate responsibility and accountability. You will be asked to clean and verify data, search for literature, and/or conduct simple data analysis. Programming skills are a plus.

MARKETING

Jonah Berger

Project 1: Why Do Songs, Books, and Movies Become Popular?

Why do some songs, books and movies catch on and become popular while others fail? Why do some online articles suck us in and get lots of engagement while others don't? We're interested in using natural language processing and automated textual analysis to help answer these questions. Ongoing projects involve analyzing song lyrics to predict Billboard rankings, analyzing movies scripts to plot the emotional arc of narratives and predict ratings and ticket sales, and analyzing online content to understand why certain articles get longer versus shorter reads. Students will work with Professor Jonah Berger and potentially some graduate students in our group. Ideal applicants will have strong programming skills, be highly motivated, and able to work independently as well as within a team.

While not required, ideal candidate will have some experience with at least some of the following: experience programming in Python and R, especially with processing large amounts of text data. Experience in one or more of the following packages: Pandas, seaborn, NLTK, spaCy, numpy, scipy, scikit-learn, and statsmodels or their R counterparts (dplyr, ggplot, tidytext, etc.). Coursework in one or more of the following, or similar courses: statistics (STAT 417, 476), machine learning (CIS 519, 520, 521), computational linguistics (CIS 530), linguistics (LING 449). Bonus if you have: Experience with jupyter notebooks, for prototyping, exploratory data analysis, and reporting; experience in sentiment analysis and/or automated assessment of text readability/quality; bash scripting (e.g., for computing on Wharton's High Performance Computing Cluster); Git for version control

Project 2: Natural Language Processing and Behavioral Insight

How can we pull behavioral insight from text? We're interested in using natural language processing, machine learning, and automated textual analysis to help answer a range of questions, from why some products and ideas catch on to what drives customer satisfaction. Ongoing projects involve analyzing song lyrics to predict Billboard rankings, analyzing movies scripts to plot the emotional arc of narratives and predict ratings and ticket sales, and analyzing online content to understand why certain articles get longer versus shorter reads. Students will

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work with Professor Jonah Berger and potentially some graduate students in our group. Ideal applicants will have strong programming skills, be highly motivated, and able to work independently as well as within a team.

While not required, ideal candidate will have some experience with at least some of the following: Experience programming in Python and R, especially with processing large amounts of text data. Experience in one or more of the following packages: Pandas, seaborn, NLTK, spaCy, numpy, scipy, scikit-learn, and statsmodels or their R counterparts (dplyr, ggplot, tidytext, etc.). Coursework in one or more of the following, or similar courses: statistics (STAT 417, 476), machine learning (CIS 519, 520, 521), computational linguistics (CIS 530), linguistics (LING 449). Bonus if you have: Experience with jupyter notebooks, for prototyping, exploratory data analysis, and reporting. Experience in sentiment analysis and/or automated assessment of text readability/quality. Bash scripting (e.g., for computing on Wharton's High Performance Computing Cluster), Git for version control

Pinar Yildirim

Project 1: Future of Marketing and Automation

The nature of my research projects are generally highly informative for the students and provide a great learning experience. The ideal student should be computationally savvy and good in mathematics and economics. The student is expected to clean and analyze data, learn and practice econometric methods. Computational and statistical skills are required, such as knowledge of Python, R, Stata, or Matlab. Above all, excellent discipline is necessary.

Project 2: Music Content Choice and Politics

This project is intending to analyze how the consumption of music content changes over the 1-2 week period around elections.

The nature of my research projects are generally highly informative for the students and provide a great learning experience. The ideal student should be computationally savvy and good in mathematics and economics. The student is expected to clean and analyze data, learn and practice econometric methods. Computational and statistical skills are required, such as knowledge of Python, R, Stata, or Matlab. Above all, excellent discipline is necessary.

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OPERATIONS, INFORMATION AND DECISIONS

Katherine Milkman

Project 1: Behavior Change for Good

The Behavior Change for Good (BCFG) Initiative at the University of Pennsylvania, led by Katherine Milkman and Angela Duckworth, is developing a digital platform to conduct large-scale field experiments designed to promote sustained behavior change in education, health, and savings. Our world-class team of scientific experts will be able to continually test and improve a behavior change program by seamlessly incorporating the latest insights from their research into massive random-assignment experiments. We have formed partnerships with some of the world's largest organizations offering education, health, and savings products to reach millions of their students and customers. Learn more about BCFG at bcfg.upenn.edu or through this Freakonomics podcast describing BCFG's plans: ***http://tinyurl.com/bcfg2017***.

The Research Assistant will contribute to research conducted on this platform by assisting with all aspects of the research process, which may include conducting literature reviews and power calculations, preparing research materials, performing data analysis, and preparing reports and presentations. The Research Assistant may also provide general assistance with the digital platform. Applicants should be familiar with social science research methods and data analysis (particularly in STATA and R). Familiarity with the Qualtrics survey platform is also helpful.

Maurice Schweitzer

Project 1: Humor and Power

We seek to understand the relationship between power and humor. Our initial findings suggest that high power people are more likely to use humor. In our follow-up work, we are interested to disentangle of differences in humor generation, perceptions of humor, and humor ability moderate this relationship.

Students will need to assist with running laboratory studies, reading relevant literature, and analyzing data. Students will work closely with a team of Ph.D. students including Brad Bitterly in this project.

Project 2: Learning from Emotional Expressions

In this project, we seek to understand the reverse-inference process of emotions. That is, what information do we glean when others express emotions. We are particularly interested in how

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relative power moderates this process. For example, when someone expresses anger, do we read that expression differently if that person is high or low power?

Students will work closely with a team of Ph.D. students led by Polly Kang. This project will involve running laboratory studies, analyzing data, and reading relevant research.

Lynn Wu

Project 1: Artificial Intelligence, Innovation and Productivity

This project aims to understand how artificial intelligence, robotics, data analytics, and information technology can fundamentally transform how firms and labor organize. This fundamental transformation has already started as we observe robotics has accelerated the rate of labor replacement. In this project, we aim to predict what individuals and firms could do to prepare for that future. We plan to examine how to use text mining on various public data sources as well some private data sources to understand to measure best practices of leveraging AI technology to innovate and compete and make predictions on the type of tasks that will be replaced by machine.

Student(s) must have strong programming skills to process a large amount of unstructured text and use machine learning and other sophisticated methods to generate topic space, sentiment variables, and other underlying constructs arise from text. One particular sector we plan to examine is the pharmaceutical industry. Students with related experiences in drug development process is preferred but not required.

STATISTICS

Edgar Dobriban

Project 1: Cloud and Distributed Computing Technology: Statistical Research Opportunities

We live in a “Big Data" world where increasingly larger and more complex datasets are collected in all areas of human activity. Cloud computing and distributed computing are two emerging technologies that enable the analysis of big data. These technologies are expected to lead to many new statistical problems. However, at the moment there is no good reference on what the biggest opportunities for new statistical research may be. In this project, you will write a review

article examining this issue. The review paper will be disseminated in the statistical research community. It will be of interest to answer the following questions:

1. What is cloud and distributed computing technology? How does it fit into the bigger ecosystem of computer science, data science, and the internet?
2. Who cares? Who can benefit the most by using cloud computing? What are the main potential benefits to industry, science, and government? In industry, we will examine the role of tech companies such as Amazon, Google etc. In government, a relevant aspect is international competition, especially regarding US vs China.
3. What are the main existing technologies, hardware and software?
   Data collection technologies include: the internet, sensors, mobile phones. Hardware technologies include: Amazon AWS, MS Azure. Software frameworks include: MapReduce/Hadoop. Spark.
4. What are the main computational and algorithmic frameworks? What are their limitations?What are the key research opportunities?
   Relevant academic courses include Reza Zadeh's Stanford course \ Distributed Algorithms and Optimization", Wei Wang's HKU course \Cloud Computing". Relevant books include Bertsekas & Tsitsiklis, Parallel and distributed computation: numerical methods. Acar and Blelloch, Algorithm Design: Parallel and Sequential. Zaharia et al. Learning Spark: Lightning-Fast Big Data Analysis.
5. What are the new statistical problems in distributed computation? What are the key research opportunities?

Project 2: What are the Most Frequently Used Statistical Methods in Modern Science?

Modern science relies increasingly on data analysis and statistical methods. Accordingly, the development of new statistical methods holds great promise for scienti_c progress. However, this is challenging, because science is moving so fast that nobody knows what the most important statistical problems are. Indeed, there is no reference for what the most important statistical problems and methods are in modern science. In the absence of such a reference, statistical method development is often based on guesswork. The \market for statistical methods" is inefficient.

Therefore, we propose to investigate the following question: What are the most frequently used statistical methods in modern science? This project would involve reading recent scientific papers from top journals like Nature and Science and extracting from them the statistical problems and methods used. In addition, it would involve creating a document presenting the results. Perhaps the document should be on a Wiki or a GitHub page, so it can easily accessed by other people.

This would be useful for many people in the statistics community. In addition, the work could also involve natural language processing and deep learning to extract information from the

papers that you cannot read on your own. It would be great if the student researcher develops a tool to extract such information and let it scrape the web forever. Finally, perhaps the most interesting part would be to identify research opportunities for the future.

This could be valuable for the development of the student, especially if they intend to do statistics research in the future. It could help them choose what to work on. To get started in choosing papers to read, we will look at the top 100 papers by Altmetric score. These are papers that people discuss on the internet, in the news, Twitter, and blogs. It is not perfect, but they tend to be important papers. We will also look at the papers published last year in Nature and Science. Maybe using as guidelines Google Scholar citations, or Semantic Scholar, could also be useful. There is also a Kaggle survey which has potentially valuable information on what methods are used in applied statistics. Finally, we will also look at a few review papers in specific areas, such as epidemiology and genomics.