

# Provost's Undergraduate Research Mentoring Program Project Descriptions Summer 2015

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

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

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

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## **Annenberg**

### **COMMUNICATIONS**

#### ***Felicity Paxton***

##### **Project 1: Voices of Change**

Launched last year as part of the 40th Anniversary Celebrations of the Penn Women's Center, the Voices of Change video series captures the inspiring stories of a diverse cross-section of women leaders at Penn. To date, 16 individual video interviews have been filmed as well as one longer "highlights" film. These can all be viewed here:

<https://www.youtube.com/playlist?list=PLgz1wTvENTknUYMIsh8lGhzdxu01omWpc> This is an opportunity for a student who has some background in film to assist with the filming, editing, uploading and promotion of a new set of interviews with students, faculty, staff and alumni. This project will also involve archival research and the selection of appropriate images/photographs for each video. This project will be ideal for any students interested in Penn's history, in oral history, in archive research, in film-making, and in the contributions of women staff, faculty and students. Reliability, creativity, initiative and excellent interpersonal skills are essential.

##### **Project 2: Gender at Penn in 2014: Where are We?**

Past research has documented the often difficult experiences of women on college campuses. But how do today's students, staff and faculty perceive gender in their everyday lives at Penn? Does it impact their experiences here? Do other variables? If so, how? This research will look into the broad question of how gender does/does not influence the experiences of members of our community. This project seeks to identify and define current and emerging issues and, where necessary, make recommendations on how these issues should be addressed. Students will have the opportunity to participate in multi-modality research. Responsibilities will involve everything from organizing and co-facilitating focus groups, to conducting one-on-one interviews, to analyzing survey data and writing up findings. Experience with any of the above preferred but not required. Reliability, initiative and a keen interest in the broad topic of gender are all essential.

##### **Project 3: Gendered Journeys: Women and Cycling at Penn and in Philadelphia**

National research shows that women make up roughly 24% of urban cyclists. This project aims to provide a clearer and deeper understanding of the gendered nature of cycling, with a focus on Philadelphia/Penn. How does Philadelphia compare to other major cities? Does the Penn community show greater parity in numbers? What reasons do women give for not cycling/not cycling? What impact does race have? What role do bike lanes play? What policy, educational

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and/or infrastructural changes would encourage more women to ride? This research project will be of interest to students interested in a variety of fields, including gender studies, environmental sustainability, city planning, health and societies, and communications. Responsibilities will range from doing bike counts, to organizing and co facilitating focus groups, to conducting one on one interviews, to analyzing data and writing up findings. Experience with any of the above preferred but not required. Reliability and initiative are both essential.

## **Arts and Sciences**

### **ANTHROPOLOGY**

*Megan Kassabaum*

#### **Project 1: Smith Creek Archaeological Project**

This project involves the archaeological excavation of a prehistoric Native American mound site in Mississippi. Through their participation, students will be exposed to the various steps in original, anthropological fieldwork and to the prehistory of the American South. The Smith Creek Archaeological Project will provide the training necessary for students to continue on in the field of archaeology. Through daily, hands-on experience in the field, students will learn the skills involved in archaeological survey, excavation, and site mapping, as well as lab skills including artifact processing and basic ceramic analysis. For students who are not necessarily planning to pursue further study in archaeology, the project will provide the opportunity to engage broadly with anthropological questions about prehistoric technology, monument construction, food production and consumption, and American Indian history. While the research questions addressed in my own research center on why prehistoric mounds were built, how they were used, and what they meant to their creators, there will be many opportunities for students to influence the questions being asked and the methods being used to answer those questions.

*Theodore Schurr*

#### **Project 1: Analysis of Mitogenome Variation in Indigenous Caribbean Populations**

In this project, we will explore indigenous people's contributions to the genetic diversity of contemporary Caribbean populations. Although archeological evidence suggests that the Lesser Antilles were populated in a series of northward and eastern migratory waves, many questions remain regarding the relationship of the Caribbean migrants to other indigenous people of South and Central America. There have also been profound changes to the demography of indigenous communities following European contact, with the influx of African and European individuals into the region since the early 16th century transforming the genetic make-up of Caribbean populations. To explore these issues, we will conduct a high-resolution analysis of mitochondrial DNA (mtDNA) sequence variation in indigenous populations from Puerto Rico, Dominican Republic, St Vincent and Trinidad. While working on this project, the student will learn various methods of genetic analysis, including PCR amplification, gel electrophoresis, DNA sequencing and possibly SNP genotyping, among others. In addition, the student will be trained in basic statistical and phylogenetic methods of DNA sequence analysis so that he/she can conduct a

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comparative analysis of Caribbean mtDNA variation. In addition to laboratory work, the student will read scientific papers that we have published on similar populations to become familiar with the research questions being pursued in this project. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for this population.

### **Project 2: Analysis of Mitogenome Variation in Mayan Speaking Populations of Southern Mexico**

In this project, we will work with Mayan speaking populations of southern Mexico to explore their genetic ancestry and population history. The study will involve the high-resolution analysis of mitochondrial DNA (mtDNA) sequence variation in a several ethnic groups from southern Mexico, including the Yucatec Maya, Ch'ol, Chontal and Tzotzil. This analysis will reveal important new details about the population structure, phylogeography, admixture and population dynamics of these indigenous groups. The data from this study will also contribute to our understanding of Mexico's role in the peopling of the Americas, the relationship between linguistic and genetic diversification in Mexico, and the rise and fall of the Mayan civilization in Mesoamerica. While working on this project, the student will learn various methods of genetic analysis, including PCR amplification, gel electrophoresis, DNA sequencing and possibly SNP genotyping, among others. In addition, the student will be trained in basic statistical and phylogenetic methods of DNA sequence analysis so that he/she can conduct a comparative analysis of Caribbean mtDNA variation. In addition to laboratory work, the student will read scientific papers that we have published on similar populations to become familiar with the research questions being pursued in this project. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for this population.

### **Project 3: Analysis of Mitogenome Variation in Otomanguean and Uto-Aztecan Populations of Central Mexico**

In this project, we will work with Otomanguean and Uto-Aztecan speaking populations of central Mexico to explore their genetic ancestry and population history. The study will involve the high-resolution analysis of mitochondrial DNA (mtDNA) sequence variation in a several ethnic groups from central Mexico, including the Cora, Huichol, Mazahua, Nahuatl, and Otomi. This analysis will reveal important new details about the population structure, phylogeography, admixture and population dynamics of these indigenous groups. The data from this study will also contribute to our understanding of Mexico's role in the peopling of the Americas, the relationship between linguistic and genetic diversification in Mexico, and the impact of the Aztec civilization on patterns of genetic diversity in Mexico. While working on this project, the student will learn various methods of genetic analysis, including PCR amplification, gel electrophoresis, DNA sequencing and possibly SNP genotyping, among others. In addition, the student will be trained in basic statistical and phylogenetic methods of DNA sequence analysis so that he/she

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can conduct a comparative analysis of Native Mexican mtDNA variation. In addition to laboratory work, the student will read scientific papers that we have published on similar populations to become familiar with the research questions being pursued in this project. For his/her contribution to the project, the student will be given co-authorship on the manuscript that describes the genetic findings for this population.

## **ART HISTORY**

*Holly Pittman*

### **Project 1: Final Publication of the excavations at al Hiba, ancient Lagash, southern Iraq**

Project 1: The Al-Hiba Publication Project Ancient Lagash (modern al-Hiba) is one of the most significant sites for studies of urbanism in the ancient world. Located in southern Iraq, the archaeological mound remains one of the only excavated cities from Mesopotamia in the third millennium BCE. The excavation seasons, comprising six campaigns that began in 1968, exposed four significant architectural complexes with associated ceramics, objects, and inscriptions. Unfortunately, the data have not met with final publication, due to the untimely passing of the project's director, Donald Hansen. To organize the final publication of these crucially important excavations, I seek an undergraduate student who can work this summer to help make the raw data available in digital form. The student will require a background in digital illustration, as she or he will render computer drawings of archaeological objects and site plans. Because artifacts are not available in physical form, the student will work from field sketches and comprehensive photo images. In addition, the student will work alongside an experienced GIS (geographical information systems) technician, to integrate the digitized plans into their spatial setting. These data will then be merged into a relational database that has been expanding since 2011. Ultimately, PURM support will not only accelerate the reproduction and publication of these varied datasets (in both digital and hard copy), but it will also provide an undergraduate researcher with experience in the cutting-edge field of digital humanities, including GIS, data coding, database design, and digital illustration.

## BIOLOGY

*Nancy Bonini*

### **Project 1: Discovering how the post-translational modification PARylation functions to modulate ALS pathology using Drosophila.**

We use the approach of genetics in *Drosophila*, coupled with biochemical analysis of mammalian cell culture models and in vitro assays, to discover new modifiers of human neurodegenerative disease and define how they function. The disease of interest to the laboratory is Amyotrophic Lateral Sclerosis (ALS). This disease causes devastating motor neuron loss and leads to paralysis and death. Specific gene products, notably TDP-43 and RNA components, such as an expanded G4C2 DNA repeat, are associated with ALS. We have generated *Drosophila* models that recapitulate these pathologies, and serve as molecular models for disease. Students will learn how to do fly genetics, how to analyze and present genetic material for investigation, and how to go about defining the molecular insight into how a modifier works. The specific project involves the discovery of a specific type of post-translational modification called polyADP ribosylation (PAR), that modulates TDP-43 pathology. The research is directed toward verifying this modification, and discovering molecularly how the post-translational modification works to modulate the disease. We suspect that TDP-43 protein may be directly PARylated, or TDP-43 may bind to PARylated protein. The project will consist of performing a number of experiments to learn the fly and PAR system using fly genetics, as well as to molecularly investigate the interaction with polyADP ribosylation by expressing recombinant human TDP-43 protein in *E. coli*, and analyzing the interaction with PAR by western blot and dot blot techniques. Experience in the laboratory, as well as rigorous and strong understanding of molecular genetics are required.

*Fevzi Daldal*

### **Project 1: Cytochromes, Copper and biogenesis of supercomplexes**

Our group is interested in the molecular characterization of the structure, function, regulation and biogenesis of cytochromes, which are heme proteins involved in major energy production pathways, including photosynthesis and respiration. We use both microbial (facultative photosynthetic bacteria) and human mitochondrial (diseased patients derived cybrid cell cultures) systems as experimental models. Our aim is to increase our basic understanding of the underlying molecular mechanisms of related diseases. Currently we pursue three integrated facets as ongoing projects: A- How do cells make cytochromes with covalently attached heme? This process is essential for life because cells that do not make cytochromes properly induce disease states, extending from porphyria, sideroblastic anemia and mitochondrial multisystem

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disorders. Cells use an exquisite machinery to carry out this process, and we dissect the components of this machine and their specific functions to understand its mechanics. B- How do cells acquire copper, which is a micronutrient essential but also toxic? If cells do not manage properly copper acquisition, traffic and delivery to the user proteins, they develop disease states, including exercise intolerance, lactic acidosis, neuromuscular diseases as well as Menkes and Wilson, Alzheimer or Parkinson diseases. C- How do cells form and regulate respiratory and photosynthetic enzyme supercomplexes in bacteria and human mitochondria? Enzyme supercomplexes are multi-subunit, higher order protein organizations that yield large macromolecular entities. They are essential for natural energy transduction, from cellular ATP generation to biofuel production. The components involved in forming supercomplexes (SCFs) and their regulation are not yet known, but the process is tightly associated with human mitochondrial myopathies, neuropathies, reactive oxygen production and aging. Elucidation of the underlying regulatory mechanisms will undoubtedly lead to novel therapies for these diseases for which no efficient cure is available. We routinely use molecular genetics, biochemistry, biophysics, cell culture and “omics” (genomic-RNAseq / proteomic-mass spectrometry) approaches. If you are interested in any aspect of the above-mentioned topics, you like to work independently or in collaboration under the supervision of an advanced postdoctoral fellow then consider applying to our group. Chosen student will participate to all aspects of the projects, from bench-work to conception and design of novel immediate steps of the work. She/he will be fully involved in hands-on execution, data collection, analyses and interpretation, and conception/design of future extensions of ongoing projects. This summer activity provides an excellent training opportunity for professional studies beyond the undergraduate level, including medical, veterinary, dental and graduate schools. If desired, it is possible to continue the project initiated during the academic year as well as independent research study. Basic 100 levels biology, and chemistry background, a keen interest to learn, and a drive to accomplish something excellent are the only requirements. This summer internship is also an excellent possibility to find out if one is interested in research-related activities in life sciences.

***Brent Helliker***

**Project 1: Evolutionary controls on leaf anatomy and hydraulics in grasses**

Grasses are vital on a global scale as grasslands, savannas and croplands cover about 40 % of the terrestrial biosphere and represent all major grain crops, yet we know little about how evolutionary changes in anatomy affect hydraulic function in grass leaves. By improving our understanding of grass hydraulics, we will elucidate how changes in climate selected for leaf anatomical differences during grass evolution, and identify targets for genetic manipulation to improve water use efficiency of grain crops. Specifically, we will determine the adaptive significance of decreased interveinal distances (IVD) and larger bundle sheaths (BS) through investigation of the hydraulic significance of BS size and IVD across a range of closely related

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grasses. In both the lab and field, the student researcher will help us learn a great deal about the physics and physiology of water movement through plants, while having the freedom to develop and build new technologies (mechanical and electronic) to examine water movement. Specific academic and professional skills to be learned include: (i) measurements/theories of photosynthesis and water loss from plants. (ii) measurements/theories of stable isotopes applications in the natural world. (iii) data analysis and presentation (iv) leaf anatomical measurements using a confocal microscope. The ideal student should have a clear desire to learn more about organismal biology and physiology (of plants!), as well as an active imagination.

***Michael Lampson***

**Project 1: Optogenetic control of cell division** ***Rising Sophomores only***

Many cellular processes depend on protein-protein interactions that are precisely regulated in time and space. Our goal is to investigate these complex and dynamic systems with experimental techniques that offer comparable temporal and spatial precision. We are developing optogenetic techniques to control protein-protein interactions with light in living cells, using a photocaged, synthetic small molecule designed to dimerize two engineered proteins. We use these tools to probe mechanisms of cell division, particularly kinetochore functions including mitotic checkpoint signaling, molecular motor activities, and interactions with microtubules of the mitotic spindle. The student will engineer proteins for optogenetic control, create mammalian cell lines expressing these proteins, manipulate the engineered proteins at individual kinetochores in living cells with a targeted laser, and examine the cellular responses by high resolution light microscopy and quantitative image analysis. 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.

***Timothy Linksvayer***

**Project 1: Genetic, behavioral, and evolutionary basis of ant personality**

Increasingly, studies in animals have demonstrated that individuals often reliably express sets of correlated behavioral traits that can be described "personality". In most cases, especially for social behavior, we know little about the genetic and evolutionary basis of these behaviors. We have developed ants as a highly social model to study the genetic basis and evolution of social behavior. This project will develop and apply assays to quantify individual- and group-level social behavior between different genetic lineages of ants to study the genetic, evolutionary, and behavioral basis of these complex social behaviors.

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### **Project 2: Social regulation of ant development and trait expression**

Social interactions strongly affect behavior, physiology, development, survival, and reproduction in a range of organisms from bacteria to ants to humans. Despite these ubiquitous effects of behavior, no highly social model exists. Ants provide such a model. This project will study how ant colonies use social mechanisms to regulate the development of brood into either reproductive queens or sterile workers.

### **Project 3: The behavioral and genetic basis of disease resistance in insect societies**

Like human societies, ant societies are highly susceptible to disease outbreaks. Unlike humans, ants have been highly social for over 100 million years and have a range of individual and group-level adaptations to combat diseases. This project will study how individual and colony-level social mechanisms affect disease resistance in ant colonies.

## **CHEMISTRY**

*Zahra Fakhraai*

### **Project 1: Using nanorods to probe surface diffusion**

Nanoscaled structures of amorphous materials have significantly modified properties compared to their bulk counterparts. It is hypothesized that this is due to enhanced dynamics and diffusion of the molecules close to interfaces. However, it is exceedingly hard to measure diffusion at free surface and to directly correlate that to the nanoscale dynamics using conventional methods. In a recent study we have shown that (Daley et al. Soft. Matter 2012) we have shown that nanoparticles can be used as probe of surface diffusion and that once the properties of the surface are probed, these relaxation dynamics can be correlated to the properties of nanoscaled thin films (Glor, Fakhraai, JCP 2014). However, spherical nanoparticles are not ideal methods of study due to geometrical reasons. We plan to use tobacco mosaic virus (TMV) as nanorods to reduce the dimensions of the system from a 2 dimensional measurement to a one dimensional measurement to improve the accuracy of the technique and to simplify the mathematical problem that needs to be solved for measurements of the diffusion coefficient. The student in this project will learn how to use atomic force microscopy (AFM) to image the diffusion of glasses using nanorods, as well as other aspect of the project including sample preparation using physical vapor deposition and other characterization techniques that are required to characterize these samples.

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*Feng Gai*

**Project 1: Assessing bio-molecular structures via spectroscopic techniques**

Students involved in this project will learn how to use various spectroscopic methods, such as fluorescence spectroscopy, infrared spectroscopy and circular dichroism spectroscopy, to determine the structures and structural changes of peptides and proteins in aqueous solution and/or other environments.

**Project 2: Single-molecule study of protein aggregation**

Students involved in this project will learn how to use single-molecule fluorescence spectroscopy to study protein conformational changes leading to amyloid formation.

*Madeleine Joullie*

**Project 1: Integration of fermentation in synthesis of complex molecules of biologic interest**

This project incorporates two fundamental areas of organic chemistry: natural product isolation and organic synthesis of complex molecules. It involves the production of biologically important molecules via fermentation, their isolation and synthetic conversion into metabolites that are presumed intermediates in biosynthetic pathways. The student will gain experience in synthetic chemistry, spectroscopy, and basic understanding of biosynthetic pathways. Successful completion of Chem 241, 242, and 245 is preferred.

*Marisa Kozlowski*

**Project 1: Organic chemistry synthetic methods**

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

**Project 2: Calculations to Predict and Explain Chemical Reactivity**

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

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*Patrick Walsh*

**Project 1: Sulfenate anion catalysts** *Rising Juniors only*

Sulfenates take center stage! Sulfenate anions are known to act as highly reactive players in the organic arena. Now they premier in the starting role as catalyst in an organocatalytic reaction. In their debut, 1–10 mol % sulfoxide/sulfenate promote the transformation of benzyl halides into trans-stilbenes under basic conditions (up to 99% yield). Mechanistic studies support the catalytic role of the sulfenate anions and the deprotonated sulfoxide as the resting state. This work is continuing in the Walsh Research Group and represents an excellent opportunity for undergraduate researchers who have completed Chem 241, 242 and 245. After being trained by a graduate student mentor, the participant will work semi-independently under the supervision of a graduate student mentor and the PI.

**Project 2: Metal catalyzed transformation** *Rising Juniors only*

Current projects available involve allylic substitution reactions and cross-coupling reactions catalyzed by nickel and palladium complexes. Learn the basics of transition metal catalyzed reactions and gain valuable experience in research as you are mentored by an experienced graduate student and the PI. The Walsh research team specializes in inventing new organic reactions catalyzed by transition metal complexes. The group also has an excellent track record of undergraduate students becoming authors on refereed publications (close to 100% success rate). Metal catalyzed reactions are the major focus of the Walsh Research Group and represents an excellent opportunity for undergraduate researchers who have completed Chem 241, 242 and 245. After being trained by a graduate student mentor, the participant will work semi-independently under the supervision of a graduate student mentor and the PI.

*Jeffrey Winkler*

**Project 1: Development of Small Molecules that Bind Hemoglobin** *Rising Juniors only*

The long-term goal is to develop new small molecule ligands for hemoglobin that disrupt binding of carbon monoxide and nitric oxide. Completion of Chem 241, Chem 242 and Chem 245 required.

## CINEMA STUDIES

*Karen Beckman*

### **Project 1: Building the Archive: Scribe Video Center**

This project is a collaboration among three parties: Penn Cinema Studies (with faculty advisor Karen Beckman), Scribe Video Center (with guidance from filmmaker and Scribe's Founder and Executive Director, Louis Massiah), and the Van Pelt Library (with support from Holly Mengel, Manuscript Catalogue Specialist, Special Collections Processing Center). Two students will work to begin the process of organizing, cataloguing, preserving and archiving the Scribe Video Center Archive, beginning with its paper archive. In addition to learning advanced archiving skills, two students will have the chance to engage with and preserve the history of one of the country's most important community media centers, a center which has also become a UNESCO model for community media centers abroad. Students with an interest in African-American and African diaspora histories, oral and urban history, radical media practice, film and media studies, and the history of West Philadelphia and the surrounding neighborhoods are particularly encouraged to apply. No previous experience necessary, as students will be trained in archiving skills, but prior archiving / special collections experience is a plus.

## CLASSICAL STUDIES

*Cynthia Damon*

### **Project 1: Manuscript transcription, collation, and encoding for a digital edition**

Transcription, collation, and encoding of medieval manuscripts and Renaissance editions from page images using digital tools. This is the fourth stage in the preparation of an eventual digital edition of a classical text from the Caesarian corpus, the Alexandrian War; previous stages were done by an undergraduate with PURM support (summer 2014), Post-baccalaureate students (fall 2014), and graduate students (spring 2015). Prerequisites are (1) knowledge of Latin, (2) a good eye, (3) enthusiasm for contributing to an entirely new editorial process. Familiarity with various processes for the digital manipulation of page images (e.g., ScanTailor) is a plus but not a requirement.

*James Ker*

**Project 1: Resurrecting a Pagan Martyr**

In the first century BCE, the Roman senator Julius Canus was executed by the emperor Caligula. As yet, there has been no detailed study of the evidence for his death and its significance for his contemporaries, despite the fact that there are two fascinating ancient accounts in both Latin and Greek that describe both Canus' execution and his reappearance to some of his friends in the days following his death; the story of Canus was also subsequently taken up and retold in medieval and renaissance texts. This project would involve conducting an analysis of the two main ancient accounts, looking closely at the main texts and their historical context, and offering suggestions about interpretation. This preliminary work would contribute to a publishable article, for which the student might be included as a co-author. The student must be able to read both Latin and Greek. The project would develop skills in language, research, and interpretation.

**Project 2: Tracing the Hours as a Time-Unit in Ancient Rome**

This project would involve analyzing the usage of the "hour" as a unit of time as far as this can be traced in Latin literature. How early do Latin authors begin referring to times of the day with this term, and how does this develop over time? The project would contribute to the supervisor's book-project that is concerned with how the Romans organized their day. The student needs to be able to read Latin. The project would develop skills in language, research, and interpretation.

**Project 3: Chronicling and Mapping Greco-Roman Literature**

This project would involve producing a resource that could be used in the Classical Studies classroom: a dynamic timeline of the main authors in Greek and Latin literature, with information about their writings and links to useful resources. Although static timelines already exist, the main innovation would be that this timeline is developed using a platform such as Prezi, which allows for a more interactive, navigable, and configurable timeline that can be posted online and employed on multiple course websites within the Classical Studies department. No prior skills are required: the student would learn up the capabilities of the Prezi platform and the resources available for compiling the timeline, and then would build the timeline in consultation with the advisor. The outcome would be a valuable teaching resource for multiple pedagogical situations.

*Peter Struck*

**Project 1: Final Preparation of a Book on Divination in Antiquity**

Divine Signs and Human Nature is a just finished manuscript that will need final editing, proofreading, footnote checking, and all the other editorial work that goes into taking a book

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from manuscript form into a published work. The topic explores divination among the Greeks and Romans. I look closely at philosophers' attempts to explain how it is that some people seem to be able to see the future: in dreams, oracles, visions, the flights of birds, or the entrails of sacrificed animals. Knowledge of Greek a real plus, but not absolutely required. Careful attention to detail a must.

## CRIMINOLOGY

*Charles Loeffler*

### **Project 1: Wrongful Conviction Estimation Project**

Each year U.S. criminal courts produce over 1 million felony convictions and substantially more misdemeanor convictions. While the adversarial legal system in the U.S. provides many legal protections to the accused in order to minimize the likelihood that an innocent person will be found guilty, it is virtually impossible to know how often a wrongful conviction occurs. DNA and non-DNA exonerations in recent years provide some basis for estimating this number, but exonerations normally happen in unusual or very serious cases, making it difficult to generalize onto the vast majority of criminal cases that result from guilty pleas lacking post-adjudication proceedings. In order to answer the question of how often someone is wrongfully convicted, this project will focus on using social surveys to estimate how often and under what circumstances wrongful convictions are likely to occur in less serious but more common criminal cases. The student will be responsible for administering and collecting survey responses from a population of convicted persons as well as creating an automated workflow for converting paper surveys into database files. Familiarity with survey administration and computer scripting languages (e.g., Python, Perl) is required. Prior course work in criminology, psychology, or law is not necessary.

## EARTH AND ENVIRONMENTAL SCIENCE

*Jane Dmochowski*

### **Project 1: Earth Science Education**

This research project will involve a literature review within the field of earth science education in order to help me assess and describe my efforts to over the last 5 years to teach Oceanography by incorporating Structured Active In-class Learning (SAIL) strategies. The ideal student researcher for this project will have interests in education and earth science and excellent qualitative and quantitative research skills. The student will be expected to work on campus

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during the summer and their primary responsibility will be compiling a working bibliography for the project, compiling a literature review and assimilating and analyzing data related to the project.

### **Project 2: The Response of Vegetation to Climate Change**

This research project will combine remote sensing data analysis, field work, and application of past biomass data to further our understanding of the effects of climate change on the tree line near Inuvik, in the Northwest Territories of Canada, located 2 degrees above the Arctic Circle near the Mackenzie River, as well as the Santa Monica Mountains in Southern California. The research will aim to determine vegetation changes (advances/delays in the date of start of season, changes in growth, etc.) from Landsat and other satellite and/or aircraft imagery, and determine the presence of correlations with temperature, precipitation, elevation, slope angle and orientation, and other environmental factors. The student will be expected to work on campus over the summer as well as travel to the Northwest Territories or the Santa Monica Mountains for roughly two weeks. The ideal student will be comfortable analyzing large data sets, have excellent quantitative and computer skills, and be interested in and familiar with relevant aspects of earth and environmental science.

### **Project 3: Environmental Impacts of the Matilija Dam**

This research project will combine remote sensing data analysis, field work, and application of past case studies to further our understanding of the effects of the Matilija Dam in Southern California. The student will be expected to work on campus over the summer as well as possibly travel to the dam site in Southern California. The ideal student will be comfortable analyzing large data sets, have excellent quantitative and computer skills, and be interested in and familiar with relevant aspects of earth and environmental science.

*David Goldsby*

### **Project 1: Experimental Constraints on the Flow of Glaciers and Ice Sheets**

The dynamics of Earth's glaciers and ice sheets, and their stability in the face of a warming climate, depend critically on the rheological properties of ice – i.e., how ice flows. Carefully designed and executed laboratory experiments can provide critical constraints on ice flow, and constitutive equations – “flow laws” - derived from such experiments allow laboratory data to be extrapolated to Earth's ice sheets via their incorporation in ice-sheet flow models. The formulation of such laws, and their robust extrapolation to the Earth's cryosphere, requires a detailed knowledge of the physical processes underlying them. Glaciologists have relied for over 60 years on the so-called Glen Law to describe ice flow in glaciers. Recent evidence from laboratory experiments, however, calls the physical basis for the Glen law paradigm into question, and demonstrates that the Glen Law fails to describe the flow of glaciers and ice sheets

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over most of their interiors. A student is sought to conduct fundamental experiments to constrain the rheology of ice at glaciological conditions. Ice creep experiments will be conducted in a high-pressure gas apparatus that duplicates the high pressures and temperatures that exist in the Earth's ice sheets. The project will involve fabrication of ice specimens, deformation tests in the high-pressure apparatus in the faculty host's ice physics lab, and post-mortem analyses of deformation microstructures using a cryogenically-equipped electron microscope. The student will work closely with the faculty host and a post-doc, and the project will culminate in a peer-reviewed publication first-authored by the student.

*Alain Plante*

**Project 1: Organic carbon storage in tropical soils**

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

*Lauren Sallan*

**Project 1: Novel Predators and Marine Revolutions in Deep Time.**

Predators can have a profound impact on the local and short-term evolution of their prey. Classic examples include the escalation of running ability in cheetahs and antelopes, or the appearance of new defenses in prey animals. In the fossil record, such escalation and trait change is thought to have driven the "Marine Revolutions" that mark the emergence of increased biodiversity. The appearance of modern fishes in the Mesozoic (251-65 million years ago) has been linked to the appearance of new anti-predator defenses among invertebrate prey, and ultimately an increase in overall species forms and numbers, setting the stage for modern forms. Thus, predation is seen as a positive influence on overall biodiversity. However, there is new evidence that increased

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predation by new fishes actually limits and reduces prey diversity at global scales. Rather, it might be the loss of predators through mass extinction or attrition that allows diversity gains. Using the fossil records of vertebrates and invertebrates, we will test whether increased predation pressure has a positive or negative effect on the biodiversity of prey classes over time. In this, we will compile a new database of marine ecosystems and functional morphologies throughout the history of multicellular life. Students will gain skills in big data analysis, coding, the practice of paleontology, and detection of evolutionary patterns in the fossil record.

**Project 2: The Impact of Ice Ages on the Evolution of Marine Biodiversity**

The Earth is currently in an ice age, in which 100,000 year glacial intervals cycle with 10,000 year warmer interglacials (which we are currently nearing the end of, barring human intervention). The only other extended ice age interval in the last 500 million years, and one of the few times when the Earth had polar ice caps, was during the Permo-Carboniferous (~360-250 million years ago). The record of this Late Paleozoic Ice Age therefore provides the only independent dataset for testing the effect of current climate cycles on biodiversity. In our current ice age, marine biodiversity is at the highest level it has ever been (until recently), reefs ecosystems are complex, and oceanic predators represent some of the largest animals on earth. However, in the Late Paleozoic, marine faunas appear to have been species poor and small, with apex predators under 1 meter in size. Coral reefs and phytoplankton, the basis of modern marine ecosystems, were virtually non-existent. Ray-finned fishes, now represented by 30,000 species, consisted of a few widespread but static lineages. This lull in their diversity has been referred to as the “Teleost Gap,” as it falls between the predicted origin of the largest living group (teleosts) and their actual first appearance. On land, tropical forests were thriving, leading the deposition of all the coal we use now, as were tetrapods and insects. How could such climatically similar ice ages have produced such different biodiversity outcomes? Determining the answer will allow us to more fully understand the relationship between climate and current biodiversity. It is possible that explosive productivity on land, combined with the formation of the supercontinent Pangaea, starved the oceans in a way not observed today. Students will gain skills in big data analysis, traditional and geometric morphometrics, climate modeling and coding.

**Project 3: New Fossil Fishes and Recovery from Mass Extinction**

The end-Devonian mass extinction (359 million years ago) represents arguably the largest loss of vertebrate species in their history, more severe than even the event that killed the dinosaurs. A thriving global community dominated by now-rare or extinct forms, such as armored placoderms and our lobe-finned fish relatives, was eliminated from both the seas and the land. Tetrapods (land animals) were nearly lost as well. It took more than 15 million years for vertebrates to fully recover and take on all the ecological roles that had been lost. In this interval, previously rare ray-finned fishes, sharks and tetrapods multiplied rapidly and adopted myriad new forms, mirroring their diversity in the modern world. Targeted examination of new and once-neglected fossils can help us to determine how animals recover from mass extinction, as well as answer

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more specific questions about vertebrate evolutionary history. How and why did ray-finned fishes (Actinopterygii) go from just 12 species at their first appearance in the Devonian to more than 30,000 species today, representing half of all vertebrates and virtually all fishes? How are these earliest successful ray-fins related to modern groups, and how did they survive? How did the first ever eel-like fishes and reef-dwelling actinopt achieve their functional forms? In this project, students will use fossils and CT scan data to describe evolutionary novelties in ray-fins. They will gain skills in the practice of paleontology, taxonomy, building evolutionary trees, making 3D models from CT scan data and statistical analysis.

*Jane Willenbring*

**Project 1: Mercury and biotic uptake in tropical forest soils**

Mercury is a toxic heavy metal that is often an environmental hazard. Although prevailing wind directions and contamination source areas suggest that the island of Puerto Rico should be a relatively pristine environment, there are high total amounts of mercury in the sediment and organic matter in rivers yet the Mercury does not seem to be taken up by plants or animals in Puerto Rico. We are trying to understand the biotic influences on the Mercury cycle and how mercury remains in a relatively inert chemical form in the tropics – unlike other temperate sites. An interested student will: 1.) spend 3-4 weeks in Puerto Rico accompanied by a graduate student and another Penn undergraduate, 2.) gain valuable field experience collecting stream sediment samples and taking field measurements, 3.) learn how to chemically analyze samples in the Earth and Environmental Science laboratories at UPenn after the collection of the samples in the field, 4.) perform independent but supervised analysis of collected material. Prerequisites: 1.) One course in introductory Chemistry, Physics or Earth and Environmental Science, 2.) an eagerness to learn new tasks, 3.) the ability to conduct field work including sometimes strenuous hikes, and 4.) the ability to take and organize notes and samples.

**Project 2: Impact of dust and organic matter on Puerto Rican soil sustainability**

Soil is produced from the rock below and from additions of dust and organic matter from above. Puerto Rico lies downwind of the Sahara desert dust plume which is a significant source of dust. The mountain soils also have significant inputs of lush organic matter from tropical forest debris. We will try to understand the processes that perturb the balance between the production of soil and the erosion of soil that impact soil sustainability. An interested student will: 1.) spend 3-4 weeks in Puerto Rico accompanied by a graduate student and another Penn undergraduate, 2.) gain valuable field experience collecting stream sediment samples and taking field measurements, 3.) learn how to chemically analyze samples in the Earth and Environmental Science laboratories at UPenn after the collection of the samples in the field, 4.) perform independent but supervised analysis of collected material. Prerequisites: 1.) One course in introductory Chemistry, Physics or Earth and Environmental Science, 2.) an eagerness to learn

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new tasks, 3.) the ability to conduct field work including sometimes strenuous hikes, and 4.) the ability to take and organize notes and samples.

### **Project 3: Stored carbon routing through a Puerto Rican watershed: the Consequences of a Warmer World**

Carbon is lost from tropical mountain forest soils via degradation and erosion. We are trying to determine the effect of different precipitation patterns on soil carbon export to help understand how carbon fluxes will change with future warming and climate change scenarios. We will use a number of field and chemical techniques to better understand the source and age of carbon as it moves through river networks in a Puerto Rican watershed. This project has a field and lab component. An interested student will: 1.) spend 3-4 weeks in Puerto Rico accompanied by a graduate student and another Penn undergraduate, 2.) gain valuable field experience collecting stream sediment samples and taking field measurements, 3.) learn how to chemically analyze samples in the Earth and Environmental Science laboratories at UPenn after the collection of the samples in the field, 4.) perform independent but supervised analysis of collected material. Prerequisites: 1.) One course in introductory Chemistry, Physics or Earth and Environmental Science, 2.) an eagerness to learn new tasks, 3.) the ability to conduct field work including sometimes strenuous hikes, and 4.) the ability to take and organize notes and samples.

## **ECONOMICS**

*Aislinn Bohren*

### **Project 1: Reputation and Gender Bias** *Rising Juniors only*

Does gender bias inhibit women from entering and succeeding in STEM careers? This project will measure gender bias in an online mathematics community, MathStackExchange. On MathStackExchange, users post or answer mathematics questions. A user's reputation score rises when others vote up her post and declines when others vote it down. We will run a randomized control trial by randomly assigning posts to male and female usernames. We will measure gender bias by comparing the peer evaluation of posts by gender. Comparison of gender bias across reputation levels will determine whether reputation is a successful way to mitigate gender bias. Comparison of gender bias across different types of posts will determine whether bias is larger for more subjective posts. Understanding the dynamics of gender bias and the types of evaluations that are more prone to gender bias are important for designing fair evaluation procedures in the workplace and effective policy initiatives to increase female representation in STEM and other underrepresented fields. Student research assistants will be involved with all aspects of this project, beginning with developing the study protocol and piloting the initial design, to generating the posts and collecting the online responses, to analyzing the results. A student with a strong mathematical background can also assist with theoretical modeling.

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Students will learn how to design and conduct a field experiment, analyze data, and write a research paper. Students can continue to participate on this project as an independent study in FA2015. Background Course Requirement: Real Analysis

*Francis DiTraglia*

**Project 1: Estimating the Effects of Online Discussions on Student Performance** *Rising Juniors only*

Online discussion boards are often proposed as a means of improving student engagement in large undergraduate courses, but little is known about their effect on course performance. This project will use data from a large undergraduate course at Penn to untangle the causal effects of student participation in online discussions. Is participation merely a proxy for effort, or do students directly benefit from time spent interacting with others online? If students do benefit, do these benefits differ depending on students' background? Research has suggested that under-represented minorities face obstacles when forming study groups and may miss out on the benefits that such groups provide. An intriguing possibility is that online discussion boards that allow anonymous posting may provide many of the same benefits as face-to-face study groups while removing these obstacles. A major goal of this project is to determine whether this is the case. We seek a student who shares our enthusiasm for improving learning outcomes by understanding online social interactions. Duties will include data-wrangling and programming in the R language and preparing graphs, tables, and short write-ups. A good working knowledge of R and statistics is required (e.g. Econ 103 and 104 or comparable statistics courses), and some familiarity with LaTeX and microeconomic theory (e.g. Econ 101) would be helpful. This project will give you the opportunity to hone your programming, statistical, and writing skills while gaining first-hand experience of academic research in economics, a particularly valuable opportunity for those considering graduate study.

*Jesus Fernandez-Villaverde*

**Project 1: Global Economic History**

I am working on a pathbreaking book on global history. This book will provide students with a brief introduction to global economic history since the early fifteenth century. The emphasis is on making students aware of the main features of the economic history of the world and how they interact with the political, social, and cultural dimensions of human activity. The subtitle, "structure and change," highlights the double theme of continuity and change, of an evolving landscape of economic life where economic agents must negotiate with trends and shocks. The book will mix narrative, analytic, and quantitative approaches to address such questions as: Why are some countries rich, and why are others not? Why did Western Europe take off in the late

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seventeenth century? Why did China and India lag behind? What was the role of international trade in these developments? How was the economy shaped by wars? What is the role of technological change in history? How has nature (climate change, epidemics, movements of animals and plants) interacted with the economy over the centuries? The research assistant will help me with some chapters of the draft.

***Rakesh Vohra***

**Project 1: The Allocation of Indivisible Goods** *Rising Sophomores only*

The problem of allocating of indivisible goods arises in a number settings such as school choice, resident matching or course assignment. The goal of this project is to test the effectiveness (in terms of efficiency and equity) of some recently proposed mechanisms for making such allocations. The student will be required to develop software to implement these mechanisms, assemble data on which to test them and analyze the results. Experience in coding and some knowledge of linear programming is essential. The student working on this project will gain a deeper understanding of optimization and some experience with optimization software. More importantly, s/he will be exposed to the challenges of thinking formally about the trade-offs between equity and efficiency in concrete settings.

## ENGLISH

***Jean-Christophe Cloutier***

**Project 1: Transcribing Jack Kerouac's Manuscripts**

In addition to currently translating into English two French novellas by American author Jack Kerouac for an upcoming volume of The Library of America (forthcoming 2016), I am also involved in putting together a bilingual scholarly edition of all his French writings, along with relevant contextualizing materials taken from Kerouac's journals, correspondence, and other unpublished materials. Much of this material has yet to be transcribed into a word processor, and I would this benefit from having the assistance of a dedicated student with this essential task. The student would gain experience in American literature, paleography, archival research methods, Kerouac's body of work and, if applicable, translation. This is a unique opportunity to work with unpublished materials by a major 20th Century author. Knowledge of French is preferable but not necessary as there is much English material to transcribe. Duties would involve transcription, handwriting analysis, proofreading and, thanks the funding provided by PURM, active archival research in the Kerouac Archive in New York.

*Suvir Kaul*

**Project 1: Land, Labor, Literature**

Over the course of the eighteenth century, in Britain and in its colonies overseas, land ownership and land usage patterns were drastically redefined. Patterns of labor changed accordingly: enclosures and the consolidation of large estates, as well as capital-intensive agriculture and infrastructure projects (roads, the drainage of fen lands), changed the lives of the rural poor and forced many into the cities or into plantations and colonies elsewhere. In these colonies, slavery and indentured servitude, as well as the dispossession of native peoples, redefined labor practices. I would like a student to work with me to develop an interdisciplinary annotated bibliography of political-economic, historical and literary texts that address these topics. A student who works on this project will gain an understanding of the socio-economic transitions that accompanied the consolidation of modern nation-states and empire. Great Britain and its empire is exemplary in this regard, and Anglophone writers in Britain, the Caribbean, and America debated at great length the costs and benefits of the often violent disruption of age-old relations between land and people. Literary writing charted the decline of traditional mores as much as it celebrated new sources of wealth at home and in the colonies. Literary texts are thus a resonant archive of historical understanding and more, for in the dialogue between them and other writing in this period we can read the trials and tribulations of vulnerable populations forced into regimes of labor and land usage that fundamentally rewrote their sense of nature, place and human possibility.

## HISTORY

*Sara Byala*

**Project 1: Coca-Cola in Africa**

I am currently undertaking research for a book on Coca-Cola in Africa. Today, Coca-Cola is – as elsewhere – everywhere in Africa. From billboards, tuck shops, and barbers’ signs to fabric, hats, and even private residences painted with the red and white logo, one cannot escape the presence of this iconic consumer product from Mozambique to Egypt, from Ghana to South Africa. The astounding reach of Coke has prompted some analysts to coin the phrase Coca-Colonization, while others have suggested using its well-trodden, refrigerated networks to distribute anti-retroviral drugs. Coke has been in Africa since 1929. Since the 1950s, it has been advertising in African languages. All over the continent, Coke has meaning to the folks who live there. Yet, to date, no one has probed the history in depth. This project seeks to do just that. To that end, I am looking for an undergraduate to help conduct archival research from the United States. Tasks would include undertaking Lexis-Nexus and other database searches to accumulate and index

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articles relevant to this topic. Additionally, the student would assist in research into the United States State Department business archives. This could include reading microfilm, making photocopies, and organizing material. An interest/ experience in Africa and or business would be welcomed. This project would be a great way for a student to gain insight into how a social scientist conducts research, giving the student valuable skills for later in his/her academic career.

*Amy Offner*

**Project 1: Anti-Poverty Programs, Social Conflict, and Economic Thought in Colombia and the US, 1948-1980** *Rising Juniors only*

This project examines postwar anti-poverty programs in order to understand the Latin American roots of US social policy, the origins of neoliberalism, and the rise of economists as public intellectuals. By following veterans of the New Deal and Marshall Plan through Colombian reform projects of the 1950s and 1960s and back to the United States in the era of the Great Society, it suggests that one way of studying the route from the 1930s to the 1960s in the United States is by traveling through Latin America. Conversely, one way of understanding the history of economic development is by analyzing its relation to First-World programs for economic recovery and redistribution. The project further illuminates the role of midcentury policymaking in popularizing what became neoliberal practices after 1980. Finally, midcentury social programs provide a context in which to study the emergence of economics as an independent discipline in Latin America, economists' strategies of social ascent, and the popularization of economic reasoning as a persuasive form of public argument. The project is a social history of economic thought, in which reform projects and the conflicts surrounding them provide the context for studying ideas. It is simultaneously a transnational history of social policy, exposing lines of mutual influence between the United States and Latin America. Research assistance will involve creating legislative histories of several US low-income housing programs (which can be done in the Penn library and provides valuable experience learning to use government documents), and compiling bibliographies on a few topics using library databases. There may be some transcription or proofreading of oral history interviews. A student research assistant should have excellent Spanish reading ability, scrupulous attention to detail, and background and interest in twentieth-century US and Latin American history. A Rising Sophomores is preferred.

*Kathy Peiss*

**Project 1: Looted Books, Restitution, and the Offenbach Archival Depot after World War II**

I am writing a book on American librarians, collectors, and information handlers in the World War II era, which examines the war's impact on US policies and practices toward information,

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knowledge, and culture. The summer project will focus on one important aspect of this history: a massive effort to save and return book collections at the end of the war. Allied forces discovered over two million books, which the Nazis had stolen from Jewish individuals and institutions. They were then gathered together in a 'collecting point' called the Offenbach Archival Depot. How the books were to be restituted, and to whom, was a thorny problem for the occupation government, archivists, and the many Jewish organizations that claimed them. The research assistant for this project will work with me to reconstruct the day-to-day operations of the OAD and the postwar restitution of books. S/he will gain extensive experience in historical methods and research. This will include organizing and analyzing primary documents, creating timelines, researching people and institutions, making an annotated bibliography, and doing archival research, both online and at physical archives such as the Center for Jewish History in New York. The best candidate for this position will have good library skills, careful note-taking ability, and background or interest in WWII, international history, Jewish history, or cultural policy and heritage. History major preferred; reading knowledge of German and/or experience with digital technology a plus but is not required.

## **HISTORY AND SOCIOLOGY OF SCIENCE**

*Etienne Benson*

### **Project 1: Wilderness: A Digital History**

Early this year, Barack Obama announced that he was asking the U.S. Congress to designate the Arctic National Wildlife Refuge, a 1.5-million-acre area on Alaska's northern coastal plain, as a "wilderness, so we can make sure that this amazing wonder is preserved for future generations." His opponents immediately denounced the proposal as an attack on Alaska's autonomy and as a hindrance to the exploitation of the state's rich oil reserves. Since the late nineteenth century, wilderness has been one of the most powerful and contested ideas in American environmentalism. How did it become so important? For many centuries, the term "wilderness" had been used to designate barren wastes, uncultivated land, and places where wild beasts could be found (from the Old English *wilddēor*, meaning wild deer or wild animal). Far from being something worth preserving, the best thing that could be done with wilderness was either to reclaim it for human use or to avoid it entirely. In the late nineteenth century, however, wilderness suddenly became seen by many — though not all — as a cherished and threatened resource, and even a vacation destination. The student's research for this project will contribute to understanding how and why this shift happened. Earlier research on this topic has tended to rely on canonical texts such as the Bible, the writings of Henry David Thoreau, the Wilderness Act of 1964, or the statements of leading environmentalists. Recently, however, the digitization of millions of books, newspaper articles, and other texts has made available a much wider range of historical sources for addressing this sort of question. These sources and the various

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computational methods available for analyzing them now make it possible to take a fresh look at the idea of wilderness and its changing role in American culture. Students with an interest in environmentalism, history, and digital humanities are encouraged to apply.

*Beth Linker*

### **Project 1: The Ivy League Nude Posture Scandal at Penn**

In the 1990s, American critics and academics became scandalized by the revelation that just decades earlier, many of the nation's elite schools took nude photographs of all incoming freshman to assess posture and physical fitness. Some claimed that the photos were a thinly disguised form of pornography, while others argued that it was a vast eugenic experiment run by "pseudo-scientists" with a hidden master-race agenda. This project will reopen the so-called Nude Posture Photo debate with the intent to offer a deeper historical consideration of the practice, seeking to understand twentieth century posture experts on their own terms. In particular, this project will uncover the practice of posture sciences at Penn. The student assisting me with this project will be utilizing the university archives and back issues of the *Daily Pennsylvanian* in order to trace posture science practices and photography at Penn. The student will be instructed on how best to utilize research personnel and resources at Van Pelt library.

### **Project 2: Surgical Enthusiasm in America**

This project addresses the question of why, throughout the twentieth century, U.S. surgeons are seen—both culturally and quantitatively—as “knife happy.” Initial concerns about the U.S.’s “mania for the knife” came from European surgeons who, at the turn of the twentieth century, believed American operators were too tolerant of “radical procedures of an experimental nature.” That U.S. surgeons adopted a “frontiersmen” attitude toward exploring all cavities of the body once anesthesia and antiseptics were in place is a common trope found in both popular literature and professional journals of the day. By the 1930s, the worry that American surgeons were cutting too frequently and too aggressively would become a concern internal to the U.S., held by certain practitioners in the profession as well as health care policy makers. In 1938, statisticians at the U.S. Public Health Service concluded that there were three times as many appendectomies and ten times as many tonsillectomies per 1,000 Americans as compared to 1910. By the 1950s, rates of appendectomies seemed to be declining, but other procedures—such as hysterectomies and cholecystectomies—seemed to becoming ever more commonplace. With surgical costs reaching an estimated 65 billion dollars by 1975, Congress formed a subcommittee to hold special hearings on “unnecessary surgeries” in order to respond to the large number of Medicare and Medicaid dollars being spent on surgical procedures. Today, in an attempt to understand why the U.S. outspends most other countries in healthcare, surgical overutilization is again a point of contention. According to certain estimates, U.S. doctors perform at least sixty million surgical procedures per year, one for every five Americans. The student who will assist me with this

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project will be conducting research using both primary and secondary sources, many of which are available online. The student will be instructed on how best to utilize research personnel and resources at Van Pelt library.

## LINGUISTICS

*Eugene Buckley*

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

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

*Gareth Roberts*

### **Project 1: Antagonistic contact and inverse affiliation: An experimental model of a surprising sociolinguistic finding**

This is an ongoing project in which an experimental model is developed of an intriguing sociolinguistic phenomenon recently observed by a Penn graduate student in Philadelphia. The student in question recorded interviews with white speakers in a racially segregated neighborhood and noted that a number of interviewees exhibited features of African-American Vernacular English in their speech. However, the individuals whose speech was most characterized by these features also espoused the most negative opinions about black people. To better understand the causal variables involved in this surprising result, we are conducting experiments in which groups of participants play a game in which they communicate in an artificial "alien" language. This allows us to manipulate and measure the relevant factors in a controlled setting. The student working on this project will work with other lab members to recruit and coordinate participants, run experiments, and assist with data storage and analysis. There may also be an opportunity for the student to be involved in study design, especially if they are able to join the lab before the end of the semester. The student should have some background in linguistics or cognitive science. (Sociolinguistics would be particularly advantageous). Some familiarity with programming, especially Python, would be preferred.

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Aside from the experience gained in the activities mentioned, this is an opportunity for the student to become familiar with innovative experimental methodologies in the study of language.

**Project 2: Population structure, social bias, and efficiency in the cultural transmission of language: An experimental study** *Rising Juniors only*

An important feature of language is that it is transmitted culturally from generation to generation. In the latter part of the twentieth century this process has come increasingly to be investigated experimentally using a method known as iterated learning, in which participants learn and are tested on artificial languages. Their output in the test phase is then used as the learning data for the next participant. This paradigm allows change due to inter-generational learning to be investigated in the laboratory. A typical finding is that this process leads a language to become more efficient. However, comparatively little research has examined the more complex social factors involved in transmission. What role, for example, do speakers' social attitudes play in this process? More basically, what happens when learners are exposed to varying data from a number of different speakers? This ongoing project seeks to answer these questions using data gathered online with Amazon's Mechanical Turk. The student working on this project will work with other lab members to recruit participants on Mechanical Turk, make sure that the experiment is set up to run (this will involve regular adjustment of parameters) and assist with data storage analysis. There may also be an opportunity for the student to be involved in study design, especially if they are able to join the lab before the end of the semester. The student should have some background in linguistics or cognitive science. Familiarity with programming would be preferred. Aside from the experience gained in the activities mentioned, this is an opportunity for the student to become familiar with innovative experimental methodologies in the study of language.

## MUSIC

*Mauro Calcagno*

**Project 1: Developing an online music edition for tablet computers**

The Marenzio Online Digital Edition (MODE) <http://marenzio.cdrs.columbia.edu/> is one of the most innovative collaborative music projects worldwide in the domain of Digital Humanities, awarded a prestigious federal grant. Developed by an international team of scholars, it introduces a new digital interface for the representation of music notation, offering users a web-based dynamic environment to study and perform music (demo at <http://youtu.be/FrQ0QNuy3JY>). The MODE interface is devised to display the works of one of the most important composers of the European Renaissance, Luca Marenzio, but is extendable to any music that can be disseminated through, and performed from, tablets. MODE also includes pedagogical materials concerning the composer, his music and times. Currently MODE has generated the edition of about 100 pieces

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in the scorewriter software Sibelius (see website, PDFs in sidebar Editions) and 5 prototypes of the digital interface (sidebar Prototypes), bridged by the encoding scheme of the Music Encoding Initiative (the musical analogue of Text Encoding Initiative). Our next step is to migrate, through encoding and other computer techniques, the remaining pieces into to the digital interface, and to research ways to make the pedagogical materials more effective for the user. The benefit for the RA is to develop computer skills and acquire knowledge of the world of music digital humanities as well as of the culture of the Renaissance. Basic computer skills and basic knowledge of music notation are expected, but initial training in notation software, XML, and FTP transfer is provided.

***Timothy Rommen***

### **Project 1: Creole Musics of Dominica**

I am currently working on an ethnographic monograph concerning the creole popular musics that have emerged in the Commonwealth of Dominica since the 1970s. I am hoping to identify a student who is interested in assisting me in producing a searchable archive of the primary and secondary written sources I will need to interact with while pursuing this project. This will involve working with microfilm copies of newspapers and sorting through online databases, and also involve consulting with library services personnel in order to get bibliographic control over the extant primary and secondary sources. The subjects that will be prioritized include traditional and popular music, festivals and competitions, theater and literature, and public policy and regional politics. Once bibliographic control has been achieved, the next step will be to delve into the individual sources and identify relevant passages, articles, and editorials and then assign them appropriate keywords. Because these keywords will drive the archive's accessibility and functionality, the student will need to attend meticulously to the logic and organization of this aspect of the project. Although most of the literature and newspaper coverage will be in English (the official language of Dominica), a student with some basic fluency in French will be better suited to sift through the entirety of this literature (this because Dominica is located in the Francophone Caribbean). This project will equip the student with a deep understanding of the processes and challenges of archival and bibliographic research and offer them the chance to develop this set of skills under the direction of a regional expert.

## PHILOSOPHY

*Michael Weisberg*

### **Project 1: Public Understanding of Evolution**

In a recent Gallup Poll, 46% of Americans reported that they believe humans were created in their present form within the last 10,000 years. These responses stand in sharp contrast to those of biologists, who overwhelmingly accept evolution. Why do Americans overwhelmingly fail to accept that humans have a purely naturalistic origin? and what do they believe about other species and other aspects of evolutionary theory? Although it is tempting to think that Americans' resistance to evolution is explained solely by ignorance or religious fundamentalism, previous research suggests that this issue is considerably more complex. For example, people's understanding of evolution is not correlated with their acceptance of it, but their understanding of the provisional nature of scientific theories is. The purpose of this project is to gain a fuller picture of what people in the United States know about the theory of evolution, to what extent they accept this theory, and what explains their beliefs and degree of acceptance. I am looking for research assistants who are interested in aiding in the construction of survey instruments, collating data from existing sources, and conducting face-to-face interviews. No pre-requisites for participation, but some knowledge of evolutionary biology and/or psychological and survey methods is desirable. Enthusiasm for the project is the most important thing.

## PHILOSOPHY, POLITICS AND ECONOMICS

*Peter Miller*

### **Project 1: Do Local Elections Increase Inequality?**

This project is co-mentored with Marc Meredith. Two factors distinguish mayoral elections from other American contests: turnout is remarkably low and more affluent voters tend to participate at higher rates than other voters. At the same time, states and local jurisdictions have wide leverage to conduct elections as they see fit. This combination of features leads to a question relevant to scholarly and policy debates on elections: can we identify policy interventions (i.e. election day registration and convenience voting reforms) that reduce inequality in local elections? Knowledge of this question is limited in the academic literature, but advances in management and analysis of big data may be helpful to expand on what we already know about local elections. Interested students will assist with assembling a set of data from academic sources and official election results and with preliminary analyses of the data. Familiarity with Stata is beneficial, but not required.

## PHYSICS

*Mark Devlin*

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

BLAST is a NASA funded high altitude balloon program. We are currently in the middle of building multiple components of an upgraded instrument. The student could be involved in mechanical design and construction, software for controlling the instrument, or electronics integration. The student will work with an experienced team of graduate students and postdocs. Anyone on this project is sure to learn a lot!

### **Project 2: The Atacama Cosmology Telescope - ACT**

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

*Douglas Durian*

### **Project 1: The Kelvin Problem**

In 1887, Lord Kelvin searched for a way to partition three-dimensional space into equal volume regions with minimal surface area. Today, this puzzle is known as “The Kelvin Problem”. Kelvin’s best guess is based on identical tetrakaidecahedra, but with curved surfaces that follow Plateau’s laws as per soap foams. This construction prevailed until Denis Weaire and Robert Phelan found a new structure in 1993 based on twelve-sided and fourteen-sided polyhedra rather than a single packing unit. Up to this day, hundreds of possible period structures have been explored but none surpass Weaire-Phelan. Yet there is no mathematical proof that Weaire-Phelan is best. So we will continue the search using the “Surface Evolver” program to create random patterns inspired by coarsening foams, which evolve in order to decrease surface area. We will begin with two-dimensional space, where the answer is hexagonal honeycombs as proved by Hales in the last decade. The central idea is to progressively anneal the system by alternating coarsening and target-volume growth. The work will also tie in to on-going experiments on the coarsening of wet foams, and has important implications for the fields of physics, mathematics, and chemical/mechanical engineering. The PI has extensive experience advising undergraduate research projects, which have resulted in ~10 peer-reviewed publications with undergrads as first author.

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*Eleni Katifori*

**Project 1: Quantifying the topological morphospace of leaf vascular networks**

Plant leaves are endowed with a beautiful and complex system of veins, whose purpose is to support the leaf, distribute water across the leaf blade and collect the products of photosynthesis. From the thick, mid-rib primary vein to the almost invisible veinlets, the organization of the venation spans many orders and is hierarchically nested in a complex interconnected network (a single leaf can contain more than 10<sup>5</sup> nodes and edges). This complex architecture is thought to be highly adaptive and showcases astounding morphological diversity. However, up to now, only the superficial leaf vein phenotypic traits (such as vein density) have been quantified, and many important topological characteristics have been ignored. In this project, we will use combine computer programming, tools from mathematics and experiment (leaf clearing and scanning) to quantify the inter- and intra- species phenotypic diversity of leaf vascular networks. This project is ideally suited for students with interdisciplinary interests in physics, biology and computer programming.

**Project 2: Characterizing the topology of language**

Human language is general, and word associations in particular can be viewed as complex networks composed of nodes (the words) and links (semantic relationships) that connect them. Such an approach has been very popular in the past decade and produced a number of exciting results. With this project, we seek to use publicly available databases of word associations and explore the hierarchical organization and other topological features of the corresponding networks. This interdisciplinary project is ideally suited for students with some programming experience and interest in languages.

## POLITICAL SCIENCE

*Michael Horowitz*

**Project 1: Terrorist alliances**

This PURM proposal involves in-depth research on violent non-state actors around the world and their alliances with both 1). Other violent non-state actors and 2). Nation-states. Whether it is Iran's support of Hezbollah or the relationship between al Qaeda and the Islamic State (ISIS/ISIL), the alliances of violent non-state actors seem to play an important role in shaping their behavior: the tactics they adopt, their success, and their longevity. This is a topic that does not just have academic relevance, but significant public policy and national security implications as well. 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 of these relationships. The

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student will be part of a team of researchers at the University of Pennsylvania, the University of Michigan, the University of Virginia, and Denver University that is investigating ties between terrorist groups. Interested students will gain research training in investigating difficult-to-find phenomena about terrorist groups 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.

*Ian Lustick*

### **Project 1: The Israel Lobby in America as a Constraint on Israeli Foreign Policy**

This project is a chapter in a book I am writing to explain Israel's failure to adapt to opportunities over the last few decades to bring an end to the Israeli-Palestinian conflict via some version of the "Two State Solution." A key element in my analysis is the effect of the Israel lobby's success in the United States that de incentivizes risk-taking or moderation by Israeli politicians. Research will involve collection, summary, analysis and coding of books and articles, both polemical and scholarly, regarding the purposes, intended effects, and unintended effects of Israel lobby activity. Some background in American politics will be very helpful.

### **Project 2: Beyond the Two State Solution: Visions of Peace between Israelis and Palestinians**

This project is a chapter in a book I am writing to explain Israel's failure to adapt to opportunities over the last few decades to bring an end to the Israeli-Palestinian conflict via some version of the "Two State Solution." One important strand of the argument in the book will require assessing alternatives to the idea of two states for two peoples as frameworks for satisfying the minimum requirements of Jews and Arabs in Palestine/the Land of Israel. Research assistance is needed to collect, analyze, code, and compare the many plans, often complex and underspecified, of federalist, cantonal, parallel state, confederal, and other imagined political frameworks. Some background in the study of Arab-Israeli affairs will be very helpful.

### **Project 3: Changing Constructions of the Holocaust in Israeli Collective Memory**

This project is a chapter in a book I am writing to explain Israel's failure to adapt to opportunities over the last few decades to bring an end to the Israeli-Palestinian conflict via some version of the "Two State Solution." Since the end of WWII no event has loomed larger in the collective consciousness of Israeli Jews than the destruction of six million Jews by the Nazis. On the other hand, the image and "lessons" of the Holocaust that now dominate thinking in Israel were not always those that were prominent or even imagined in Israeli culture and politics. Research will involve systematic critique of analyses I have already prepared of changing constructions of the

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Holocaust in Israeli political and social life with an emphasis on enriching the evidentiary base and establishing as much clarity in the presentation of findings as possible. Reading knowledge of Hebrew will be very valuable.

*Michele Margolis*

**Project 1: The Politics of Faith: Religious and Political Trends Over Time**

Have you ever opened the newspaper and been surprised at how much talk there is about religion? Have you ever wondered why there is so much religion in American politics? My research asks how people's religiosity and voting decisions are related, how this relationship has changed over time, and what causes these changes to occur. I am looking for students to assist me over the summer in collecting data and identifying trends over time. I am particularly interested in candidates who want to learn new computing skills and how to visualize data (i.e., make awesome graphs)

*Rudra Sil*

**Project 1: Russia, Eastern Europe, and Central Asia: Material Factors and Long-Term Human Development in Comparative Perspective**

With the exception of the first decade after the fall of communism, there appears to be a remarkable consistency in where Russia, Eastern Europe and Central Asia line up alongside the rest of the world when it comes to their position on the human development index. This project seeks to outline a long-term perspective on countries viewed as 'post-communist.' Looking carefully at long-term trends in material factors connected to geography, natural resources, and demography, the project is designed to raise questions about the impact of both communist development strategies and post-communist economic reforms, at least insofar as these have any bearing on the relative standing of post-communist countries when it comes to trajectories of human development (as opposed to simple GDP growth rates). The implications of this analysis could be to diminish the significance of current debates over development strategies, macroeconomic policies, and regime type relative to larger material forces.

**Project 2: Varieties of Petrostates**

Most discussions of petro-states tend to view them in uniform terms, assuming all to be equally "dependent" on revenues generated from oil and gas exporters, and thus also equally vulnerable to price drops related to declining demand or over-supply. This project is motivated by the suspicion that most commentators tend to underestimate the variation among petro-states (and the implications of this variation for their ability to leverage rising oil prices or survive declining oil prices). There is variation in the precise extent to which state budgets and GDP growth

depend on revenue from petroleum exports, in the structure of the ownership of natural resources, and in the trends evident in NON-petroleum sectors of the economy. Variation along these dimensions have important implications for not only for the developmental trajectories of individual oil/gas exporters but also for the overall architecture of geoeconomics and geopolitics, particularly in light of falling demand in the global north and growing demand in the global south.

## PSYCHOLOGY

*Harvey Grill*

### **Project 1: What causes obesity? Individual differences in response to satiation signals**

Obesity is a major world health issue. Thus, it is important to understand the etiology of this disease, especially because there is large population of obese as well as a population that remains lean. What accounts for these differences? This study will explore individual differences in responses to satiation signals (e.g. cholecystokinin, glucagon-like peptide-1, peptide YY) and how they may correlate with future weight gain using a rat model. Here, the hypothesis is that individuals who are less responsive to post-meal satiation signals will have a greater propensity for weight gain. Follow up studies will be performed when appropriate to determine the neural mechanisms that mediate the effects to be seen. This project will involve peptide injections, behavioral analysis (e.g. food intake measurements, progressive ratio responding analysis, etc.), ELISAs, and follow up studies may involve molecular techniques such as qPCR and Western blotting. Students will be trained by current lab members and will be expected to eventually work independently on the experiments within this project.

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

In the face of the modern obesity epidemic, it is important to understand the control of food intake and weight gain. Liraglutide, a GLP-1 analogue, was recently FDA approved to treat obesity. However, the neural substrates involved in the intake reduction by this drug are not fully known. Recent studies have suggested that GLP-1 reduces food intake at least in part by acting on the brain to reduce food reward. Experiments within this project will examine novel brain regions (e.g. PVT) and their involvement in the control of food reward. This project will involve central GLP-1 agonist microinjections and extensive behavioral analysis using paradigms such as conditioned place preference, progressive ratio responding, and reinstatement of food seeking. Students will be trained by current lab members and will be expected to eventually work independently on the experiments within this project.

*Melissa Hunt*

**Project 1: Mindfulness Based Stress Reduction and Smoking Cessation** *Rising Juniors*  
*only*

Mindfulness interventions such as Mindfulness Based Stress Reduction (MBSR) have proved to have amazingly helpful effects across a range of psychological and behavioral health domains, including depression, anxiety, chronic pain, health related quality of life and general stress management. One prior study explored the impact of adding mindfulness to a smoking cessation program, and found quite modest, but nevertheless encouraging results. I believe that a more targeted 8 week mindfulness treatment program may be quite effective in helping people quit smoking. A student who works on this project over the summer will read extensively in the mindfulness and smoking cessation literature and will help design a randomized controlled trial for a smoking cessation intervention to begin in the fall. The student will have the opportunity to participate in an 8 week MBSR program over the summer and will collaborate with the faculty PI on all aspects of study design, culminating in submission of a complete IRB proposal and initial subject recruitment. The student will also have the opportunity to learn to gather physiological data (like EKG and respiration) which will be used as outcome measures in the trial. The ideal candidate is a Rising Juniors who may be interested in a career in clinical psychology and/or behavioral health and would like to continue in the fall to help run the study intervention groups in the context of year-long independent study. No prior research experience is required, but an interest in mindfulness meditation, yoga and/or behavioral health interventions is a bonus.

*Sara Jaffee*

**Project 1: Coding Adolescents' Perceptions of Risk and Protective Factors**

We are interested in how adverse childhood experiences (e.g., maltreatment, community violence, poverty) “get under the skin” to affect neuroendocrine and immune systems that are thought to alter adolescent mental and physical health. Moreover, we are interested in factors that buffer youth from the negative effects of exposure to adversity. To enrich our understanding of protective factors, we conducted focus groups with adolescents to assess their perceptions of factors that protect youth in their communities from adversity. The next step is to code transcribed audio-recordings of the focus groups for both novel and known protective factors identified by adolescents. We are seeking a PURM student to work closely with a PhD student in clinical psychology and the study PI, Sara Jaffee, PhD, to conduct qualitative coding of the focus groups. This will involve working with the PhD student and Dr. Jaffee to develop a codebook of known protective factors (e.g., having a role model). The PhD student and the PURM student will work together to code the focus group transcripts and modify the codebook as novel protective factors are identified. Once the coding is completed, the team will consolidate codes

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into broader themes. The result will be new knowledge about the activities, experiences, and relationships that adolescents feel help protect them from negative effects of adverse experiences. Thus, working on this project will provide a PURM student with content knowledge about factors that promote resilience for at-risk youth, as well as methodological experience in qualitative research methods. The PURM student will also be expected to help the project manager to recruit adolescents for the second wave of the study.

### **Project 2: Goal-Setting in Adolescence**

Adolescence is a period when youth are expected to start setting goals for the future, including academic and career goals. Youth who have experienced adversity (maltreatment, community violence, adult domestic violence) may not set as many goals, may set different kinds of goals, or may set less realistic goals for themselves than youth who have experienced low levels of adversity. We recruited 100 adolescents from CHOP primary care practices in West and South Philadelphia who reported on their goals for the future as well as factors that might facilitate achieving their goals. In this project, PURM students will code the goals interview (e.g., for goal content), test the hypothesis that exposure to childhood adversity is related to the kinds of goals adolescents set, and will have the opportunity to identify other variables in the data set that facilitate or hinder adolescent goal-setting. PURM students will become familiar with SPSS statistical software to conduct analyses and will also be involved in conducting literature searches on the goal-setting literature. The PURM student will also be expected to help the project manager to recruit adolescents for the second wave of the study.

### **Project 3: Socially Supportive Relationships in Adolescence**

Although youth who have been exposed to adversities like maltreatment, community violence, or adult domestic violence are often doing "better than expected" in terms of their mental health or their school achievement, many youth find it difficult to maintain these competencies. One reason for this may be that their exposure to adversity remains constant, but their access to protective factors (including socially supportive relationships with adults or peers) is inconsistent. In a study of 100 adolescents recruited from CHOP primary care practices in West and South Philadelphia, we gathered data on teens' socially supportive relationships. PURM students will help enter these data to identify who teens are identifying as their social supports, what kinds of support these people are offering, how frequently teens are in contact with these supports, and whether individuals who are named as important sources of social support remain important social supports a year later. PURM students will test whether youth who have been exposed to adversity have less consistent access to socially supportive relationships than non-exposed youth and will test whether consistent access to socially supportive relationships promotes positive well-being among adversity-exposed youth in particular. PURM students will become familiar with SPSS statistical software to conduct analyses and will also be involved in

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conducting literature searches on the social support literature. The PURM student will also be expected to help the project manager to recruit adolescents for the second wave of the study.

*Paul Rozin*

### **Project 1: Conflicted Omnivores**

We are generally interested in how people deal with ethical aspects of eating meat (that is, eating animals). One reasonably large group of omnivores, which we call conflicted omnivores, do not think it is right confine and kill animals for food, but they continue to eat meat. We are interested in how they manage to continue to do something that they feel is unethical.(with Matthew Ruby, postdoctoral fellow)

### **Project 2: Chinese, Indian and American differences in how they view the past and the future**

With graduate student Xuan Gao, and Professor Gal Zauberger from marketing, we are interested in the different ways that Chinese, Indians and Americans think about the future. We are also exploring cultural differences in the value of the personal past, the degree to which people exert effort to create good memories and to preserve them

### **Project 3: Individual differences in disgust sensitivity**

With Hana Zickgraf, a graduate student and former PURM summer intern. This project is an attempt to improve the measurement of individual differences in disgust sensitivity. Rozin is the author of the currently most widely used scale, but there are problems with it. The major problems are how to deal with sexual and moral disgust. We are trying out different types of questions.

*Ayelet Ruscio*

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

Psychologists have long known that anxious and depressed individuals differ from healthy individuals in their physiological reactions to significant events. However, reactions have been studied almost exclusively in laboratory settings, limiting the events to which participants can be exposed and raising questions about generalizability to real-world settings. Fortunately, recent collaboration between scientists and industry has resulted in the development of ambulatory devices capable of measuring psychophysiological responses outside the laboratory. Our lab has begun using these wrist-worn devices, in conjunction with smartphone ratings of event characteristics, to investigate changes in physiology (skin conductance, motor activity) following

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events in the daily lives of anxious, depressed, and healthy individuals. Of particular interest is how these groups react to everyday positive and negative events, and how this in turn affects symptom levels. Ultimately, this research has the potential to identify biomarkers that signal vulnerability for persistent emotional disorders. This project is ideally suited for a student who is interested in the intersection between clinical psychology and neuroscience, physiology, or bioengineering. The student will be trained in psychophysiological assessment and will interact with clinical populations. Given the novelty of these procedures, the student will work closely on developing methods for isolating, extracting, and analyzing event responses from the continuous stream of ambulatory psychophysiological data collected. The student will also collect data from clinical participants and assist with the daily operations of this study. The project will be co-mentored by Professor Ruscio and postdoctoral psychophysiological Dr. Mathersul. For more information about our research see <https://sites.sas.upenn.edu/ruscio-lab/pages/research>.

**Project 2: Psychophysiological Responses to Reward in Depression**

Depressed individuals often experience diminished enjoyment of rewarding or pleasant events. Indeed, blunted physiological reactivity to rewards has been proposed as a possible biological marker for depression vulnerability and persistence. However, studies exploring this possibility have been limited in two ways: (1) they have focused on relatively mild, generic rewards (e.g., pleasant images, small monetary gains), raising questions about responses to robust rewards that more closely resemble those experienced in everyday life; and (2) they have focused on the immediate reward response, without considering potential dysfunction in the time course of responding. The current project extends past research by exploring responses to a more intense and personally significant rewarding experience: receiving positive feedback on a performance task. Psychophysiological (heart rate, skin conductance) and subjective (thoughts, feelings) responses will be measured before, during and after the reward delivery. By tracing the temporal dynamics of the physiological response in depressed and healthy individuals, we will be able to describe far more precisely the nature of dysfunctional reward processing in depression. This project is ideally suited for a student interested in the intersection between clinical psychology and neuroscience, physiology, or bioengineering. The student will be trained in psychophysiological assessment and will help to identify and analyze temporal features of the physiological response. The student will also collect data from clinical participants and assist with the daily operations of this study. The project will be co-mentored by Professor Ruscio and postdoctoral psychophysiological Dr. Mathersul. More information about our research can be found at <https://sites.sas.upenn.edu/ruscio-lab/pages/research>.

**Project 3: Relationship between Psychophysiological and Subjective Experiences of Arousal in Anxiety**

Anxiety disorders have significant, negative effects on quality of life. The physiological nature of the anxiety response (e.g., racing heart, muscle tension, difficulty breathing) is particularly debilitating. Research suggests that a mismatch between the subjective experience of anxiety and

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the actual physiological response, especially in stressful contexts, may contribute to the maintenance of anxiety. However, overestimation of physiological arousal has mainly been observed in people who experience panic attacks. Less is known about individuals whose bodily symptoms are more subtle (e.g., muscle tension; feeling “keyed up” or restless), yet still critical to their experience of anxiety. The current project will expose anxious individuals to a stressful (public speaking) task. Measures of psychophysiological arousal (heart rate, skin conductance, muscle tension, motor activity) will be compared to subjective perceptions of bodily arousal assessed throughout the task. Of particular interest is how closely subjective experiences match physiological responses in anxious versus healthy individuals, and the extent to which subjective anxiety modulates the intensity and duration of physiological responses. This project is ideally suited for a student interested in the intersection between clinical psychology and neuroscience, physiology, or bioengineering. The student will be trained in psychophysiological assessment and will help develop a system for mapping subjective ratings onto physiological data. The student will also help collect data from clinical participants and assist with the daily operations of this study. The project will be co-mentored by Professor Ruscio and postdoctoral psychophysiologicalist Dr. Mathersul. More information about our research can be found at <https://sites.sas.upenn.edu/ruscio-lab/pages/research>.

***Robert Seyfarth***

**Project 1: Determining early predictors of success in Seeing Eye® Dogs**

What are the developmental factors that have a positive effect on the ultimate performance of Seeing Eye® dogs? To address this question, we have been following a cohort of 137 puppies since birth, observing mother-pup interactions, collecting maternal salivary cortisol during stressful separation events, and following the developmental course of cognitive skills and temperamental traits by testing puppies at six weeks and between eight to ten months. These skills include those which have been previously shown to predict performance, such as flexible attention, retrieval, and laterality (paw preference), as well as several less explored but promising measures, such as inhibitory control, problem-solving skills, and the chronic effects of arousal. In the next phase of the project, we will continue to track these variables when the adolescent dogs return to headquarters, before they begin their months of intensive training. We will also be collecting salivary samples from the adolescent dogs to track their stress levels over the transition period. Our goal is to determine which variables, at which points in development, should be targeted for improvement in future puppy cohorts. The student will work closely with a graduate student on-site at The Seeing Eye, about 2 hours away in Morristown, NJ. The student will assist in testing the 12-to-15-month-old dogs on the various behavioral and cognitive tasks. The student will also gain first-hand experience in hormone collection techniques, data entry, and video coding. Previous experience with dogs is preferred, and it would be helpful if the student has taken Animal Behavior (BBB/Bio/Psyc 231).

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*Sharon Thompson-Schill*

**Project 1: Effects of non-invasive stimulation of human brain on thought, language, and memory**

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

**Project 2: Imaging Human Thought**

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

*Deena Weisberg*

**Project 1: Why do Americans resist evolution?**

In a recent Gallup Poll, 46% of Americans reported that they believe humans were created in their present form within the last 10,000 years. These responses stand in sharp contrast to those of biologists, who overwhelmingly accept evolution. Why do Americans fail to accept that humans have a purely naturalistic origin? and what do they believe about other species and other aspects of evolutionary theory? This project begins to answer these questions by interviewing people from a variety of backgrounds about evolutionary theory. In these interviews, we will assess what people know about the theory of evolution and to what extent they accept it. We will also measure demographic factors, like people's religious backgrounds and their trust in scientists, to see what might explain the widespread resistance to evolution. The student will assist the professor in all aspects of conducting and running psychological studies on this topic. Duties will include reading the scientific literature, creating stimuli, recruiting subjects, interviewing subjects, compiling subjects' responses, and managing and analyzing data.

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Applicants should have completed some coursework in biology, philosophy, psychology, and/or cognitive science.

**Project 2: What do children know about science?**

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

**Project 3: How do children learn from fantasy stories?**

Stories are important teaching tools in childhood. Even though the events depicted in them are fictional, stories nevertheless present some information that is true in reality, which children should incorporate into their background knowledge. But how do children know which pieces of information should remain quarantined within the story, and which should be exported into reality? To answer this question, this project presents preschool-aged children with fictional stories and asks whether they will apply information presented in these stories to real life. These stories vary in their degree of fantasy, with some being entirely realistic, some containing a few fantasy elements, and some containing many fantasy elements that violate a variety of real-world laws. Children will be asked whether the information presented in these stories could possibly be true, and we will test how the type of story they hear might change their answer to that question. Learning more about children's imaginations and their interactions with stories can help us to create better educational media and to understand more about how their critical-thinking capacities develop. The student will assist the professor in all aspects of conducting and running psychological studies on this topic. Duties will include reading the scientific literature, creating

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stimuli, recruiting subjects, interviewing subjects, compiling subjects' responses, and managing and analyzing data. Applicants should have completed some coursework in psychology, cognitive science, and/or neuroscience. Previous experience with children is desirable but not required.

## **RELIGIOUS STUDIES**

*Justin McDaniel*

### **Project 1: The Emperor of All Asia**

Is there anything that unites all of Asia? From Turkey to Japan, from Tibet to Indonesia? This question is the starting point of an ambitious book project on the one deity that is found in nearly every Asian culture, language, and religion -- Indra. Indra is found in Greek, Hittite, Iranian, Indian, Nepali, Tibetan, Thai, Cambodia, Indonesian, Chinese, Korean, and Japanese religion and mythology. Images of this god of thunder and intoxication come in many forms throughout Asia and are found in pre-historical sites in Central Asia, as well shopping malls in modern Bangkok. He is a god for Hindus, Buddhists, Taoists, Jains, Zoroastrians, and related to both Zeus and Dionysius in Greek Mythology. The student who assists me with this project must have advanced reading knowledge of either Chinese, Japanese, Malay/Bahasa Indonesia, Kannada, Tamil, or Telegu, as well as a willingness to explore library and museum collections for references to Indra in numerous sources. They will have opportunities (depending on funding) to visit museum collections in Washington DC, New York, London, and Paris to help develop a large database of images and textual references about Indra. This is excellent preparation for careers in Asian Studies, Art History, Religious Studies, Linguistics, Literature, Anthropology, Classical Studies, and Museum Studies.

## **ROMANCE LANGUAGES**

*Lydie Moudileno*

### **Project 1: Representing the French in American Popular Culture**

The purpose of this research project is to collect a cross-section of representations Frenchness in recent US popular culture. Several essential questions will motivate the study: How have France and "the French" appeared in North American popular media (print, online and visual) throughout the last twenty years? Further, how do these images reiterate or disavow stereotypical representations of Frenchness (from the "chic" Parisian and the brooding existentialist to beret-wearing, wine drinker or, more recently, banlieue residents and postcolonial minorities). Among

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these recurring images of the French, which are the most persistent and what cultural and historical events trigger them? I am particularly interested in identifying these moments and in examining how these stereotypes function whenever they are reactivated. In order to answer from an informed perspective, the student will assist in identifying and organizing data from a range of sources including media, literature, cinema, television and popular culture at large. For this research be a productive experience for both the student and for myself, I wish to find someone who is attuned to contemporary popular culture in the United States while also being interested in France (ideally, this would be someone who also spoke some French). He or she would help compile a digital database of images of and commentaries on French people as a category. This database will be used to further develop a course I plan to teach regularly at Penn and in my own research on the multifaceted definitions "Frenchness" in both American and French contemporary popular imaginaries.

## SOCIOLOGY

*Amada Armenta*

### **Project 1: Latino Immigrants and the Law**

The student will help Dr. Armenta work on a project examining legal service provision in the Latino immigrant community. He or she will work on identifying and mapping legal service providers throughout Philadelphia, compiling a literature review, and conducting observations (and possibly interviews) at legal clinics in the city. Ideally, the student will have taken at least one social science course and should speak fluent Spanish.

## THEATRE ARTS

*Rosemary Malague*

### **Project 1: Contemporary American Plays by Women - Scene Anthology**

A book project that is nearing publication, this anthology of scenes from contemporary American Plays by women will be the first feminist collection for student actors. I am working in collaboration with a colleague at Davidson College. Student responsibilities will include: reading plays to evaluate their appropriateness for inclusion and, as we move closer to publication, securing publishing rights for the scenes that will be anthologized. Students interested in Gender and Society/Women's Studies, Cinema Studies, Creative Writing, English, and Theatre Arts are encouraged to apply.

**Project 2: Regrouping: Stella Adler and Harold Clurman, 1941-1951**

This project is a study of the professional and marital relationship between famed actress and acting teacher Stella Adler, and equally renowned director and theatre critic Harold Clurman. Both founding members of the historic Group Theatre (1931-1941), Adler and Clurman each had tremendous impact on the development of the American Theatre, but their relationship and mutual influence has not been studied. Having already gathered archival research--including their torrid and volatile correspondence--I am seeking a researcher to assist in compiling and analyzing documentation of their relationship during this decade. Clurman wrote extensively from Hollywood, where he pursued a career in film; Adler from New York, where she sought to reinvent herself after the demise of the Group Theatre. The project brings together the following areas: American studies and history; cinema studies; dramatic literature and criticism; and gender studies. This project will involve seeking out all documentary evidence of this relationship, and assisting in the analysis of this important but under-studied relationship. Reading (and deciphering) handwritten letters will be a key part of this project; researching published information about Adler and Clurman will provide context. The project may also include assisting on interviews with family members and friends who survive them.

*James Schlatter*

**Project 1: "When the Dead Won't Die": the presence of ghosts, demons, and hallucination in classical and contemporary war literature**

This project grew out of my research and teaching interest in classical and modern war plays, specifically plays that portray soldiers suffering the trauma of warfare and its aftermath. My earlier research for a conference paper focused on classical Greek plays and their re-staging for contemporary audiences titled "The Madness of Ajax." This research also drew on recent psychoanalytic literature, in particular two books by psychiatrist, Dr. Jonathon Shay, "Achilles in Vietnam" and "Odysseus in America," which drew on these classical Greek epics as a reference for American soldiers returning from war afflicted with what has now become widely identified as PTSD. More recently I have been investigating and teaching contemporary American plays that deal with this urgent issue. A number of new American plays use the dramatic figure of a ghost or demon to engage the frightening reality of war trauma, the tragic implications for a soldier--and also the American public--unable to forget or bury the memory of what happens to soldiers in battle. Several very important non-fiction books written recently engage this issue with unsparing honesty, including "Demon Camp: a Soldier's Exorcism," by Jennifer Percy, and "Knife Fights," by Lt. Col. John A. Nagel. For this PURM project I would want to expand this

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research to include a much wider range of classical and modern literature--fiction and non-fiction, history, journalism, novels, poetry, and plays whose focus is on the impact of war on the emotional, mental, spiritual, and moral lives of soldiers. While this research would be of great help to me in my research and teaching, there is a strong possibility that it would provide the basis for a theatre performance, which I would direct in the fall semester for the Theatre Arts Program. This performance would be what is called a devised piece, and would be made up of an assemblage or collage of fragments of texts to be performed by an ensemble of student actors. The focus would be on the portrayal of ghosts, nightmares, and hallucinations as embodiments of war trauma. I am very happy to work with any student who would find this research interesting. There would be a creative component in addition to the more traditional research for this project. A student choosing this PURM project could expect to engage in dialogue with me about ways in which a performance might be structured using the material discovered. I would welcome any student interested in history, literature, theatre, psychology, or journalism. I would of course especially encourage any student currently enrolled who is a veteran. No experience in theatre is required, only a deep interest in or curiosity about the subject of--and possible creative uses for--my research.

## **VISUAL STUDIES**

*Ian Verstegen*

### **Project 1: Digitizing the Italian Renaissance Workshop**

This PURM grant is intended to expose an undergraduate student to Italian Renaissance artist's workshop through his drawings. The student will gain knowledge about Renaissance art history and science, and make original discoveries in research, which support the professor's forthcoming book on Federico Barocci. After an introduction to contemporary scholarship on Barocci, the professor will introduce his model of the working process of the artist (Marciari and Verstegen, *Master Drawings*, 2008). He will introduce the functioning of the reduction scale, a scientific instrument in use at the time, for the production of Barocci's drawings. Some background in digital tools (primarily Photoshop) is expected, but the professor will demonstrate how to make same scale comparisons of drawings and paintings. The professor will give the student tasks to reconstruct the creation of different paintings. These will be discussed and compared with the professor's model. The student will then complete analyses of paintings using scaled computer comparison and suggest the working process for such works. Students are encouraged to work up a paper or create a web page in support of their future efforts in the auction world or graduate school. The student will meet regularly with the faculty member and discuss weekly tasks, including scanning, digitally matching works to scale, and analyzing relationships, and comparing these results with scholarly works available.

## **Dental Medicine**

### **ORAL MEDICINE**

*Sunday Akintoye*

#### **Project 1: Skeletal Site-Specificity of Mesenchymal Stem Cells**

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

## **Design**

### **CITY PLANNING**

*Amy Hillier*

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

The Ward: Race and Class in Du Bois' Seventh Ward (formerly Mapping Du Bois) is now in its tenth year. Directed by Associate Professor of City and Regional Planning, Amy Hillier, the project aims to engage high school students and the broader public in a dialogue about race and racism using W.E.B. Du Bois's 1899 classic book, *The Philadelphia Negro*, as its springboard. Du Bois came to Philadelphia in 1896 to study the problems that Blacks living in Center City between Spruce and South Streets—the heart of the black community—faced. To date, our team has created an online interactive mapping system of the area Du Bois surveyed, a 19-minute documentary, “A Legacy of Courage: W.E.B. Du Bois and *The Philadelphia Negro*,” curriculum materials, oral history collection and board game. For more about the project, visit [www.dubois-theward.org](http://www.dubois-theward.org). During the summer of 2015, our team will focus on finalizing our five-day high school curriculum, expanding our oral history collection, and integrating personal stories with digital maps showing neighborhood change. Interest in working with high school youth, interviewing experience, and experience with graphic design and/or video editing welcome but not required.

*Megan Ryerson*

#### **Project 1: Landing on Empty: Estimating the Benefits from Reducing Fuel Uplift in the International Aviation System**

The choice of fuel uplift for a flight is a canonical example of decision making under uncertainty. Given the lack of decision support tools and the extreme downside risk, dispatchers and regulators in the U.S. load quantities of fuel that reflect extreme conservatism. The aim of my work in the area of fuel loading is to quantify the cost of this approach to flight planning and to use these findings to support federal policy regarding fuel loading and contingency planning. The federal government is currently actively seeking strategies to reduce fuel consumption from aviation. My fuel loading research seeks to inform federal stakeholders about the potential to save fuel by crafting policy on airline fuel loading. My prior work involved collecting extensive data from a major US airline on their fuel loading practices. I estimated cost-to-carry factors for a range of aircraft types and calculated the cost to carry unused and excess fuel for domestic flights. The results from domestic flights only show that excess fuel loading has major cost and

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environmental consequences. As the domestic results are complete and a baseline methodology has been established, I am now looking for an undergraduate intern to assist me with the International Fuel Cost to Carry work. The student will be responsible for 1. understanding airline fuel planning for international flights (which is rather complicated and very different from domestic flight planning); 2. merging large publicly available aviation and weather databases with a detailed dataset from a major U.S. airline for all their domestic flights, June 2012-May 2013; 3. helping me establish "excess fuel" definitions based on the details of international fuel loading rules; 4. writing R scripts that implement these "excess fuel" definitions and calculate the cost (in pounds of fuel, monetary cost, and environmental cost) to carry unused fuel on arrival and discretionary fuel as defined. The student would be expected to perform these duties and to help prepare a document discussing the method and the results. I am looking for a student with a strong background in statistics, an ability to code in R or to learn quickly, and a passion for transportation and aviation operations and policy. I am also looking for a student who is comfortable working on a diverse team and possibly getting to meet and present results to airline executives and representatives from the Federal Aviation Administration. This project is an exciting opportunity for a student who is interested in transportation operations, transportation policy, and analytical methods.

## **FINE ARTS**

***Kenneth Lum***

### **Project 1: Monument Lab**

Monument Lab is an architectural and sculptural installation project sited for the courtyard and southern perimeter of Philadelphia City Hall. I am co-curator of this project which will involve Penn Architecture students, Pew Heritage, Penn Institute of Urban Research and Haverford College Urban Studies. The architectural component will consist of a Penn architecture students designed pavilion which will serve as a venue for presentations on urban matters related to Philadelphia. The project is set for mid-May to start July. I need a student to simply watch over this space as a kind of information guide during this period. Preference is for a student adept in terms of digital modeling and illustrating as following the project, the student would serve as my own art studio assistant. I am working on four large public art commissions.

### **Project 2: Public Art Project Assistant**

I am working on several large permanent public art projects. I need a student adept in digital media. The student would have access and should be familiar with the facilities offered in the photo and image floor of Addams Hall. Work would range from high definition scanning of images to 'flyover' image construction in service of visualizing the public sculpture or pavilion.

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Students should have understanding the language of contemporary art and the issues at play in terms of public space.

*Nancy Novack*

**Project 1: Cowgirls Are Forever** *Rising Juniors only*

The Cowgirls Are Forever PURM fellowship is for a motivated student majoring in Cinema Studies; Video Production; American History; Communications; Women’s Studies; or Education. Cowgirls Are Forever is an innovative multi-media project that encompasses an in-progress documentary film, a graphic novel, and an interactive website. We are also developing an educational outreach curriculum entitled Saddle Your Own Horse - a female empowerment program for high schools and leadership institutes. Using filmed interviews and historical research, Cowgirls Are Forever preserves a cultural legacy and inspires women and girls with the bold, authentic, independent spirit of the American cowgirl. The PURM intern will have a unique experience in the real-world of documentary film-making and how it can be combined with an educational outreach program. Our model is Spike Lee’s film “When The Levees Broke” and the accompanying Teacher’s College curriculum: Teaching The Levees. Professional skills obtained include: organizing, and loading filmed material into a Media Composer editing project; selecting key stories from interviews creating rough-cut assemblies; researching media archives; participating in creating short ‘webisodes;’ and helping to maintain a social media presence. If there is a film shoot during the internship, the intern will help plan pre-production and assist on set. Academic opportunities include: researching and identifying trailblazing cowgirls who can be featured in our stories; researching and identifying appropriate foundations, and assisting with grant applications; expanding content and assisting in curriculum development and implementation. PennDesign, Fine Arts Professor Nancy Novack leads our team, and we’re headquartered in Brooklyn, NY.

## **Education**

### **CONSORTIUM FOR POLICY RESEARCH IN EDUCATION**

*Jonathan Supovitz*

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

The Consortium for Policy Research in Education (CPRE) investigates pressing problems in education to inform policymakers and practitioners with evidence-based knowledge. CPRE has studied the design, implementation, and effects of state and local policies intended to improve elementary and secondary education through its research on policy, standards, school improvement programs, school reform, and school governance. Our work delves into the relationships between educational policy and organizations, school and classroom practice, and the impact these issues have on student learning. Presently CPRE is conducting NSF funded formative assessment research in Philadelphia schools as well as other research related to Common Core State Standards, student assessment, and social media's impact on education policy. Our summer project offers an undergraduate researcher the opportunity to contribute meaningfully to these important projects while building expertise in education policy. Working closely with CPRE researchers, the student will lead the development of an extensive literature review spanning several areas of research and education policy research in general. This project offers authorship opportunities on forthcoming papers and reports and hands-on experience with data analysis and software. There are no prerequisites for this position; however, it is a writing-intensive role and knowledge of Microsoft Office is a plus. The ideal candidate will have excellent writing skills, will enjoy research, and will be interested in education policy.

### **EDUCATION, CULTURE, AND SOCIETY**

*Ameena Ghaffar-Kucher*

#### **Project 1: Education for Refugees at the Crossroads of the World** ***Rising Juniors only***

In 2009, the US admitted refugees from 60 nationalities. A significant number of these refugees are resettled in New York City, many of whom are under the age of 25. These refugee youth present immense educational needs and face daunting educational barriers, including interrupted formal education, lack of academic English, past and on-going trauma, marginalization, discrimination, and lack of adult support. However, under the right conditions, education may help restore social and emotional well-being. While educators are key socializing figures in the lives of refugee students, without sufficient training and information they may misunderstand

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culturally-influenced patterns of engagement among refugee students and their families. This project asks: What are the specific educational needs of refugee students in New York City schools? How are schools meeting their needs? What school institutional factors best facilitate their academic achievement? To address these questions, my colleagues and I are conducting a qualitative study of recently arrived refugee and asylum-seeking children in a range of high-schools in New York City. We invite a dynamic student interested in issues pertaining to education, refugees, and human rights to join our team. Specific tasks will include data transcription, participation in team meetings (virtually and at least one team meeting in NYC), as well as some initial data coding and analysis. This experience will introduce the student researcher to the building blocks of qualitative research and will be an opportunity to be part of an important research project.

## **EDUCATIONAL LINGUISTICS**

*Betsy Rymes*

### **Project 1: Citizen Sociolinguistics: Using Social Media with High School Students to Develop Critical Awareness of Community and Literary Language**

My current research investigates how a high school English teacher and his students can use Internet repositories of sociolinguistic information to 1) build students' critical awareness of social variation in English and other languages; 2) enhance students' engagement with English literature; and 3) collaboratively compile a pilot version of a publically available sociolinguistic wiki, that is, a website that allows users to add, modify, or delete content (like Wikipedia). I have been collecting classroom data all year and will need assistance to travel to the high-school in the Spring, interview students and teachers, and to transcribe and analyze data. We will also be building a plan for the Fall when English teachers will implement the curriculum we develop and continue to build the wiki. By participating in this project the research assistant will learn how to conduct classroom research, conduct interviews, organize and analyze qualitative data using coding software (Dedoose), and how to think through research questions and analytic methods with a team.

## HIGHER EDUCATION

*Marybeth Gasman*

### **Project 1: Research Assistant - Minority Serving Institutions Research**

The student will work with our research teams at the Penn Center for Minority Serving Institutions (MSIs) and Professor Marybeth Gasman, in particular, to conduct qualitative and quantitative research related to MSIs. The student will learn how to do various kinds of research, gain in-depth knowledge on issues pertaining to low-income, students of color and MSIs. The student may be involved in producing a report and writing peer-reviewed articles as part of their summer work.

*Laura Perna*

### **Project 1: International Higher Education Access, Governance, and Finance**

The Alliance for Higher Education and Democracy (AHEAD, [www.ahead-penn.org](http://www.ahead-penn.org)) is dedicated to promoting the public purposes of higher education in fostering open, equitable, and democratic societies around the globe. Through its capacity building and international initiatives activities AHEAD faculty are engaged in a variety of projects focused on creating, building, and sustaining world-class institutions of higher education and research. AHEAD faculty are engaged in a variety of projects exploring issues of access, governance, and finance in other nations. Working closely with the faculty mentor, the selected student will work on one of AHEAD's current international higher education projects. The ideal candidate will have excellent writing and communication skills, enjoy research, and have an interest in issues pertaining to higher education access, governance, and finance in other nations. The selected students will gain experience working with primary and secondary resources to prepare presentations and reports.

### **Project 2: Gender, Economic Development, and Higher Education**

The Alliance for Higher Education and Democracy (AHEAD, [www.ahead-penn.org](http://www.ahead-penn.org)) is dedicated to promoting the public purposes of higher education in fostering open, equitable, and democratic societies around the globe. Through its capacity building and international initiatives activities AHEAD faculty are engaged in a variety of projects focused on creating, building, and sustaining world-class institutions of higher education and research. As countries with emerging and developing economies seek ways in which to compete in the global market place there is growing recognition of the critical role the education of women plays in achieving long-term economic growth and stability; its absence leads to lost potential. Working closely with the faculty mentor, the student will assist with an on-going project in Saudi Arabia (no travel required) and in research that explores whether female graduates have the opportunity and

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freedom to pursue careers in sectors that are critical to building a knowledge-based economy—careers that are not traditionally open to women. The ideal candidate will enjoy research and have an interest in issues pertaining to gender and higher education and/or economic growth and development. The student will gain experience working with primary and secondary resources pertaining to higher education and gender to prepare presentations and reports.

## **READING/WRITING/LITERACY**

*Gerald Campano*

### **Project 1: Participatory Multilingual ESOL Class**

The Community Literacies Project is facilitating a participatory, multilingual ESOL class (largely composed of Vietnamese, Mexican, and Guatemalan adult learners from the local community) at a social justice and education center in Philadelphia. The ESOL class and accompanying research project are structured around Participatory Action Research (PAR) approaches. The formal data collection and facilitation of the class will occur from approximately June 1- August 15, 2015. Our goal is to understand through this research what the resonances and differences are for immigrant families across experiences, nationalities, and generations, as well as what educational environments create conditions for solidarity, mobilization and activism. Primary duties during the student’s research period include 1) attending the ESOL class; 2) planning and facilitating, alongside doctoral students and the faculty advisor, the ESOL class each week; 3) working one-on-one during class time with Vietnamese- and Spanish-speaking learners who are beginning to learn English; 4) documenting class through ethnographic field notes; 5) conducting, alongside doctoral students and the faculty supervisor, semi-structured interviews with participants. Spanish or Vietnamese speaker preferred, or someone with ESOL instructional experience, but not necessary. The ideal candidate has an interest and passion for community activism, immigrant issues, and education.

*Amy Stornaiuolo*

### **Project 1: Literacy Practices in Urban High School Makerspaces**

In an effort to support 21st century learning in urban schools, some districts have begun to experiment with innovative models that align school curricula with principles of design thinking, critical “making,” and participatory learning. This research project is a study of one such high school in North Philadelphia that is integrating “makerspaces” into the structure of its school day to encourage students to design, build, and compose with (and across) various media and materials. The project, a four-year ethnographic study that will complete its first year this summer, focuses specifically on the relationship between students’ identities and their literacy

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practices in these “makerspaces” – especially as many of their creations address the “wicked problems” that students have identified in their school and community. Applicants should be able or willing to learn to conduct qualitative research through participant observations and interviews at the research site in North Philadelphia (early in summer); to take, code, and analyze data using qualitative research software; and to participate in research team meetings at the Penn Graduate School of Education. Applicants should be interested in urban education, willing to work as part of a larger research team, and effective communicators and collaborators willing to work closely with first year high school students and school stakeholders.

### **Project 2: Global Youth Media Collaborative: Write4Change**

The Global Youth Media Collaborative (GYMC) is a consortium working to develop a model of cross-cultural communication and global citizenship by linking youth around the world via educational social networking. GYMC’s central project is to create a global online writing community for young people (ages 13-21): Write4Change. This community will connect high school age students around the world as they write to make a difference in their local and global communities – in the long term, we will create a multilingual web-based platform that integrates collaborative composing tools, visualizations, and mechanisms for sharing and interacting with other users around the world. We are looking for someone to join our team in the design and pilot phase this summer. This summer we will establish three pilot sites in U.S. schools to serve as a foundation for a network of international sites. A research assistant would work at the Philadelphia school site gathering pilot data on the Write4Change curriculum in early summer, work with the team to analyze the Phase 1 data, help develop curriculum for Phase 2 of the project, participate in grant writing, and engage with the team in designing the social networking platform.

## **Engineering and Applied Sciences**

### **BIOENGINEERING**

*Jason Burdick*

#### **Project 1: Injectable Hydrogels for Biomedical Applications**

This general project area is in the development of hydrogels (water-swollen polymers) that are injectable via a syringe. To accomplish this, we have begun designing a class of self-assembling and shear-thinning polymers that meet specific criteria for injection. The project will be to further understand the properties of the material system related to features including mechanical properties and disassociation, as well as towards applications in therapeutic molecule delivery and even 3D printing.

*Brian Chow*

#### **Project 1: Synthetic Biology and Optogenetics**

The goal of this project is to develop novel methods for rationally programming cells in order to systematically reverse- and forward-engineer their behavior. Student will focus on decoding how transient sensory stimuli are transduced into persistent changes through transcriptional signaling and gene regulation, by combining experimental methods in optogenetics and synthetic biology with mathematical modeling. Students from any department and year are welcome. Proficiency in molecular cloning is required.

*Jennifer Phillips-Cremins*

#### **Project 1: Elucidating the transcriptome in an Alzheimer's Disease model**

The goal of this project is to explore the genome-wide transcriptome in a mouse neural stem cell model of Alzheimer's Disease. Student will create RNAseq libraries in wild type neural stem cells and neural stem cells genetically engineered to display a neuronal phenotype characteristic of Alzheimer's disease.

#### **Project 2: Unraveling 3-D genome folding in an Alzheimer's Disease model**

The goal of this project is to map 3-D genome folding in a mouse neural stem cell model of Alzheimer's Disease. Student will create RNAseq libraries in wild type neural stem cells and

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neural stem cells genetically engineered to display a neuronal phenotype characteristic of Alzheimer's disease.

### **Project 3: Mapping 3-D genome folding after CRISPR/Cas9 perturbation of embryonic stem cells**

The goal of this project is to map 3-D genome folding in mouse ES cells before and after transient overexpression of a plasmid encoding dCas9. Student will need to use site-directed mutagenesis to mutate Cas9 into dCas9. Once vector is validated, student will transfect ES cells and characterize their phenotype during a time course of overexpression. Pellets will be fixed for a comparison of 3-D genome folding in wild type and dCas9 overexpression ES cells by a senior member of the Cremins lab.

*Beth Winkelstein*

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

Apply engineering principals to understand and define how tissues and cells deform in response to mechanical stimulus, in the context of painful injury. May require working with in vitro and in vivo systems, imaging data and engineering principals - experience not needed but willingness to learn is a must.

### **Project 2: Neuroscience Approaches to Pain**

Projects include analysis of neuronal responses in a variety of injury and pain conditions - both CNS neurons and peripheral neurons. Student will need to assist with experiments and perform analyses of neural activity - which we will teach them. Opportunity for signal analysis techniques and neural network studies.

## **CHEMICAL AND BIOMOLECULAR ENGINEERING**

*Matthew Lazzara*

### **Project 1: Imaging Protein-Protein Interactions in Live Cells**

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

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

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

### **Project 3: Improving Response of Brain Cancer Cells to Targeted Therapy**

Glioblastoma multiforme (GBM) is the most common form of adult brain cancer, with an average survival time of about 12 months due to poor patient response to chemotherapy and radiation. While the epidermal growth factor receptor (EGFR) is commonly over-expressed in GBM and is known to play a role in GBM progression, molecular therapeutics targeting EGFR have thus far failed to produce patient benefit in clinical trials. Our lab has identified a new signaling pathway that controls GBM cell response to EGFR inhibitors. The aim of this project is to leverage this new understanding into improved therapeutic approaches for GBM. The project will involve mammalian cell culture work, molecular biology (cloning), immunoblotting, and flow cytometry. The student will work closely with a graduate student to learn the required techniques.

*Wen Shieh*

### **Project 1: Cyanobacteria-Enabled Conversion of Waste Nitrogenous Matter to Protein**

Unregulated releases of waste nitrogenous matter (primarily as  $\text{NH}_4^+$ - and/or  $\text{NO}_3^-$ -nitrogen) into the aquatic environment have caused many water quality problems, e.g., eutrophication of surface water bodies, toxicity to aquatic organisms, public health risks linked to nitrate in drinking water, and increased treatment expenditures required for nitrogen removal. The removal of nitrogenous matter from water and wastewater is required in regions where clean water resources are scarce and thereby, reclamation and reuse of treated wastewater are inevitable in order to meet increasing water demands. Biological nitrogen removal (BNR) technologies are perhaps the most used means to remove waste nitrogenous matter from water and wastewater. The conventional BNR process uses a community of physiologically diverse bacterial species to carry out the bacterially-mediated reactions. First, chemoautotrophs (e.g., *Nitrosomonas* and *Nitrobacter*) oxidize  $\text{NH}_4^+-\text{N}$  to  $\text{NO}_2^--\text{N}$  to  $\text{NO}_3^--\text{N}$  in a series of reactions that are referred to as nitrification. Bicarbonate is used as the carbon source for cells synthesis with oxygen used as the terminal electron acceptor. Intensive oxygenation is required to meet chemoautotrophic oxygen demands. Then, heterotrophs such as *Pseudomonas* sp. reduce  $\text{NO}_3^--\text{N}$  to  $\text{N}_2$  under the anoxic conditions using an external organic carbon source for cell synthesis and  $\text{NO}_3^-$  as the terminal electron acceptor (denitrification). The nitrification/ denitrification scheme is effective, provided that a delicate balance is maintained between chemoautotrophs and heterotrophs. Two

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separate bioreactors are often used in tandem to meet this requirement. Moreover, expensive chemicals such as bicarbonate and methanol are needed to achieve desired reaction rates and extents. Therefore, the denitrification/denitrification process, despite its popularity, is expensive and sometimes problematic. On the other hand, photosynthetic microorganisms such as cyanobacteria (commonly known as the blue-green algae) are capable of incorporating nitrogen species into cellular skeletons through a combined high-affinity transport/diffusion mechanism, with cellular protein produced in the presence of CO<sub>2</sub> and light. Moreover, it was reported elsewhere that certain cyanobacterial strains are capable of synthesizing cellular protein without photosynthesis, provided that organic matter in wastewater is abundant. Therefore, it appears that cyanobacteria may be a better agent to convert waste nitrogenous matter in water and wastewater into valuable by-products with minimum needs for chemicals and energy and thereby, leading to better resource recovery and recycling. To our best knowledge, limited information on optimizing the cyanobacteria-enabled system for the intended applications is available. This project aims at assessing the potential of using cyanobacteria as the primary agent to enable efficient conversion of waste nitrogenous matter to protein. Two feed streams will be used to cultivate cyanobacteria: a synthetic, inorganic feed stream with NH<sub>4</sub><sup>+</sup> and/or NO<sub>3</sub><sup>-</sup>-nitrogen as the sole nitrogen sources. As a result, both CO<sub>2</sub> and light will be required to initiate and sustain the conversion. A second feed stream, the supernatant collected from a lagoon that stores the manure collected from a dairy farm, will be used to ascertain that certain cyanobacterial strains are capable of performing nitrogen conversion without photosynthesis when organic matter in wastewater is abundant. As a result, the tests will be conducted with or without CO<sub>2</sub> and light. The upflow photo-bioreactor system developed in Professor Shieh's laboratory will be used to conduct the experimental work. Two laboratory-scale photo-bioreactor systems will be operated in parallel, with each receiving a specific feed stream. The photo-bioreactor systems will be placed inside an enclosure where the light input and intensity can be controlled. CO<sub>2</sub> will be supplied to cyanobacteria by bubbling ambient air directly into the liquid phase. The dairy farm supernatant will be diluted if necessary to achieve the desired feed concentration. Steady-state data will be collected and analyzed to assess the effectiveness of cyanobacteria-enabled conversion of waste nitrogenous matter to protein. The analyses to be performed will include nitrogen species, organic matter (as COD, chemical oxygen demand), cell biomass (as VSS, volatile suspended solids), and total cellular protein. The instruments in both Algaculture and Biotechnology Laboratories of the Department of Chemical and Biomolecular Engineering (CBE) will be used to perform the analytical work. A junior or Rising Sophomores will be appointed to carry out the experimental work and prepare the research report. The experiments will be performed in the Algaculture Laboratory, Department of Chemical and Biomolecular Engineering. It is anticipated that a paper that is suitable for publication in a refer journal will be produced.

## **Project 2: Biomatrix with Filamentous Backbones**

Biologically-mediated reactions are highly effective in converting numerous anthropogenic organic compounds found in liquid waste streams into innocuous end-products. Two morphologically different bacterial groups are commonly grown in the same bioreactor to carry out the desired bio-reactions: floc-forming bacteria and filamentous bacteria. Floc-forming bacteria are clustered and embedded in dense aggregates (i.e., bio-flocs) and thereby, they can easily be separated from the liquid waste stream by gravity upon the completion of biodegradation. On the other hand, filamentous bacteria are bulky and their loosely-structured architectures produce poor settling properties. Kinetically speaking, floc-forming bacteria perform best when O<sub>2</sub> and nutrients (mainly N and P) are abundant, because their near-spherical shapes produce relatively small surface-to-volume ratios. As a result, in situ bubble oxygenation/mixing and nutrient addition are required to attain the desired aggregate mass in the bioreactor. Conversely, filamentous bacteria are highly competitive in the oxygen and nutrient deficient environments, because the filamentous morphology yields a large surface-to-volume ratio that facilitates the mass transfer at the liquid-cell interface. Most bioreactor systems currently employed for liquid waste treatment are designed to grow large quantities of floc-forming bacteria, however, the proliferation of filamentous bacteria is inevitable because of their competitive advantages. In addition to high operating expenditures, these systems are highly susceptible to poor biomass-liquid separations that often lead to excessive biomass losses and deteriorated treatment performance. This project will attempt to grow a biomass structure that is morphologically different from the aggregates that are populated with floc-forming bacteria. In essence, a loosely-structured biomatrix dominated by filamentous bacteria will be grown in the bioreactor to carry out the desired bio-reactions. It is hypothesized that the biomatrix grown will be capable of capturing and retaining the cells with diversified physiological characteristics in close proximity to initiate and sustain the desired bio-reactions. As a result, the biomatrix is able to offer the integrated functions of biodegradation, biomass retention, and biomass-liquid separation directly in the bioreactor. The bioreactor will be operated under the upflow and gas effervescence-free conditions to maintain the structural integrity of the biomatrix. External oxygenation, which can closely be controlled, will replace the in situ bubble oxygenation to satisfy the biochemical oxygen demands. A bioreactor system with these novel features could represent a much-needed breakthrough in the environmental biotechnology. Additional applications can also be identified which will benefit from this unconventional biotechnology. A laboratory investigation will be performed to produce the experimental evidence that ascertains the validity of the hypothesis. Ethylene glycol (CH<sub>2</sub>OHCH<sub>2</sub>OH) and ammonium chloride (NH<sub>4</sub>Cl) will be used as the carbon and nitrogen sources, respectively, to grow the biomatrix. Ethylene glycol is chosen because it is commonly used as the deicing and antifreeze agents. It is toxic to wildlife and aquatic organisms. A C/N ratio > 50 will be used to prepare the feed stream to encourage the growth of filamentous bacteria. A glass bioreactor will be modified to accommodate for the flow scheme required to grow and maintain the biomatrix. The degree of oxygenation will be chosen as the sole experimental variable. The hydrodynamic conditions in

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the bioreactor which will affect the stability of the biomatrix are quantified through the definition of RMS (root-mean-square) shear gradient  $G$ . The biodegradation effectiveness of the biomatrix will be measured in terms of C and N removals. The stability of the biomatrix will be assessed in terms of biomatrix specific volume ( ) and biomass washout rate ( ). A junior or Rising Sophomores will be appointed to carry out the experimental work and prepare the research report. The experiments will be performed in the Bio-Environmental Engineering Laboratory, Department of Chemical and Biomolecular Engineering. It is anticipated that a paper that is suitable for publication in a refer journal will be produced.

## COMPUTER AND INFORMATION SCIENCE

*Norman Badler*

### **Project 1: Sound synthesis and recognition system**

We have an existing sound propagation and perception system (“SPREAD”), but there is no simple interface to generate sounds other than by selecting them from a list (e.g., environmental sounds or speech phonemes). The English language has many words to describe sounds. (We have a list.). Can these words be used to parameterize and/or index into sound generation procedures? Inversely, can sound features be used to index into attributes reflected in the dictionary of words? Then our virtual agents can hear sound attributes and describe the features (and thus maybe identify the sound) without having to match the sound form exactly. Students will need to be able to learn to use existing computer programs and write and integrate new code. Interest in Natural Language Processing, Artificial Intelligence,, Audio processing, and/or Computer Graphics is most appropriate.

### **Project 2: Mine Simulation**

Some years ago we began a project on simulating work and evacuation in underground mines. This initial effort should be completely rebuilt in the Unity game engine using ADAPT. There are several interesting parts to this, including crew and work scheduling, virtual humans interacting with machinery, physiological modeling depending on airflow and disaster (fire) by-products, and evacuation planning. See P. Huang, J. Kang, J.Kider Jr., B. Sunshine-Hill, J. McCaffrey, D. Velázquez Rios and N. Badler. “Real-time evacuation simulation in mine interior model of smoke and action.” Computer Animation and Social Agents (CASA) 2010. Students will need to use ADAPT and Unity software systems and write new C# software modules. Interests in human logistics, work allocation, disaster management, planning, and simulation would be handy.

*Joseph Devietti*

**Project 1: Making Multithreaded Programming Faster and Safer**

Multithreaded programming is much more challenging than writing programs with a single thread of execution, as parallelism and nondeterminism make such programs hard to understand and test. We are pursuing several research projects to make multithreading simpler and safer to use, including schemes to automatically catch programming errors and to automatically identify and fix performance bugs in multithreaded code. These projects span the hardware/software boundary, making use of hardware performance counters, hardware simulators, compilers and runtime systems like the Java Virtual Machine. We're looking for smart, motivated undergraduates to contribute to these projects. Knowledge of a scripting language (Python, Ruby, etc.) is very desirable. Some experience with parallel code is helpful, as is having done well in CIS 240.

*Ani Nenkova*

**Project 1: Teaching computers to read the medical literature**

The medical literature is so vast that medical practitioners and advisory bodies are often unsure about what is the best treatment for a certain medical condition. When possible, they commission systematic reviews, in which experts read all relevant papers and summarize the available trustworthy medical knowledge on a topic. The goal of this project is to start teaching computers to read the medical literature and to identify important medical information, by leveraging the extensive resources of already completed systematic reviews. Specifically we will develop methods to identify the four key pieces of information: population (what subjects were involved in the study, i.e. children, overweight men, diabetic women), intervention (how was the medical problem addressed), comparison (intervention with the effect of which the current intervention is compared) and outcome (what is the main conclusion about this intervention). The project will involve a range of research activities, requiring different levels of technical ability. We will annotate systematic reviews and medical papers for spans of text where key information is conveyed; will create an ontology to describe the relationships between semantic categories involved in the expression of the key information; will extract textual features to represent text and will develop classifiers for the detection of key elements in the text of medical papers. Introductory programming and data structures courses such as cis120 and cis 121 will provide sufficient background for students so that they can successfully engage in the technical challenges to be addressed in the project.

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### **Project 2: Predicting reader reaction to news**

Our ability to search news is rather limited. If we know what we are looking for, we can enter keywords. Else, we are likely to see articles news outlets have placed prominently or that people share most. In this project we will make use of a large collection of New York Times articles, paired with aggregated reader reactions along several dimensions---interest, practical utility, surprise, awe, anger, anxiety and sadness---to learn to predict reader reaction. Such capabilities will improve search and content recommendation, allowing users to search for content that will have practical utility, that will make them happy, etc. The project will require prior experience with programming and data structure equivalent to cis120 and cis 121. Familiarity with supervised machine learning or natural language processing is a plus but is not necessary.

### **Project 3: Wikipedia as educational resource**

Many students turn to reading Wikipedia when they encounter new concepts and material in their classes. But what are the properties of Wikipedia as an educational resource? Is the information there accurate and complete? Is it focused enough or can students, without realizing, drift to material unrelated material? Can Wikipedia be used to generate test questions and exercise to test student knowledge and augment learning experience? We will examine these questions in the context of introductory class on natural language processing, contrasting the information in Wikipedia with standard textbooks and lecture note material. The project will involve natural language processing work to map Wikipedia entries and textbook material, annotation of general knowledge in the domain and specific implementation details, as well as generation of test questions for introductory NLP courses.

## **ELECTRICAL AND SYSTEMS ENGINEERING**

*Cherie Kagan*

### **Project 1: Engineering Quantum Dots for Efficient Solar Photovoltaic Devices**

Colloidal, semiconducting quantum dots (QDs) are emerging materials for more efficient and cheaper photovoltaics. Their size-dependent materials properties promise unique physical phenomena to increase device performance and their solution processability is compatible with low-cost, large-scale production. The performance of current QD- based solar cells is primarily limited by the optoelectronic properties of this material, namely carrier mobility and lifetime. To further improve these two parameters, the chemistry of the high area surface of QDs needs to be engineered. Modification of the QD surface can increase carrier mobility by replacing bulky native ligands, extend carrier lifetime by passivating trap sites and even change doping levels through the introduction of additional atoms. In this project, the student will work with PhD students and post- doctoral researchers building on our previous knowledge of QD physics,

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chemistry and device fabrication to explore new routes to modify the surface of QDs and to study the physics needed to enhance the performance of QD- based solar cells. Skills and techniques that will be learned include: spectroscopic measurement (e.g. UV-Vis, fluorometry, and Fourier transform infrared spectroscopy), solar cell fabrication and measurement (spin coating, thermal evaporation) and electrical characterization (e.g. current- voltage measurement). Motivated undergraduate students in materials science, chemistry, chemical engineering or physics are preferred.

*Jan Van der Spiegel*

### **Project 1: Sensor Network Design for Free-Moving Non-Human Primate Behavior Training**

Background description: In-vivo test plays an important role in the brain-machine-interface experiment. An efficient, animal-friendly training device will help researches to guide non-human primates to quickly establish a conditioned reflex. This project seeks to improve the performance of an already existed training prototype device. Necessary Students' duties and responsibilities: 1) Improve the graphic user interface; 2) implementation of monitoring system; 3) microcontroller based signal processing . Some coding experience required.

### **Project 2: Left or Right – Identification of Free-Moving Non-Human Primate Body Segments**

Background description: In-vivo test plays an important role in the brain-machine-interface experiment. A real-time monitoring of the body movement of a target animal during the test is used to generate a corresponding control and/or stimulate. This project seeks to build a wireless identification system, which can be integrated into already existed customized device, to improve the control of an in-vivo animal test. Necessary Students' duties and responsibilities: 1) debugging of commercial available wireless identification product; 2) customized redesign based on commercial product. Basic understanding of circuit design and good circuit debugging skill is required. Experience in hardware coding is helpful.

### **Project 3: Magic in geometry – design of reconfigurable flexible antennas**

Background description: Reconfigurable antenna enables capacity to change an individual radiator's fundamental operating characteristics through electrical, mechanical or other means. This project aims to explore the potential application on various pluripotent structures. Necessary Students' duties and responsibilities: 1) 2D/3D geometry modeling of different structures; 2) training on flexible PCB fabrication; 3) Sample fabrication and bench testing. Experience in 2D/3D modelling is helpful. Student with good physics interest is encouraged to take this project.

## MECHANICAL ENGINEERING AND APPLIED MECHANICS

*Robert Carpick*

### **Project 1: Measurement and control of custom instruments for measuring friction and wear**

Mechanical systems invariably rely on contacting surfaces subject to friction and wear for effective transmission of force and motion. The efficiency and reliability of such systems are greatly influenced by the mechanical behavior of materials at these interfaces, which are inherently multi-scale and often strongly influenced by surface chemistry. Atomic force microscopes (AFMs) have greatly advanced our understanding of nanoscale processes by allowing for the fundamental investigation of frictional contacts. However, phenomena such as large-scale plastic deformation, fracture, and tribochemistry, which are often inaccessible for an AFM, can strongly impact macroscale friction and wear. This project is an effort to broaden our understanding of interface chemistry and stress-driven wear processes at the macroscale, using novel, custom-built instruments for multiscale and in-situ friction and wear studies. An instrument for measuring friction and wear across length-scales, developed as a macro-analog to the AFM, uses optical force transduction and a modular cantilever assembly which allows force measurement across many orders of magnitude (from  $1\mu\text{N}$  to  $10\text{N}$ ), even in extreme environments. Additionally, a second instrument developed for remote operation under ultra-high vacuum enables friction and wear studies within an in-house Surface Science Apparatus, followed by surface chemical analysis without disrupting the environment. The incoming student will work on instrumentation and software to control of both tribometers. This includes interfacing the tribometers with data acquisition hardware and developing the LabView software for measurement and control. This will provide an excellent opportunity to learn LabView programming and hardware control, skills which are universally applicable. The student will be closely mentored by a graduate student and a post-doctoral researcher in the lab. No prior LabView experience is required.

*Celia Reina*

### **Project 1: Far-from equilibrium entropy calculations**

The Hamiltonian dynamics that govern classical atomic motion is entirely reversible, i.e., if time is reversed, particles exactly follow the reverse path. However, at the continuum scale, most processes are fully irreversible, such as the boiling of water, a plate braking on the floor or the expansion of the universe. This irreversibility and direction of time at the macroscopic scale is characterized by the notion of the entropy, and although it appears paradoxical, it is not at all incompatible with the microscopic time symmetry. The PURM student will be in charge of

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developing a small molecular dynamics code in MATLAB, exploring different techniques to compute the entropy of the system and understanding its relationship to the irreversibility of the process.

## **Law**

### **AFRICANA STUDIES/SOCIOLOGY**

*Dorothy Roberts*

#### **Project 1: Interracial Marriage and Racial Equality in Chicago, 1937-1967**

I am conducting an interdisciplinary book project on interracial marriages in Chicago from 1937 to 1967. I inherited from my father, an anthropologist at Roosevelt University, numerous boxes containing original interviews he conducted in Chicago during this period with hundreds of interracial couples, as well as notes, articles, and other related materials. I am using this archive to write a book exploring the role interracial marriage played in the changing racial politics in Chicago from the perspectives of the couples. How did interracial couples experience and understand their marriages in relation to the intensifying challenge to the racial order? Students will help me to organize and analyze the archive on interracial marriages and conduct additional research related to this topic. Students will learn how to conduct and analyze original research, including ethnographic, legal, and archival data. This position would be especially helpful to students interested in careers in law, sociology, anthropology, Africana Studies, political science, and history. It requires excellent organizational and research skills, creative thinking, and care with original documents.

### **CENTER FOR ETHICS AND THE RULE OF LAW**

*Claire Finkelstein*

#### **Project 1: Post-traumatic Stress Disorder (PTSD) Conference**

The Center for Ethics and the Rule of Law (CERL) is an academic center that unites preeminent scholars and practitioners from around the world to engage in multi-disciplinary conversations on the legal, ethical, and political issues of war and national security. CERL anticipates hosting a two-day conference on Post-traumatic Stress Disorder (PTSD) in Fall 2015. The conference will address the ethical, legal, and moral issues associated with PTSD. CERL will bring together scholars, high ranking military personnel, physicians, philosophers, among others to expand the discourse surrounding PTSD. Key individuals involved in the project include Professor Claire Finkelstein, Founder and Director of CERL; Dr. Stephen Xenakis, retired brigadier general and Army medical corps officer with 28 years of active service; and Edna B. Foa, Ph.D., Professor of Clinical Psychology in Psychiatry at the University of Pennsylvania. Through the conference, developed as an open and pluralistic environment for intellectual exchange, CERL will research

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and share knowledge on understanding PTSD and the magnitude of health and social problems facing hundreds of thousands of service men and women and their families. Students will be engaged in all aspects of planning, research, and organization of the conference. They will have the opportunity to engage with member of CERL's impressive global network of scholars and practitioners and will attend weekly meetings with prominent guest speakers from the academia, military, government, or the private sector. These meetings will be dedicated to discussing the recent developments in national security law and policy. Students will work as a team under the supervision of CERL's leadership, and will participate in CERL's activities to the greatest extent possible to augment their research skills and learn from a real-world perspective. The program also offers the unique opportunity to make critical professional contacts, which may serve to open doors to future opportunities.

**Project 2: The Origins of Conflict and Approaches to Conflict Resolution Conference**

The Center for Ethics and the Rule of Law (CERL) is an academic center that unites preeminent scholars and practitioners from around the world to engage in multi-disciplinary conversations on the legal, ethical, and political issues of war and national security. CERL anticipates hosting a two-day conference on The Origins of Conflict and Approaches to Conflict Resolution in Spring 2016. This conference will involve an interdisciplinary analysis and discussion of the origins of armed conflict as well as an exploration of possible approaches to preventing and diffusing armed conflicts before they occur. In particular this conference will examine the role of ethnicity, religion, family structure and ideology to understand the evolution of terrorism and radicalism, as well as in both classical and alternative approaches to reducing the incentives to turn to violence. Participants for this conference will include leaders in the U.S. intelligence, homeland security, and foreign relations communities, as well as nongovernmental organizations and academic institutions. Students will be engaged in all aspects of planning, research, and organization of the conference. They will have the opportunity to engage with member of CERL's impressive global network of scholars and practitioners and will attend weekly meetings with prominent guest speakers from the academia, military, government, or the private sector. These meetings will be dedicated to discussing the recent developments in national security law and policy. Students will work as a team under the supervision of CERL's leadership, and will participate in CERL's activities to the greatest extent possible to augment their research skills and learn from a real-world perspective. The program also offers the unique opportunity to make critical professional contacts, which may serve to open doors to future job opportunities.

**Project 3: Preparation of CERL's forthcoming academic publications**

CERL's will produce two academic publications: "Sovereignty and the New Executive Authority" and "The Weighing of Lives in War; Combatants and Civilians in the Jus in Bello" with Oxford University Press. "Sovereignty and the New Executive Authority" will address the expanding powers of executive authority and its implications for democracy in a time of increased national security concerns and terroristic activity. "The Weighing of Lives in War:

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Combatants and Civilians in the Jus in Bello” will explore the ethical and legal challenges that face our commanders, policy makers, and combatants in times of war. The weight assigned to combatants’ lives has implications beyond the battlefield. For example, the more risk on the battlefield soldiers are expected to bear, arguably the greater the national obligation to compensate and care for wounded warriors. Students will be involved in researching, writing and editing and will be exposed to all aspects of the academic publishing process. They will also communicate with the authors of the papers collected in the volumes. Students will have the opportunity to engage with member of CERL’s impressive global network of scholars and practitioners and will attend weekly meetings with prominent guest speakers from the academia, military, government, or the private sector. These meetings will be dedicated to discussing the recent developments in national security law and policy. Students will work as a team under the supervision of CERL’s leadership, and will participate in CERL’s activities to the greatest extent possible to augment their research skills and learn from a real-world perspective. The program also offers the unique opportunity to make critical professional contacts, which may serve to open doors to future job opportunities.

## LAW

*Paul Robinson*

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

Empirical research shows that laypersons have very sophisticated intuitions of justice. This project builds upon that innate expertise to bring laypersons into the debates about criminal law rules and their underlying principles. By using a series of carefully selected real-world provocative cases, a popular audience is introduced to the challenges facing criminal law drafters and drawn into the existing debates. This is a particularly important project because American criminal law, unlike any other body of law, is almost exclusively codified. That means that it is crafted by the popular democratic processes within legislatures, rather than by judicial decisionmaking in courts. Thus, the only effective path to the long-term improvement of criminal law is through the education of voters. The current project agenda calls for finding and developing cases for two planned books: (1) *The Crimes of Heroes*, which investigates those situations in which current criminal law rules and community intuitions of justice may conflict; (2) *Crimes that Shaped Our World*, which investigates how popular reaction to certain crimes have brought legal and social reforms, both good and bad. The undergraduate student's work will involve searching a variety of newspaper, magazine, legal, and other databases and writing up case narratives, guided by regular discussions with Professor Robinson. Particularly useful would be a creative and thoughtful mind and excellent writing skills.

## **Medicine**

### **ANESTHESIOLOGY**

*Seema Bhatnagar*

#### **Project 1: Sex differences in hypothalamic peptides regulating stress and arousal**

Stress can lead to the development of mental disorders such as post-traumatic stress disorder (PTSD), anxiety, and depression. The incidence of these disorders is much higher in women. Currently, we do not understand the gender-related neurobiology of these disorders, which hinders progress in effective treatments for these stress-related illnesses. This project seeks to address this problem by examining the neurobiology of sex differences in repeated stress in a rodent model. The hypothalamic neuropeptides orexins are known to regulate stress responses and attentional/arousal processes. We observed that females have more orexin mRNA, activation of orexin neurons, and release of orexins in the cerebrospinal fluid. In the proposed project, we will test the hypothesis that differences in orexin expression and function between males and females are due to gonadal hormones. Female rats will be gonadectomized and/or replaced with estradiol and progesterone.. Students will collect primary data while working with animals, assist in surgical and stress procedures, conduct behavioral testing and analysis, section brains and perform immunocytochemical staining for orexin neuron activation, collate all data, conduct statistical analyses and present results in lab meetings. Students will be mentored by a post-doctoral fellow on a day-to-day basis and will be meet with the PI once a week to discuss progress on the project as well as any other issues relevant to the student (career choices, coursework etc.). The lab offers a dynamic and diverse environment and places a high value on a positive and valuable research experience for undergraduate students.

#### **Project 2: Mechanisms underlying vulnerability to stress**

Current data in our lab suggests that hippocampal vascular endothelial growth factor (VEGF) is involved in vulnerability to chronic stress. We have shown that VEGF is increased in the hippocampus of rats vulnerable to the effects of chronic stress, and that administration of VEGF to the brain creates a stress-vulnerable behavioral and neural phenotype. However, it is unclear whether brain VEGF is necessary for the stress-vulnerable phenotype. VEGF can act through several different receptors, many of which could promote stress vulnerability. To avoid these issues we plan on conducting experiments that inhibit brain VEGF using brain administration of a VEGF monoclonal antibody. The student will assist in administration of antibody, administer the stress and behavioral procedures to determine vulnerability, collect tissue, section brains to assess neural endpoints, collate all data, conduct statistical analyses and present results in lab meetings. Students will be mentored by a post-doctoral fellow on a day-to-day basis and will be

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meet with the PI once a week to discuss progress on the project as well as any other issues relevant to the student (career choices, coursework etc.). The lab offers a dynamic and diverse environment and places a high value on a positive and valuable research experience for undergraduate students.

*Maurizio Cereda*

**Project 1: Spatial propagation of lung injury: new imaging markers of inflammatory progression in acute respiratory failure**

Acute respiratory distress syndrome (ARDS) results from the propagation of an inflammatory insult in the lung; it causes respiratory failure in almost 200,000 patients annually, and 60% of these will be dead within two years. Our goal is to design strategies to limit early propagation of ARDS and to reduce its impact in patients. Our laboratory has perfected an animal model of early ARDS in which we measure injury propagation using multimodal high-resolution imaging. Our armamentarium includes micro-computerized tomography and hyperpolarized magnetic resonance imaging; we are studying the functional and metabolic consequences of illness and therapy. Our recent findings indicate that imaging allows prediction of ARDS progression, allowing early therapeutic intervention to limit the propagation of injury. Students will assist in data collection, with particular involvement in 3D image reconstruction, segmentation, and analysis techniques. The involvement will depend on the student's experience, availability, and most importantly interests. For those interested, students can learn animal preparation and surgery techniques, run the biological experiments associated with the project, and perform tissue analysis to measure regional inflammation in the lung. There are no particular prerequisites for students.

*Roderic Eckenhoff*

**Project 1: General anesthetics and Parkinson's disease**

Clinical evidence suggests that general anesthesia can worsen Parkinson's Disease symptoms, and potentially accelerate the disease. A strong preclinical rationale exists as well. DJ-1 knockout rats are now available, and the phenotype closely mimics Parkinson's disease. We will expose these rats to different anesthetic paradigms, and study their motor behavior and brain histochemistry afterward to address the hypothesis that certain anesthetics can accelerate this important and common disease.

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**Project 2: Propofol exposure in neonatal mice alters myelination via SIRT-2 inhibition**

**Rising Juniors only**

We recently showed that the general anesthetic propofol inhibits the deacetylase, SIRT-2, and this enzyme is found in high abundance in myelin. Propofol exposure in neonatal animals cause delayed learning and memory problems. We hypothesize that SIRT-2 activity is important for myelination, and that its inhibition by propofol will alter myelination and therefore, brain network development in a durable manner. We will expose neonatal rats to propofol, and then study their brain with western blot or ELISA analysis for biochemical measures of myelination.

***Huafeng Wei***

**Project 1: Mechanisms of neuropathology via disruption of intracellular calcium homeostasis in Alzheimer's disease**

Our previous studies have demonstrated that disruption of intracellular calcium homeostasis play important roles on progress of neuropathology in Alzheimer's disease, especially in pathological amyloid aggregation and memory loss. This project will continue to investigate if dantrolene, a drug to treat malignant hyperthermia in anesthesia practice, will be good candidate to stop the progress of neuropathology and memory loss in different cellular and animal models of Alzheimer's disease. This will help us to develop new class of medicine that treat Alzheimer's disease effectively.

**Project 2: Mechanisms of general anesthetics mediated neurodegeneration via their effects on autophagy**

Our previous studies suggested that disruption of intracellular calcium homeostasis play important roles on general anesthetics mediated neuronal apoptosis in various tissue cultures and in the developing brains of rodents. We will continue to study if general anesthetics control cell survival fate by their effects on autophagy process via differential activation of InsP3 or ryanodine calcium channel located on the membrane of endoplasmic reticulum. This will help us to understand mechanism of anesthetics mediated neurotoxicity and to improve perioperative patient safety.

## BIOCHEMISTRY AND MOLECULAR BIOPHYSICS

*Benjamin Garcia*

### **Project 1: Understanding the role of combinatorial histone PTMs during stem cell differentiation**

Post-translational modifications (PTMs) to histone proteins constitute a major type of epigenetic mechanism that regulates chromatin structure and gene expression patterns in eukaryotes. In addition to their important roles in standard physiology, disruptions in histone PTM signaling patterns have been suggested to be significant, potentially causative factors in various human diseases such as cancer. As most histone PTM work in the chromatin biology field is accomplished using site-specific antibodies, the quantitative measurement of combinatorial histone PTMs co-occurring on the same molecule has been unmet. Our objectives include the continued development of quantitative mass spectrometry-based proteomics and bioinformatic methods for quantitatively interrogating combinatorial histone PTM patterns, and applying these approaches to investigate histone mediated epigenetics mechanisms behind key areas of health related biological research. This project will apply our approaches to investigate epigenetic histone PTM signaling during human embryonic stem cell differentiation. The goal is to identify changing histone PTMs during stem cell differentiation, characterizing combinatorial histone PTM binding protein complexes that translate these PTM patterns, and determining the role of these combinatorial PTMs in maintaining the pluripotent state or facilitating to a specific lineage.

*Jeremy Wilusz*

### **Project 1: Investigating the functions of circular noncoding 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 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

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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.

## **BIOENGINEERING**

*Michelle Johnson*

### **Project 1: Muscle control of a simple robot after stroke** *Rising Juniors only*

After a stroke, a person often have residual motor disabilities in the affected arm and leg that affect their ability to complete daily tasks. They often have a condition called spasticity that can cause muscles to hyper-activate. For example, during an exercise, the triceps may be over active and impede elbow flexion and extension. We have developed a simple robotic device (crank arm: Haptic Theradrive) to enable stroke survivors with arm/hand impairment to exercise using commercial and custom games to improve their arm/hand motor control. The robot adapts to the user's strength and existing ability to turn the crank to provide assisting forces as needed to enable exercises. The goal of the project is to use real time muscle activity measurement to help a patient learn better control over their upper limb and to help guide the robot on when to assist or not assist the user. The student will learn to use simple sensors developed to measure muscle activity and integrate them into the robot system. At minimum, the goal is to measure muscle activity of the biceps and triceps in real time and to use Matlab (new and existing programs) to read the sensors, process the signals and use them. Familiarity with Matlab, Simulink and Python is helpful. A desire to do interdisciplinary research is a plus. Engineering is preferred. Exposure to mechatronics and robotics a plus.

### **Project 2: Technology-assisted screening for motor delays in Infants** *Rising Juniors only*

Infants born pre-term are at risk for developing neurological and motor delays which will later affect their arm and leg motor control and their ability to function normally at play or school. We have been developing a SmartToy Gym for early screening of infants (age: 3 months to 9 months). The Gym is being develop to sense intentional and unintentional kicking, reaching, grasping type movements of atypically developing and typically developing infants when a toy is present and when it is not. The student will join the development team to refine measurement tools and algorithms. The student will help recruit and collect usability data on at least 5 typically developing infants and 5 atypically developing infants. Familiarity with Matlab, biomedical sensors and some programming is helpful. A desire to do interdisciplinary research is a plus. Engineering backgrounds is preferred. Exposure to mechatronics and robotics a plus.

### **Project 3: Global Health and Tele-rehabilitation robotics** *Rising Juniors only*

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Stroke and other non-communicable diseases are the leading cause of adult disability in the US and the world. We have been developing affordable rehabilitation robots to be used in low and middle income countries such as Mexico and Botswana. With commercial collaborators, we have developed "rehab-in-a-box," an affordable robot gym for adults with motor control impairment in the arm and leg. The goal of this project is to assist in conducting a usability testing of the system with at least 2 stroke, 2 SCI and 2 CP persons to determine the feasibility for intervention and motor recovery this demographic. The student be responsible to help develop the experiment, help with recruiting and perform testing of subjects. In addition the student maybe asked to help develop an android-based tele-rehabilitation application for remote monitoring the system use. Familiarity with Matlab, biomedical sensors and some programming is helpful. A desire to do interdisciplinary research is a plus. Engineering backgrounds is preferred. Exposure to mechatronics and robotics a plus.

## CANCER BIOLOGY

*Luca Busino*

**Project 1: Inhibiting E3 ubiquitin ligases: development of an unbiased approach** ***Rising Sophomores only***

Protein ubiquitylation is achieved by covalent transfer of chains of ubiquitin to a lysine residue in the substrate by E3 ubiquitin ligases. The human genome encodes for a large number of E3 ligases (~600, more than kinases), which ubiquitylate hundreds of different substrates. The recent success of a Ubiquitin Proteasome System (UPS) inhibitor (Velcade) for the treatment of blood cancers have opened a novel therapeutic avenue, thus a major frontier in the ubiquitin field is the identification of molecules that can inhibit the catalytic activity of specific E3. In mammals, recent evidences have pointed out how metabolites and small molecules can interact and effectively regulate E3 function (i.e., Fbx13-FAD, CRBN-thalidomide). Based on these examples, we have decided to develop an unbiased methodology to identify metabolites and/or small molecules interacting with E3 ligases leading to compounds that can be chemically “adjusted” in order to improve their bioactivity and bioselectivity. Specifically, we aim to identifying metabolites and/or small molecules that interfere with E3 ligases homodimerization, providing a molecular strategy to treat tumors at their molecular route. In addition to a potential therapeutic application, this project intends to develop an unbiased method to identify small molecules targeting E3 ligases.

*Sandra Ryeom*

**Project 1: The tumor microenvironment and metastases**

Our lab is investigating the role of the tumor microenvironment in mediating metastases to different organs. Specifically we are interested in understanding how stromal cells in the lung and the liver interact with endothelial cells in these organs to promote seeding of metastatic cancer cells. Students involved in this project will learn to isolate primary lung and liver fibroblasts and endothelial cells and work with mouse models of cancer. They will learn to characterize activated fibroblasts and endothelial cells both functionally and biochemically through cellular assays, Western blotting and RT-PCR.

**Project 2: Down syndrome and Acute Lymphoblastic Leukemia**

Our lab is interested in understanding the increased incidence of acute lymphoblastic leukemia (ALL) in children with Down syndrome (DS) and to determine whether the treatment related complications that occur frequently in DS children with ALL is related to the trisomic expression of genes on chromosome 21. Students involved in this project will utilize mouse models of Down syndrome and will investigate the role of the innate immune system by isolating primary neutrophils and macrophage during chemotherapy and steroid treatment. Student will learn how to assess neutrophil and macrophage function and perform biochemical studies examining a specific set of genes on chromosome 21 that may affect the activation of innate immune cells.

## CARDIOLOGY

*Emil deGoma*

**Project 1: Patient-centered approach to preventive cardiology: Developing a web-based decision aid to promote shared decision-making**

This research project focuses on the development and testing of a novel web-based patient decision aid that conveys the benefits and harms of evidence-based therapies for the prevention of cardiovascular disease in order to improve shared decision making between patients and clinicians. Incorporating core health care concepts such as benefit-harm analysis, risk communication, and shared decision making as well as the evidence base supporting a key public health priority – the prevention of cardiovascular disease – this project is ideally suited for undergraduates interested in patient-oriented research. The research plan will include the following, tailored depending on interests: \* Leading one-on-one interviews of patients and health care providers to: 1) identify patient and clinician needs to guide development of the decision aid and 2) assess comprehensibility, feasibility, and acceptability of the web-based decision aid. The undergraduate student will help synthesize the qualitative data obtained from

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these discussions. \* Conducting a comprehensive literature search to refine estimates of the benefits and potential harms of interventions such as aspirin, statins, and blood pressure-lowering therapy. The student will be mentored on query methods for electronic biomedical databases, critical appraisal of scientific publications, and basic risk statistical concepts (e.g., relative risk reduction, absolute risk reduction, number needed to treat). \* Communicating with health care providers and patients to assist with study recruitment efforts. The student will be mentored on a key requirement for successful execution of any clinical research project – identifying and inviting eligible subjects and participating in the informed consent process.

**Project 2: Familial hypercholesterolemia: Is genetic testing the key to improving early detection and treatment?**

Familial hypercholesterolemia (FH) accounts for an estimated 20% of myocardial infarctions under age 45 and as many as 5% under age 60. FH is characterized by severely elevated levels of low-density lipoprotein cholesterol, a heightened risk of premature coronary heart disease, and a 50% chance of inheritance in first-degree relatives. While early detection and appropriate treatment of FH can significantly reduce the risk of premature CHD and death, 90% of FH patients have not been properly diagnosed and, of those diagnosed, many are not receiving appropriately aggressive treatment. In an effort to bridge the treatment gap, my team has launched I FIGhT FH (Is Family screening Improved by Genetic Testing for Familial Hypercholesterolemia?), the first randomized trial designed to rigorously assess the impact of genetic testing on the success of family screening efforts for FH. We hypothesize that identification of a causative mutation will: 1) augment FH patients' and providers' perceptions of cardiovascular risk, resulting in increased medication use and adherence and improved LDL-C control; and 2) improve participation of both FH probands and relatives in cascade screening, the systematic testing of family members of affected individuals. Students will develop a deep knowledge of FH, one of the most common single gene disorders, and gain exposure to genetic testing in the cardiology clinic. Students will be directly involved in the recruitment and follow-up of patients and relatives with FH. For more information:

<http://uphsxnet.uphs.upenn.edu/precisionmedicine/cardiovascularh.html>

**Project 3: Low-radiation coronary CT angiography in the management of familial hypercholesterolemia**

Familial hypercholesterolemia (FH) is a monogenic disorder characterized by elevated low-density lipoprotein (LDL), a heightened risk of coronary heart disease (CHD), and a 50% chance of inheritance in first-degree relatives. An estimated 1.1 to 1.6 million people in the US have FH. While early detection and appropriate treatment of FH can significantly reduce the risk of premature CHD and death, 90% of FH patients have not been properly diagnosed and many are not receiving appropriately aggressive treatment. A potential tool to address the treatment gap in FH is coronary CT angiography (CCTA), a non-invasive imaging modality to evaluate coronary plaque that is clinically indicated for selected symptomatic patients. Whether asymptomatic FH

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patients merit CCTA remains unknown. Evaluating a potential role for CCTA in the treatment of FH patients is timely due to recent advances in CCTA including low-radiation protocols, semi-automated plaque quantification software, and dual-energy image acquisition to enhance plaque characterization. The overall goal of this study is to determine the effect of low-radiation CCTA on risk assessment and management of asymptomatic FH patients without known CHD. Beyond FH, our project will inform the use of low-radiation CCTA to characterize and quantify coronary plaque. This analysis is relevant to risk assessment in non-FH populations as well as to the evaluation of novel therapies for atherosclerosis. Students will develop a deep knowledge of FH and gain exposure to an emerging non-invasive imaging technique, coronary CT angiography. Students will be directly involved in the recruitment and follow-up of patients with FH.

## **CARDIOVASCULAR MEDICINE**

*Yuli Kim*

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

Dramatic improvements in the treatment of infants and children with congenital heart disease (CHD) have resulted in a recent increase in the number of adults living with this condition. The new subspecialty of adult congenital cardiology focuses on this emerging population. One of the challenges of providing long-term care for adults with congenital heart disease is the lack of consensus about what constitutes quality care (i.e. what practice patterns improve patient health outcomes). A panel of experts recently published the first set of quality indicators for individuals with secundum atrial septal defects, coarctation of the aorta, Eisenmenger syndrome, d-transposition of the great arteries, tetralogy of Fallot, and any CHD that required the Fontan procedure. The purpose of this project is to investigate quality indicator completion patterns in an adult congenital heart disease clinic and clinics for several other adult cardiology specialties to evaluate the best setting for management of these conditions and current gaps in quality of care. The student will be mentored by the medical director of the Philadelphia Adult Congenital Heart Center, a joint program of the Children's Hospital of Philadelphia and Penn Medicine. Emphasis will be placed on developing competency in clinical research through involvement in protocol preparation, data collection, data analysis, and presentation of results. Additionally, the student will have unique clinical opportunities to shadow cardiologists and cardiothoracic surgeons to learn more about the management and treatment of these congenital heart defects.

*Bonnie Ky*

**Project 1: Early detection of cardiotoxicity in pediatric sarcoma patients**

Anthracyclines are highly effective chemotherapeutic agents and used widely in the treatment of childhood cancers. However, these agents are associated with a significant risk of adverse cardiovascular effects, with cardiovascular disease being among the leading causes of morbidity and mortality in the large population of childhood cancer survivors. As such, in children treated with anthracyclines, there is a critical need to develop methods to detect subclinical cardiovascular disease earlier, and in particular, sensitive diagnostic and predictive imaging measures of cardiac dysfunction have a potential to fill this knowledge gap. In this retrospective cohort study, we propose to determine the changes in sensitive echocardiographic measures of cardiac function, myocardial strain, and define if these changes are associated with subsequent heart failure and cardiomyopathy. This is a highly multi-disciplinary study, led by investigators within cardiology and oncology, at the Children's Hospital of Philadelphia (CHOP) and the Hospital of the University of Pennsylvania (HUP) at the Perelman School of Medicine at the University of Pennsylvania. We seek a highly motivated, detail-oriented, and hard-working undergraduate student to play an integral role in our project. The student's primary role will be to work with the investigators to create the clinical and echocardiography database. This will entail medical chart abstraction; de-identification of echocardiograms; and generation of the database infrastructure. The student will have direct guidance from the study investigators and biweekly meetings with the senior cardiology fellow, who is the lead investigator on the project. Educational conferences and observer experiences are also available within CHOP and HUP oncology and cardiology.

## **CELL AND DEVELOPMENTAL BIOLOGY**

*Marisa Bartolomei*

**Project 1: Placental development with Assisted Reproductive Technologies (ART)**

Assisted Reproductive Technologies (ART), including in vitro fertilization (IVF), have helped many couples overcome infertility. ART use is high in some developed countries, accounting for as many as 8-10% of all births. Unfortunately, ART pregnancies are associated with a number of maternal and fetal health risks, including abnormal development of the placenta and low birth weight. Currently, it is unknown how ART causes these adverse effects. In this project, the student will assess the impact of ART on fetal and placental development in a mouse model. The goals are to determine how ART affects the placenta and subsequent fetal development and to identify how early abnormalities occur. Working closely with a postdoctoral researcher, the student will gain a basic knowledge of mouse embryonic development, experimental design, data

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collection, and statistical analysis. Techniques the student will perform include tissue collection and processing, bright field and fluorescence microscopy, histological analyses, and gene expression assays. Additionally students will participate in lab meetings, journal clubs and be exposed to modern biomedical research.

### **Project 2: Characterization of human induced pluripotent stem cells (iPSCs) for genomic imprinting studies**

We study genomic imprinting, a phenomenon exclusive to mammals, in which a gene is expressed either from the chromosome inherited from father or the chromosome inherited from mother. Only a few genes are imprinted in mammals. Epigenetic mechanisms, including parental chromosome specific DNA methylation, regulate imprinted gene expression. Loss of imprinted gene expression (LOI) is associated with human childhood disorders, such as Beckwith-Wiedeman Syndrome (BWS), and cancer. Human iPSCs are a useful in vitro system to model human disease with defined genetic abnormalities. We have generated iPSCs from fibroblast cells of BWS patients and from normal controls. We will manipulate the normal controls lines using genome editing to define sequences critical for proper imprinted gene expression. We will differentiate iPSCs into cell types where disease phenotypes are observed in patients with LOI. Our goal is to define the mechanisms by which abnormal imprinted gene expression causes disease in human iPSCs. The proposed project asks the following question: are imprinted genes properly expressed and properly epigenetically marked in male and female iPSCs before and after differentiation? To address this question the student will learn to use existing gene expression and DNA methylation methodologies and establish new assays for additional imprinted genes. This is an excellent opportunity to become acquainted with the human iPSC literature and the importance of epigenetic regulation of iPSCs, which is often overlooked when establishing iPSCs to model diseases of interest. Additionally students will participate in lab meetings, journal clubs and be exposed to modern biomedical research.

## **DERMATOLOGY**

*Leslie Castelo-Soccio*

### **Project 1: Understanding the genetics of rare hair and skin disorders**

This project looks at patients and families with undiagnosed hair and skin disorders. DNA samples will be obtained after families are recruited and these samples will be sequenced and analyzed. Students would be involved with recruitment and consenting of patients as well as analysis of DNA sequences for gene identification. Students would help with research to identify potential candidate genes for the disorders. Students would be involved in writing up the papers that result from these findings. Students would learn about rare disorders with mendelian

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genetics and analysis of dna samples. There would also be opportunity to interact with patients and families. Genetics background and coursework would be a plus but is not a prerequisite.

**Project 2: Designing a labeling interface for dermatology images.**

The project involves implementing a labeling interface for mobile device apps to analyze dermatology images. The aim is to separate facial images interactively into regions of different clinical significance. While adaptable to many applications, we will test the app for analyzing images of alopecia areata in children. Given the complex visual appearance of most dermatological conditions, even manually labeling can result in high inter-rater variability. The student will work closely with both a computer vision scientist and a dermatologist to build guidelines into the app; these guidelines will aid clinicians in labeling more efficiently and with higher accuracy. Skills in computer programming for iOS mobile platforms are essential.

*Albert Yan*

**Project 1: Designing an interface for comparing dermatology images.** *Rising Juniors only*

The project involves implementing an interface for mobile device apps to allow clinicians to compare disease severity between images. The goal is to provide an easy way for clinicians to view a set of images and assign, to each one, a severity score, as well as a measure of disease progression/regression. The app will be used for analyzing images of acne in children. The student will work closely with both a computer vision scientist and a dermatologist to: integrate the app with automated image analysis; test concordance between the systems; and output simple disease statistics. Skills in computer programming for iOS mobile platforms are essential. Basic knowledge in statistics, computer vision and machine learning will be helpful, but is not required

## EPIDEMIOLOGY

*Karen Glanz*

**Project 1: UPenn Prevention Research Center**

This project will connect a student to the CDC-funded UPenn Prevention Research Center (UPenn PRC) and related research studies. The UPenn PRC, directed by Dr. Karen Glanz and Dr. Kevin Volpp, includes the following cores: Administrative Core; Community Engagement, Partnerships, and Technical Assistance Core; Communication and Dissemination Core; Training Core; and Evaluation Core. This position will assist with tasks associated with the overall implementation of the Center and will provide opportunities to work with several faculty members on a variety of tasks. Potential activities include connecting with community based

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organizations and building academic-community research partnerships, working with UPenn PRC leadership to develop clear and frequent communication for PRC collaborators and the broader public, and collecting evaluation data. There are several research projects that are part of the UPenn PRC and this project includes an opportunity to work on two research studies. The first research study involves creating and testing campaign messages related to skin cancer prevention in adults and the second involves developing culturally relevant messages and strategies to promote awareness about dementia. For both projects, this position will assist the research teams with participant communication, data collection, and data entry/cleaning. Students should have proficiency in Microsoft Office. Excellent organizational, interpersonal, and communication skills are essential to success in this position.

*Blanca Himes*

**Project 1: Integrating diverse genomic datasets to identify transcriptome changes that characterize asthma**

The overall goal of this project is to better understand the genetics of asthma by using integrative genomics approaches that include relating disease-associated variants, differentially expressed genes, known biological pathways, and relevant functional datasets. Main duties include data collection from online repositories, meticulous organization of data, and literature searches. Subsequent opportunities to analyze data using R will be available if the student has the necessary experience or is willing to learn basic computing and statistics. Student must be an enthusiastic, driven, and mature individual who is looking for research experience.

**Project 2: Development of Web Applications to Display Results of Genomic Studies**

The overall goal of this project is to help develop web applications that display results of genomic data analysis related to pulmonary diseases. Main duties include using R and the Rstudio shiny package to display meta-analyses results of microarray and RNA-Seq data. While computing is integral to this project, students will also learn about analysis of genomic expression data and become familiar with pulmonary diseases. Students with programming experience preferred, but those who are enthusiastic, driven, and independent learners will also be considered.

*Michael Levy*

**Project 1: Epidemiology and Control of Bed Bugs and Chagas Bugs**

My lab works on two parallel urban plagues: Chagas disease (a parasitic disease carried by the bloodsucking triatomine bug) in Arequipa, Peru and Bed bugs (a distant cousin of the triatomine bug) in Philadelphia, Pa. We conduct entomological, ecological and epidemiological studies to

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try to figure out how these bugs move through urban environments and how to control them. Over the summer we will be working in the laboratory in Philly testing insecticidal paint, which we know works against triatomines, against bed bugs, while In Peru our team will be testing heat treatments, which we know work for bed bugs, against triatomines. Students will be responsible for feeding the bed bugs biweekly (using a feeding system, not your arm), and will be involved in all aspects of the projects (study design, analysis, writing papers etc.). Computer/Math and/or Spanish skills are required, but more importantly a commitment to work with the team long term.

*Elizabeth Lowenthal*

### **Project 1: Caregivers support for HIV Treatment Adherence in Adolescents in Botswana**

This study will utilize data from a 5-year Botswana-based study of HIV treatment adherence among adolescents. The student will work with a dynamic multi-country team and will utilize data from microelectronic monitor caps (MEMS) and HIV viral load data. Using epidemiologic methods, the student will assess whether the number of caregivers involved with the adolescents treatment adherence and the relationships between the adolescent and caregivers can help predict who will struggle most with treatment. The student will learn how to interpret MEMS data, how to use RedCap electronic databases, and basic programming with Stata analysis software. This work is likely to lead to a professional publication for the student.

### **Project 2: Preparation for an RCT in Zimbabwe**

This project will involve setting up a database and case report forms for a Zimbabwe-based randomized trial of stigma reduction to increase adolescent HIV testing and retention in care. The student will interact with members of the U.S.-based team as well as Zimbabwe-based team members (via Skype) and will gain familiarity with epidemiology methods. The student will learn to program a RedCap Database and to set up data queries using RedCap and Stata data analysis software. This collaborative work could lead to publication opportunities for a student who wanted to continue working with the team beyond the summer period.

### **Project 3: Mixed-methods adherence study**

Measures of adolescents' medication adherence may vary greatly for the same individual depending on whether the measurements are made using self-report, parent-report, pill counts, pharmacy refill data, or biological measures. This study will utilize qualitative (focus group and in-depth interview) and quantitative data to describe differences and reasons for differences between adherence measures. The student will learn to utilize NVivo software for qualitative analysis and Stata for quantitative analysis. By working with a dynamic multi-country team, the student will gain insights into public health, medicine and Epidemiology.

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*Haochang Shou*

**Project 1: Pilot Study of Acne Severity Quantification using Image Features** ***Rising***  
***Sophomores only***

The project aims to develop objective metrics to quantify acne severity and disease subtypes using image features. The student will assist with experiment design on image acquisition; develop concordance measures to assess the sensitivity and specificity for the existing imaging segmentation algorithms; conduct statistical analysis to predict clinical outcome through selected image features. Eventually the predictive models can turn into a web interface that automatically suggests disease classification based on the input image. The students are required to have certain quantitative and programming background. Understanding the basic statistical terminologies such as distribution, regression and testing will be an advantage.

## GENETICS

*Arupa Ganguly*

**Project 1: Search for hidden germline mutations in bilateral retinoblastoma - a childhood onset eye cancer**

Retinoblastoma (RB) is a childhood ocular tumor that can lead to blindness and death if not diagnosed and treated promptly (OMIM #18020). The disease can be bilateral (30%), or, unilateral (70%). Germline mutations in the RB1 gene cause bilateral RB, while bi-allelic somatic mutations of the RB1 gene in a retinal cell cause unilateral disease. The present challenges for RB management are preventing loss of an eye, blindness, and other serious effects of chemotherapy and other modes of treatment that reduce the life span or the quality of life. Thus use of chemotherapeutic drugs should be limited to specific group of patients for whom the benefits outweigh the potential disadvantages. Mutation screening for RB1 gene can identify patients who will benefit. For an individual with a germline mutation, systemic chemotherapy would be favored. In contrast, patients with no germline mutation can be spared the toxicity of chemotherapy or radiation therapy by undergoing enucleation of the involved eye. My laboratory has tested thousands of RB cases and successfully detected mutations in 94% bilateral cases. This project will involve scanning the non-coding regions of RB1 gene in the bilateral patients without detectable mutations, by PCR amplification of the intronic and the 5'-UTR/3'-UTR regions followed by Sanger sequencing and dosage analysis. In bilateral cases without family history, the analysis will be repeated on next-generation sequencing platforms to identify de novo, mosaic mutations. The project will provide hands-on training in the genetic analysis of a classic childhood onset human genetic disease such as retinoblastoma.

## ***Kyoung Jae Won***

### **Project 1: Identifying functional role of TZD**

Obesity, caused by excess calories stored as fat in white adipose tissue (WAT) over time, is a major risk factor for metabolic disorders including Type 2 diabetes. Brown adipose tissue (BAT), which dissipates cellular energy in the form of heat, has been recognized as a therapeutic target because of its demonstrated anti-obesity properties.. Certain WAT depots are able to convert to a “brown-like” state (or brite) following exposure to cold or chemical compounds such as thiazolidinedione (TZD). The browning effect by TZDs is observed in WAT precursors but not in fully matured WATs. Besides their browning effects, TZDs have been used as a treatment for diabetes because of their effect of increasing insulin sensitivity. However, clinical use of TZDs has been limited because of serious safety concerns such as potential cardiovascular risks. Therefore, it is important to understand the mechanism of the browning effect on WAT by TZDs for therapeutic purposes. TZDs act by agonizing PPAR $\gamma$  (peroxisome proliferator-activated receptor  $\gamma$ ). However, our understanding about the regulatory mechanisms of TZD is still limited. In our preliminary studies using global run-on sequencing (GROseq) data, we found co-transcriptional splicing events are prevalently observed in a significant level. More importantly, we found that TZD increased co-transcriptional splicing events in the key genes in adipocyte. TZD also regulated the transcriptional levels of key genes important for alternative splicing such as hnRNPs. Additionally, we also found that early B-cell factor 2 (Ebf2), an important factor for BAT formation, interacts with a number of spliceosome proteins significantly. Based on our preliminary results, we propose to study the TZD mechanism in regulating co-transcriptional splicing through systematically comparing the transcriptome and epigenome of fat depots. Specifically, we will: Aim 1: Studying alternative splicing regulated by TZDs and its association with browning effect In our preliminary study using GROseq, we observed that TZDs regulate co-transcriptional splicing levels and the transcription levels of spliceosomal genes. Based on this, we hypothesized that TZDs regulate alternative splicing. To study alternative splicing events regulated by TZDs, we propose to generate large-scale RNA sequencing (RNAseq) in adipocytes before and after treating TZDs. Using bioinformatics analysis, we will identify isoforms differentially regulated by TZDs. By comparing the results obtained by GROseq and RNAseq, we will study the isoforms spliced co- or post-transcriptionally. The identified isoforms will further be validated using real-time PCR (RT-PCR). We further hypothesize that the isoforms regulated by TZDs are associated with browning of white fat. To test our hypothesis, we will compare the isoforms regulated by TZDs with the BAT’s transcriptomic data we generated with the collaboration with Dr. Seale. We will overexpress the identified isoforms in WAT to see if they are associated with browning effect. Aim 2: Identifying mRNA half-lives regulated by TZDs Previous studies showed that pre-mRNA splicing extends half-life and isoforms spliced differently have different half-lives. Considering that TZDs regulates alternative splicing, we further hypothesize that TZDs regulate mRNA stability by regulating alternative splicing. To calculate mRNA half-lives, we will design

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a computational model (a first-order system) using nascent RNAs and fully spliced RNAs (RNAseq). The first-order system uses the amount of nascent RNAs as an input and total RNAs as a response of the system. This dynamic model will calculate the half-life of RNAs. The predicted half-lives will be compared with previous prediction or detection. The student will perform bioinformatic analysis to process genome-wide datasets. Computer programming skill is needed.

**Project 2: Studying the role of hypothalamic miRNAs in aging**

Aging lowers the replicative potential and the capacity for tissue regeneration of most cells including brain cells. There is an increasing emphasis on understanding how aging contributes to a decline in brain functions, cognition being a prime example. A clear understanding of the neurobiological mechanisms underlying normal age-related changes will be essential in helping elderly populations maintain cognitive performances as they age. The hypothalamus is a key brain region crucial for the neuroendocrine interaction between the central nervous system and the periphery. A striking observation was made recently about the new function of the hypothalamus whose inflammatory changes control aging throughout the body. Therefore, it is very important to understand the gene regulatory information in the hypothalamus. Micro-RNAs (miRNAs) are short (~22 nucleotides) non-coding ribonucleic acid (RNA) molecules that negatively regulate the expression of protein-coding genes. A number of study found that miRNAs are differentially regulated during aging in many tissues including the hypothalamus. In our preliminary study using transcriptomic data, we observed changes in the gene expression throughout the mice lifespan. We observed that a collection of hormones and immune related genes are associated with aging. Interestingly a significant number of hormone-related genes were the targets of miRNAs. Based on our preliminary results, we hypothesized that miRNAs regulate aging-related genes. To prove our hypothesis, we suggest to generate small RNAseq data to identify the miRNAs differentially regulated between old and young mice. Furthermore, we will identify the target of the age-associated miRNAs. However, the current miRNA target prediction methods suffer severe false predictions. To overcome this, we will use our new bioinformatics techniques to identify miRNA-mRNA hybrid reads from an AGO binding crosslinking and immunoprecipitation followed by massive sequencing (CLIP-seq) data, which have been known to occasionally generate miRNA-mRNA chimeric reads during its the ligation process. Applying this novel approach we recently developed, we will search for the target of the age-associated miRNAs in the hypothalamus. The hypothalamus plays a crucial role in the body weight homeostasis through an intricate network of the precise regulation of peripheral hormones and central transmitters. Understanding the aging mechanism in the hypothalamus will lead us to the identification of efficacious drug targets to increase the lifespan. The miRNAs in the hypothalamus have been suggested as a key regulator of the energy balance. Our aims will elucidate the intricate transcriptional circuitry that governs aging in the hypothalamus which can be validated in mice. The student will perform bioinformatic analysis to process genome-wide datasets. Computer programming skill is needed.

## HEMATOLOGY/ONCOLOGY

*Erica Carpenter*

### **Project 1: Personalizing care for melanoma patients through next generation sequencing of circulating tumor DNA**

Our lab develops and implements cutting edge technologies to support the delivery of personalized medicine to patients with cancer. We focus on capture and molecular analysis of circulating tumor cells (CTCs) and cell-free tumor DNA 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. Innovation in my lab is driven by the needs of clinicians such as Dr. Tara Gangadhar, MD, who will serve as co-mentor for this project. 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 melanoma patients enrolled on Dr. Gangadhar'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 melanoma patient treatment, including participation in meetings (called Tumor Boards) to review next-generation sequence data and its clinical implications. 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.

## INFECTIOUS DISEASES

*Kristen Feemster*

### **Project 1: Identifying Differences in Infection Control Policies in CHOP Ambulatory Clinics**

We are in the third year of a study to learn about the risk of developing a respiratory viral infection after a clinic visit among young children. Our preliminary data suggests that a prior clinic visit does increase risk for developing an influenza-like illness (ILI). The next step in our investigation is to identify infection control practices that differ among clinics with low and high rates of healthcare-associated ILI (HA-ILI). This project is a prospective observational study that seeks to identify and measure clinic characteristics, and infection control practices to inform the development of a standardized protocol to be implemented in ambulatory settings. Students will

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directly observe infection control practices, administer surveys to clinic staff, conduct literature reviews, and participate in lab meetings. Students should be responsible, flexible, have great interpersonal skills, and be capable of both group and individual work. Students should be able to work at least 20 hours per week over the summer and will need to complete a background check to be able to work within CHOP. There are no prerequisites.

**Project 2: Parent perceptions of healthcare-associated respiratory infection in pediatric clinics: implications for infection prevention in**

Pediatric ambulatory sites may be an important source of healthcare-associated infection (HAI) and subsequent disease transmission within communities. However, little is known about the epidemiology of HAI attributable to an outpatient encounter. While specific infection prevention and control (IPC) guidelines exist for ambulatory settings, few studies have evaluated the consistency or effectiveness of their utilization. This project will utilize qualitative methods to explore: parent perceptions about the risk for healthcare-associated respiratory infections in the pediatric ambulatory setting, expectations about IPC practices within a pediatric primary care clinic, and the acceptability of proposed IPC interventions. Students will conduct semi-structured interviews, code and analyze interviews, conduct literature reviews, and participate in lab meetings. This work will compliment parallel research exploring perceptions among ambulatory healthcare workers (HCW) and inform a larger study that evaluates specific factors that influence acceptability of IPC practices and develop and test specific interventions designed to reduce HAI risk in the pediatric ambulatory setting. Students should be energetic, have great interpersonal skills, be flexible, and be capable of both group and individual work. Students will need to complete a background check to be able to work within CHOP.

## **MEDICAL ETHICS AND HEALTH POLICY**

*Jennifer Walter*

**Project 1: Improving communication with families of seriously ill patients in the pediatric ICU: a randomized controlled trial**

This project is a prospective randomized controlled trial that aims to explore how factors of communication between physicians and patients of children admitted to the intensive care unit impact parent satisfaction and patient outcomes at the Children's Hospital of Philadelphia. Students will conduct literature reviews, collect data from the medical record, administer surveys, and participate in lab meetings. Students should be responsible, flexible, and curious, have strong writing skills, great interpersonal skills, and be capable of both group and individual work. We also expect students to have some skill in conducting literature reviews. Students should be able to work at least 20 hours per week over the summer and will need to complete a background check to be able to work within CHOP. There are no prerequisites.

## MEDICINE

*Laura Su*

### **Project 1: Understanding the role of T cell cross-reactivity in vaccination response**

We are interested in how common microbial exposures help shape your immune system. In particular, we are interested in whether T cells that are "cross-reactive" with microbes are better at becoming activated by the influenza vaccine. We are using a newly developed yeast display system to probe the role of T cell cross-reactivity in determining the robustness of the immune response. You will learn a number of techniques, including protein production, yeast culture, and flow cytometry. This project is currently ongoing and will likely result in a publication in the near future.

### **Project 2: Defining the inflammatory processes in osteoarthritis**

We are interested in why people develop osteoarthritis. How much of the disease is from wear and tear and how much is the result of aberrant inflammatory process? What kind of immune cells are causing joint destruction? We will be performing detailed immune profiling on the joint tissues from people from osteoarthritis. You will learn how to process cartilage and synovial fluids and perform flow cytometry.

## MICROBIOLOGY

*Hao Shen*

### **Project 1: Protective immunity and vaccines against bacterial pneumonia**

Pneumonia caused by *Streptococcus pneumoniae* (Sp) remains a leading cause of serious illness and numerous deaths in children and elderly worldwide. Current pneumococcal vaccine is effective in preventing colonization by inducing serotype-specific antibodies. However, there is an increasing prevalence of infection by serotype strains not included in the vaccine; this highlights the need for a universal vaccine that protects against all serotypes. In our recent studies, we have found that mice intranasal immunized with Sp are protected against challenge with a different serotype Sp strain. Sp infection in lung results in a tremendous CD4+T cell expansion and activation that consisted of mostly IL-17 producing Th17 cells. Adoptive transfer of Sp-specific CD4+ memory T cells provides cross protection against pneumonia and bacteremia, and the protection is dependent on IL-17 produced by memory CD4 T cells. Our results suggest that Sp memory Th17 cells played a key role in providing broad protective immunity against invasive Sp infection in a serotype independent manner. This PURM project

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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.

*Jianxin You*

**Project 1: Mechanistic investigation of the oncogenic Merkel cell polyomavirus**

Merkel cell polyomavirus (MCV) is a novel human polyomavirus that has been discovered in Merkel cell carcinoma (MCC). MCC metastasizes rapidly. It is one of the most aggressive human skin cancers with an extremely high mortality rate of 33% and less than 45% five year survival rate. MCV is also an abundant virus frequently shed from healthy human skin. However, many aspects of the MCV life cycle remain poorly understood and the mechanisms by which MCV contributes to the highly lethal skin cancer are largely unexplored. Our ongoing research aims to tackle these important questions and to elucidate the molecular mechanisms by which the major MCV oncogene, MCV small T (sT), contributes to the MCV life cycle and oncogenic mechanism. Our lab has recently published a series of studies that shed light on the impact of host DNA damage response on MCV replication and transformation. This PURM project will investigate the mechanistic role of MCV sT in LT-mediated viral DNA replication, and elucidate how sT function contributes to MCV-associated tumorigenesis. Together, these studies delineating the function of this critical viral oncoprotein will offer exciting insights into the largely unknown MCV virology and oncogenic mechanism. By participating in this project, the student will learn a number of innovative molecular virology techniques established in our lab, build experience in experimental design, and gain knowledge on DNA virus-induced tumorigenesis. If the research results in a publication, the student will also be part of the team to work on this publication.

## NEUROLOGY

*Hongyu Sun*

**Project 1: Functional dissection of hippocampal neuron subpopulations underlying early-life epilepsy**

Early life seizures are often refractory to conventional antiepileptic drugs, yet there have been few advances in the discoveries of new therapeutic strategy with no side effects. This could be due to lacking of specific treatment targets. This project aims to target the selectively activated neurons during seizures. We will use a newly generated transgenic c-Fos-GFP/tTA mouse model

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to label the active neurons with green fluorescent protein and identify novel therapeutic targets. The student will learn the procedures for mouse genotyping, tissue collection, quantitative PCR, basic immunochemistry staining and microscopy imaging techniques. This position is ideal for those who are interested in translational research. Prior experience working with mice is preferred.

## NEUROSCIENCE

*Jonathan Raper*

### **Project 1: Development of a simple neuronal circuit** *Rising Juniors only*

The Raper laboratory studies how circuits form in the developing nervous system. We use a variety of molecular, genetic, and histological techniques to study how the axons of olfactory sensory neurons find their way to their correct targets in the zebrafish brain. An undergraduate researcher with a strong science background is required to help generate and screen mutant fish, collect and process embryos for analysis, image embryos by confocal microscopy, and analyze data. Ideally, this summer experience could develop into an independent research project suitable for an honors thesis.

### **Project 2: Engineering fish that can smell light** *Rising Juniors only*

Fish are attracted to food sources, avoid injured fish, and home in on their breeding grounds based on their sense of smell. We can generate transgenic zebrafish in which the expression of a light-activated stimulator of neuronal activity is restricted to small subsets of olfactory sensory neurons that target specific locations in the brain. We seek an undergraduate researcher with a strong science background to develop a behavioral assay that will tell us whether fish are attracted or repelled by light activation of these sensory neuron groups.

*Sigrid Veasey*

### **Project 1: Neural Injury in Sleep Loss**

We have recently discovered that chronic repeated short sleep in adult male mice results in loss of a subset of neurons essential for attention and brain health: the locus coeruleus neurons. But are these the only neurons injured? Can the mice recover behaviorally? Is the injury similar in female mice and in adolescent mice. Students will learn an array of techniques to understand sleep/wake regulation, what happens to neurons molecularly across sleep loss and how does sleep benefit neurons by using sleep/wake recordings, behavioral testing, immunohistochemistry, quantitative PCR and protein assays, including westerns and immunoprecipitation.

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### **Project 2: Does sleep loss worsen Alzheimer's**

Locus coeruleus neurons originate in a small nucleus in the brainstem, but extend to every area of cortex in the brain as the only source of noradrenaline in the cortices. Noradrenaline is essential for coordinating increased neuronal activity with glial responses and blood supply. Having recently identified injury to and loss of locus coeruleus neurons with chronic sleep loss, we hypothesize that sleep loss may accelerate Alzheimer's through injury to the locus coeruleus. A Japanese group recently made a superior Alzheimer's mouse model and this model will be tested for effects of chronic sleep loss on behavior sleep and neuron survival and neuronal metabolics.

## **ONCOLOGY**

*Yael Mosse*

### **Project 1: Targeting oncogenic ALK signaling**

Neuroblastoma (NB) remains a leading cause of childhood cancer deaths. Children who do survive are left with long-term side effects, many of which can be life threatening. In this era of more rational therapies, substantial efforts are being made to identify optimal targets. We discovered that activating mutations of the ALK oncogene are the major cause of hereditary NB, and that somatically acquired mutations and amplification events often drive the malignant process in a subset of sporadic tumors. This was the motivation for the first phase of this project, where we then demonstrated that the common ALK mutations result in differential kinase activation and differential sensitivity to ATP-competitive inhibitors. This work established ALK as a tractable molecular target in NB and led to a now completed pediatric phase 1 trial and ongoing phase 2 trial of crizotinib, the only FDA approved ALK inhibitor. The results from the first 4 years of our R01 show the complexity of ALK activation in NB, and demonstrate that inhibition of a mutant kinase domain is much more challenging than fusion proteins present in lymphomas and lung cancer. This provides the impetus for the long-term goal of this research proposal to develop novel therapeutic strategies aimed at effectively inhibiting ALK-mediated signaling. The primary objective is to develop a responder hypothesis for therapeutic stratification of newly diagnosed patients with ALK-mutant NB, to elucidate mechanisms of resistance to crizotinib, and to define circumvention strategies in the clinic. The central hypothesis to be explored here is that rational and effective ALK-inhibition strategies can only be successfully developed after elucidation of the clinical implications of ALK alterations identified in patients and the mechanisms driving intrinsic resistance. The motivation is the urgent need to improve high-risk NB survival rates and decrease treatment-related morbidities. We will test our central hypothesis in three specific aims: 1) Define the functional consequences of patient-derived ALK alterations; 2) Identify mechanisms of sensitivity and resistance to ALK

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inhibition; and 3) Develop rational therapeutic combinations targeting ALK signaling pathways to overcome resistance. The first Aim, based on recent unpublished data showing a variety of alternative genetic mechanisms for ALK activation, will be a discovery effort in the relapsed NB genome, correlating sequence variations with oncogenic potential and prioritizing next-generation ALK inhibitors for preclinical and clinical testing. Aim 2 is devoted to elucidate mechanisms of intrinsic resistance to crizotinib that will allow for rational prediction of combinatorial therapies for further evaluation. The final Aim will garner the preclinical justification required to move combination therapies to the clinic, building on our extensive preliminary data of synergistic drug interactions in crizotinib-resistant models. We consider this project significant because it will result in identification of key oncogenic vulnerabilities in NB cells, biomarkers of response and resistance which will be integrated into phase 1 trials, and the proof-of-concept required to justify alternative ALK inhibition strategies for early phase clinical trial development.

### **Project 2: Re-activating p53 as a therapeutic target in neuroblastoma**

TP53 is one of the main regulators of apoptosis, senescence, cell cycle arrest and DNA repair. The expression, function and stabilization of p53 are governed by a complex network of regulators including p14ARF and MDM2. MDM2 is the main negative regulator of p53 activity and stability. Unlike adult tumors, neuroblastomas at diagnosis usually retain wild-type p53. Even at time of relapse, p53 mutations have only been reported in 15% of tumors in the only published series of paired diagnostic and relapsed neuroblastoma tissues. Nevertheless, the p53 pathway is commonly impaired due to upstream MDM2-p14ARF-p53 network aberrations. In cells with intact p53 downstream MDM2 inhibition, and subsequent increases in nuclear p53 levels, reactivate dormant apoptotic pathways and rapidly induce apoptotic cell death. TP53 has been reported to be a direct transcriptional target of MYCN in NB and sensitizes cells for MYCN-driven apoptosis. In vitro studies suggest MYCN-amplified cell lines may circumvent p53-dependent apoptosis by selecting for cells with aberrations in the p53/MDM2/p14ARF pathway (44). Suppression of the MDM2 inhibitor p14ARF through multiple mechanisms, amplification of MDM2, and elevated expression of p14ARF inhibitors BMI1 and TWIST1 are all found in subsets of diagnostic and relapsed NB samples. Inhibition of the expression or function of MDM2 in NB cells leads to nuclear accumulation of functional TP53, indicating that targeting of MDM2 may offer therapeutic benefit. Several pre-clinical studies have shown activity of the MDM2/TP53 antagonist Nutlin-3 in NB cell lines alone and in combination with genotoxic agents (53, 54), as well as in NB xenograft models and multi-drug resistant TP53 wild-type cell line xenografts (55). We are currently developing additional preclinical data in collaboration with Novartis to support incorporation of HDM201, an MDM2 inhibitor, into our master protocol clinical trial, focused initially on patients with wild-type TP53 and no other mutation-therapy match.

### **Project 3: Antibody Drug Conjugate Targeting of the ALK Oncogene in Neuroblastoma**

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Proof-of-concept that immunotherapy can be effective in neuroblastoma was recently demonstrated in a phase 3 trial of high-risk neuroblastoma patients using a ch14.18 antibody that targets the disialoganglioside GD2 (expressed on tumors of neuroectodermal origin). Neuroblastoma patients treated with this antibody together with interleukin-2 (IL-2), granulocyte macrophage-colony stimulating factor (GM-CSF), and isotretinoin experienced a 20% increase in event-free survival as compared to those receiving standard therapy only. Future treatment strategies must be positioned to rationally exploit known tumor-specific alterations – as has been successful in chronic myelogenous leukemia (CML), gastrointestinal stromal tumors (GIST), breast cancer, renal cell carcinoma (RCC), and a subset of non-small cell lung cancers (NSCLC). Many of the drugs that have been so valuable clinically in these cancers are small molecule inhibitors for specific tyrosine kinases, including Gleevec, Sutent, Iressa, and Tykerb. However, it has become clear that targeting receptor tyrosine kinases with small molecule inhibitors alone is not sufficient. We will use our established in vitro and in vivo systems to test the efficacy of 2 antibody-drug conjugates (ADCs) targeting ALK developed with our commercial collaborator. We will assess the response of a panel of cell lines and mouse models to these ADCs. We will verify biological activity against the target molecule ALK and seek to identify the mechanism of action of ALK-targeted ADC therapy. Through this multidisciplinary approach, we seek to develop a robust pre-clinical rationale for immunotherapeutic targeting of ALK with the overarching goal of expediting the path to a Phase 1 clinical trial of this innovative treatment modality following the proposed period of support.

## **ORTHOPAEDIC SURGERY**

*Atul Kamath*

### **Project 1: Patient Attitudes and Perceptions in Orthopedic Surgery**

The patient experience, including perioperative expectations and perceptions, play an important role in outcomes after non-surgical and surgical treatments. The mentee will join on projects related to understanding and evaluating the attitudes and perceptions related to orthopedic surgery, from sports medicine/ hip preservation to total joint arthroplasty care. Ongoing work in retrospective and prospective topics will be included, and the student's motivations and interests will guide this mentorship experience. It is anticipated that the student will produce a peer-review publication under the close guidance of the mentor. The student will also get an in-depth exposure to orthopedic surgery, including potential to shadow in clinic and the OR. The mentor has worked with a number of students of varying levels, including current Penn Med students and residents. There are no specific prerequisites, but interest in clinical/ patient outcomes important; statistical background is a plus.

### **Project 2: Readmissions in Orthopedics - Causes and Consequences**

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Readmissions for medical/ surgical complications in orthopedic surgery is an important topic. Readmissions have both medical and health economic implications. The mentee will join on projects related to understanding and evaluating the causes and consequences of readmissions related to orthopedic surgery, from sports medicine/ hip preservation to total joint arthroplasty care. Ongoing work in retrospective and prospective topics will be included, and the student's motivations and interests will guide this mentorship experience. It is anticipated that the student will produce a peer-review publication under the close guidance of the mentor. The student will also get an in-depth exposure to orthopedic surgery, including potential to shadow in clinic and the OR. The mentor has worked with a number of students of varying levels, including current Penn Med students and residents. There are no specific prerequisites, but interest in clinical/ patient outcomes important; statistical background is a plus.

**Project 3: Risk stratification in Orthopedic Surgery - Implications for Health Policy**

Optimizing patients for surgery remains an important part of successful outcomes in orthopedic surgery. More study is needed to define risk factors for poor outcomes after orthopedic surgery interventions. The mentee will join on projects related to understanding and evaluating the role of risk stratification related to orthopedic surgery, from sports medicine/ hip preservation to total joint arthroplasty care. Ongoing work in retrospective and prospective topics will be included, and the student's motivations and interests will guide this mentorship experience. It is anticipated that the student will produce a peer-review publication under the close guidance of the mentor. The student will also get an in-depth exposure to orthopedic surgery, including potential to shadow in clinic and the OR. The mentor has worked with a number of students of varying levels, including current Penn Med students and residents. There are no specific prerequisites, but interest in clinical/ patient outcomes important; statistical background is a plus.

***Xiaowei Liu***

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

During pregnancy and lactation, increased calcium demand 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 reproduction is quickly reversed, and bone mass is partially recovered following weaning. Our lab is interested in better understanding the mechanism that causes these dramatic changes in maternal bone. Using a rat model, we are working to assess the effects of pregnancy, lactation, and weaning 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 reproduction. Students will use image processing techniques to make precise measurements of bone structure, remodeling, and mechanical properties, in order to determine the effects of pregnancy, lactation and post-weaning recovery on bone quality. Additionally, students will participate as we move this study to a

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mouse model, allowing students to gain valuable experience in animal research. This project would be ideal for an engineering student with interests in biomechanics, physiology, and imaging. Students will gain experience in image processing, experimental techniques, and data analysis. An interest in working with animals and a basic understanding of computer programming are helpful for this position.

### **Project 2: The Effect of Mechanical Loading on Bone Remodeling and Microstructure**

Bone is a dynamic tissue which responds to its mechanical environment by forming new bone to withstand high loads and getting rid of old bone when it's no longer needed. In vivo mechanical loading can be used as a tool to stimulate new bone formation, but too much load can also cause damage to the bone. This project will involve establishing an in vivo loading paradigm in rats and mice to stimulate bone formation without detrimental effects. Students will handle live animals, apply loading to the animal's bone while they are under anesthesia, and use the micro-computed tomography to track changes in bone over time. Students will use computational image processing techniques to analyze bone changes over time, and learn laboratory techniques such as fine dissection, plastic embedding, and histomorphometry. This project would be ideal for biology, bioengineering, or mechanical engineering undergraduate student at any stage with interests in biomechanics, bone, and in vivo animal work. Students will gain experience with standard laboratory animal techniques, in vivo loading and scanning, and image processing techniques. No prior experience is necessary for this position.

*Neil Sheth*

### **Project 1: Building an Orthopaedic Center of Excellence in Moshi, Tanzania** ***Rising Juniors only***

We are in the process of trying to build an orthopaedic hospital in East Africa. At this stage, most of the work being done is focused on financial modeling and defining the burden of orthopaedic disease.

*Louis Soslowsky*

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

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

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

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

# PATHOLOGY

*Yair Argon*

## **Project 1: Cell-based assay for growth-promoting activity**

Human growth is dependent on hormones and growth factors. An important one, made by several body tissues, is insulin-like growth factor (IGF) and its absence leads to a severe short-stature syndrome accompanied by developmental retardation. This project will continue to explore our previous discovery that the production of IGF is strictly dependent on the activity of glucose-regulated protein 94 (GRP94). In the absence of GRP94, cells that usually make IGF cannot do so, leading to abnormally small tissues. Using a unique cell-based assay developed in the lab, we will determine whether a given variant of human GRP94 can support the production of IGF and to what extent. Multiple variants of GRP94 are available for testing from normal human populations as well as from IGF-deficient subjects. We already showed that some variants cannot fully support IGF production in this cellular assay. The summer project will continue such functional screening of human GRP94 variants. The methods involved will include molecular cloning, cell culture and fluorescence microscopy.

## **Project 2: Activity of GRP94 in the immune system**

Glucose-regulated protein 94 (GRP94) is found in all cells and tissues, but in the immune system it regulates two critical kinds of proteins - Toll-like receptor, that are present on the surface of lymphocytes and direct their response to infectious agents, and cytokines, which are specific hormones made by lymphocytes from infected individuals. GRP94 is a very selective protein and it regulates some members of the Toll-like receptor family or the cytokine family, but not others. The summer project will be part of a larger effort in the lab to better define how GRP94 selects the proteins that it regulates. The work will involve site-directed mutagenesis and analysis of the expression of the resultant mutants in cells.

## **Project 3: Bioinformatic analysis of human sequence variations**

Sequencing of the human genome is now done on a large enough number of patients, that rare sequence variants are found quite often. One immediate question about such genomic variation is whether it is causing the condition for which the patient is seen. Because of our prior expertise,

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we focus on variations in a set of human enzymes that either attach sugars to proteins or modify them. The connection between the biochemical activity and the phenotype of the patient is often not readily apparent and therefore we employ bioinformatics approaches to generate or validate functional hypotheses. This summer project will analyze one or more of the mutated enzyme sequences with a suite of RNA, protein structure and protein-protein interaction algorithms, predict how the genomic mutations can affect the function of the enzymes. This project is largely computer-based, but interfaces with experiments in cell culture and in animal models of disease.

***Khalil Bdeir***

**Project 1: Developmental endothelial locus-1 (Del-1) is a novel anti-thrombotic and anti-inflammatory mediator of AIS.**

Acute ischemic stroke (AIS) is most commonly initiated by thrombotic vascular occlusion, followed by a complex series of events, including an inflammatory response that act in concert to cause ischemic neuronal dysfunction. Notwithstanding intensive research, tissue-type plasminogen activator (tPA) is the only approved treatment for AIS. However, its brief therapeutic window and post-treatment bleeding complications have limited its clinical use. Therefore, there is a need to identify novel targets that dissociate physiological hemostasis and tissue repair from pathological thrombus formation and cell injury. Here, we focus on a recently discovered anti-inflammatory protein, Developmental Endothelial Locus-1 (Del-1), which is highly expressed in the brain that we hypothesize is also involved in the pathogenesis of thrombosis that leads to AIS. Our data demonstrate that Del-1 has potent anti-thrombotic activity. We propose that Del-1 combines anti-thrombotic activity mediated through its phosphatidylserine (PS) and/or integrin binding domains with anti-inflammatory actions that have been attributed to integrin blockade. At the onset of ischemic vascular injury, depletion of Del-1 by PS-expressing cells and microparticles may exacerbate thrombus formation and increase infarct size. Our data show for the first time that constitutive Del-1 deficiency is prothrombotic, increases infarct size and causes more extensive cerebral necrosis in a murine model of stroke. Intervention with a single dose of a recombinant fusion protein we created of Del-1 with Fc fragment of IgG r-Del-1-Fc rescues the phenotype of Del-/- mice at nM concentrations in the blood. Our main hypothesis is that Del-1 is a novel brain derived hemostatic factor that plays a role in the pathogenesis and potentially the management of AIS. This will be tested through these aims: Aim 1. We will more fully characterize the impact of Del-1 deficiency on the development of thrombosis and AIS using two models of vascular injury, MRI imaging techniques to measure infarct size, and cerebral blood flow. The student will be involved in maintaining mice colonies which includes breeding and genotyping. In addition, student will assist in processing tissues and measurement of protein levels, infarct size and other markers of thrombosis and inflammation.

*John Lambris*

**Project 1: Interaction mode of a potentially new inflammatory mediator of the complement system**

The human complement system, an integral part of innate immunity, has long been recognized as an important mediator of immune and inflammatory processes. During activation of the complement cascade, a variety of effector molecules are generated that prime and activate immune cells through complement receptor-mediated signaling. Our group has recently discovered a potentially new effector molecule and is currently establishing assays for its functional characterization. The project described here is primarily focused on the generation of effector derivatives using methods of peptide synthesis, separation techniques and mass spectrometric analysis in order to determine the functional requirements for signaling. The student will also be involved in the activity testing of the effector derivatives using various cell-based assays. Given the focus of the project, candidates should have an interest in peptide synthesis as well as in biochemical and cell-based assays. Our lab is equipped with state-of-the-art instrumentation and has large experience in complement biology, inflammation research and immunology. The project thereby provides a unique insight into an interdisciplinary research project, exposure to a broad range of relevant techniques, involvement in assay development and an opportunity to work with experienced researchers.

**Project 2: Preclinical formulation of a therapeutic complement inhibitor**

In view of its strong involvement in immune and inflammatory diseases, the human complement system has developed into an interesting therapeutic target. Almost two decades ago, our group discovered a peptide-based inhibitor (compstatin) that blocks a central step in the complement cascade, and derivatives of this compound have already entered clinical development. While we produced new lead analogs with improved potency, their application in preclinical animal models would largely benefit from compound formulations that ensure high stability and reliable administration. The student involved in this project will research about feasible buffers and solvents, screen for compound solubility, and monitor stability under different conditions. Suitable formulations will also be subjected to established activity assays in vitro. Our laboratory has large experience in drug discovery and development as well as complement biology and inflammation research. The student will learn about critical aspects in drug formulation and development, thereby providing a unique interdisciplinary experience and exposure to state-of-the-art techniques

## *Zissimos Mourelatos*

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

Messenger RNAs (mRNAs) convey, from DNA, the genetic information that will generate all proteins. Numerous factors regulate the stability, localization and translation of mRNAs and coordinate these processes with cellular and organismal physiology. We have discovered a novel pathway of mRNA metabolism and we investigate how it is tied to translation, cell proliferation and differentiation by using biochemical, cell biological and high throughput approaches. The student that undertakes this project will be guided by very experienced and collegial postdoctoral fellows and will participate in generation of libraries for next-generation sequencing, cellular fractionations and purification of ribonucleoproteins (RNPs) for characterization of their associated RNAs, from human and mouse cells lines, including embryonic stem cells and differentiated cells.

### **Project 2: Biogenesis and function of piRNAs**

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

## *Karuppiah Muthumani*

### **Project 1: DNA vaccine development for emerging infectious diseases using consensus vaccine approach**

Effective vaccines are still needed to combat a number of deadly diseases including Human immunodeficiency virus (HIV), Malaria, Flu, Middle Eastern Respiratory Syndrome (MERS) and several emerging mosquito-borne pathogens such as Dengue Virus (DV), West Nile Virus (WNV) and Chikungunya Virus (CHIKV). Over the past 25 years, multiple vaccine platforms have been explored to induce protective viral-specific immunity. DNA is one such platform and has already been studied in numerous clinical protocols. The platform’s safety has been well-documented in the clinic with more than 20,000 persons having received DNA vaccines with no

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adverse effects. In addition to its enviable safety record, the technology is made attractive by the simplicity of its engineering and production as compared to live attenuated and killed viral vaccines. DNA vaccines are also very stable and, therefore, ideal candidates for third world distribution where an effective vaccine is most needed. We are engineering several vaccines into enhanced consensus DNA constructs using the improvements to second-generation DNA vaccines such as DNA optimization, RNA optimization, and electroporation (EP) have given the platform-increased immunogenicity and comparing their ability to drive immune responses for HIV, DV, RSV, CHIKV and MERS virus.

### **Project 2: Generation of synthetic anti-sera for passive immunity against infectious diseases**

We characterize and purify neutralizing antibodies from the sera and use novel technology to identify and isolate relevant monoclonal antibodies. We clone these sequences into our enhanced DNA vectors to generate full human IgG expression vectors and we are evaluating these antibody-encoding DNA plasmids as novel prophylactic or therapeutic treatments for pathogenic emerging viral infections such as DV, RSV, CHIKV, MERS, Flu and other pathogens of interest. These DNA plasmids have the potential to generate therapeutic levels of mAb in vivo through more cost-effective and simplified treatment regimens. These plasmids will provide a safe, non-live, and non-viral approach to deliver antibody-mediated immunity against pathogens within 1-2 days of delivery.

### **Project 3: Molecular functions of the Host-Pathogen Interactions**

The molecular functions of viral proteins are arguably the most important pathogenic factors during viral infection. Using modern tools of virology and immunology, we explore the molecular basis of cellular protein functions, the interaction between viral factors and host cell signaling proteins, and general T cell and APC's functions. By studying viral proteins and their interacting cellular partners, our research is aimed at understanding the mechanisms of these interactions and developing new compounds that block them for drug and immunotherapeutic development.

*Daniel Ricklin*

### **Project 1: Tissue/cell-targeting of complement inhibitors**

The human complement system is a critical part of immune surveillance as it enables elimination of pathogens and cell debris while sparing healthy human cells. In several diseases, however, excessive complement activation leads to an attack of host cells and contributes to tissue damage and inflammation. Our group has developed several potent complement inhibitors that either act in circulation or can be coated on biomaterial surfaces. However, in certain diseases, protection of a particular cell type by targeting inhibitors towards cell-specific markers may be of

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advantage. We recently identified a promising peptide that directs complement inhibitors to red blood cells, which may find application in hematological diseases. For future development of that targeting approach, characterization of the binding properties of such targeting entities will be important. The student involved in this project will prepare various derivatives of the targeting molecule, label them with fluorescent markers, and evaluate them for cell binding activity and specificity using flow cytometry. Promising derivatives will also be coupled to complement inhibitors and thereby targeted inhibitors will be tested for cell-protective activity using established assays. Candidates should have an interest in peptide synthesis, biochemical and cell-based assays, and will be exposed to an applied, interdisciplinary research project and a variety of state-of-the-art methods.

## **PEDIATRICS**

***Lamia P. Barakat***

### **Project 1: Cross Cultural Psychosocial Assessment Tool**

Identifying factors associated with ongoing distress for children with cancer and their families is recommended to facilitate cancer care and assure timely provision of evidence based psychosocial care. There are commonalities among psychosocial risk factors and health disparities (e.g. resource limitations, socioeconomic status, social support, family problems, and cancer-related beliefs). Identifying these factors early in treatment in a psychometrically rigorous manner can contribute to the reduction of health disparities by connecting families to needed psychosocial resources and interventions. Brief, theoretically grounded user-friendly screening measures validated for families from diverse backgrounds (e.g. Spanish-speaking) are not currently available. We will address potential disparities by establishing a measure developed in our laboratory - the Psychosocial Assessment Tool (PAT) - as a valid screener of psychosocial risk for English and Spanish speaking families over the course of pediatric cancer treatment. The PAT is based on a conceptual model of risk and its implications for care in pediatric cancer – the Pediatric Preventative Psychosocial Risk Model. It includes brief screening of child (and sibling) and family factors/domains known to be associated with ongoing or escalating distress (e.g., resource considerations, socioeconomic status, child and sibling developmental and behavioral problems, and family problems, cancer-related beliefs). This is a three-site prospective study of parents of children with cancer with the purpose of validating English and Spanish versions of a screener of psychosocial risk (the PAT) to be completed at multiple time points from diagnosis through the end of treatment. Mothers/fathers/caregivers of 540 (including 123 Spanish speaking) children newly diagnosed with cancer at The Children's Hospital of Philadelphia, M.D. Anderson Cancer Center, and Nemours / Alfred I. duPont Hospital for Children will complete the PAT and validating measures of factors/domains in English or Spanish. Parents (caregivers) of children newly diagnosed with cancer will provide data using REDCap (with the option of paper and

pencil if they prefer) at up to three data points (depending on their child's treatment protocol): T1- Newly diagnosed (within one month of diagnosis); T2 - 6 months after diagnosis (for 70% of the sample, children will be on treatment; for 30% this will serve as the off-treatment data point), and T3 - off treatment (for children whose treatments is > 6 months in duration). Healthcare professionals who use the PAT (n = 15) from multiple sites in the U.S. and internationally will participate in interviews which will be analyzed qualitatively. At the conclusion of this study a validated screener of psychosocial risk for families, in English and Spanish, will be ready for use and broader dissemination in pediatric cancer. Identifying psychosocial risk factors will contribute to optimal provision of cancer care to all families by facilitating the delivery of evidence-based interventions specific to family needs. The assessment of factors related to health disparities on the PAT will provide for a brief measure of psychosocial risk that can be integrated into future research to assure the ongoing reduction of health disparities in cancer.

### **Project 2: Clinical Trial Decision-making among Adolescents and Young Adults with Cancer**

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

their primary caregivers. In an iterative process, DECIDES will be revised based on feedback from our AYA Patient Steering Committee, their primary caregivers, and a Scientific Advisory Committee. Using mixed methods, acceptability and feasibility of DECIDES will be evaluated. Efficacy will be estimated for involvement and decision-making processes by comparing AYA (ages 15 to 24), who are newly diagnosed with leukemia, non-Hodgkin's lymphoma or a sarcoma and offered treatment via a Phase III clinical trial, and their primary caregiver randomized to receive DECIDES (n = 24) or to usual care (n = 24). This research is central to the goals established by the Children's Oncology Group and National Cancer Institute to address the unique and unmet needs of AYA with cancer through increased research on availability of and enrollment on clinical trials. Data from this study will inform a larger multi-site randomized trial to establish the efficacy of DECIDES.

### **Project 3: Acceptability and Feasibility of In Utero Hematopoietic Cell Transplantation (IUHCT) for Sickle Cell Disease (SCD) and Thalassem**

Sickle cell disease (SCD) and thalassemia major are autosomal recessive genetic blood disorders, medically referred to as hemoglobinopathies. SCD affects 1 in 500 African American newborns in the United States and according to the National Heart, Lung and Blood Institute, between 70,000 and 100,000 African Americans are currently living with the disease, with an average life expectancy of 40 to 50 years. Thalassemia major is common among people of Mediterranean and Asian descent and an estimated 1,000 people in the United States are currently living with the most severe form of thalassemia major. In utero hematopoietic cell transplantation (IUHCT) is a potentially curative treatment for both SCD and thalassemia major, yet questions of efficacy still exist and clinical data is needed to support progress in testing the treatment. Prenatal genetic testing and counseling (PGTandC) are essential for determining eligibility for an IUHCT trial, but its acceptability and awareness is low in ethnic minority communities. Likewise, engagement in clinical trials is also limited due to other significant barriers such as mistrust of use of genetic test information and a focus on risks over benefits of participation in clinical trials research. With sufficient recruitment and retention, clinical trials can be undertaken in a manner that allows researchers to answer questions of efficacy of experimental treatments for SCD and thalassemia major. The aims of the proposed research are to establish the acceptability of PGTandC and feasibility of early Interventions for SCD and thalassemia major using a two-phase approach. In the first phase, we will survey young adults with SCD or thalassemia major and parents of a child with SCD or thalassemia major to determine knowledge of SCD or thalassemia major genetics and PGTandC and attitudes towards PGTandC, early interventions, and clinical trials research. In addition, we will explore the association of parenting stress or perceived general stress and health-related quality of life in shaping attitudes. The second phase, guided by results from the first phase, theory on health behavior change and decision support tool development guidelines, we will develop and test a decision aid that targets knowledge, attitudes and provides unbiased information about SCD, thalassemia major, PGTandC, and benefits and barriers to participation in the planned IUHCT clinical trial.

*Garrett Brodeur*

**Project 1: Role of CHD5 in Neuroblastoma Tumorigenesis**

Neuroblastoma is the most common solid tumor of childhood, accounting for 15% of deaths from childhood cancer. High-risk neuroblastomas are characterized by specific genomic changes, such as MYCN amplification and 1p36 deletion. We identified CHD5, which encodes a chromatin remodeling protein, as a tumor suppressor gene (TSG) that is deleted from 1p36 in these tumors. CHD5 is preferentially expressed in the nervous system and testis, and low CHD5 expression is strongly associated with adverse prognostic features as well as outcome. We are studying the following areas: 1) the mechanisms that regulate CHD5 expression (transcription factors, epigenetic modifications, microRNAs); 2) the proteins with which CHD5 associates to form a NuRD-type chromatin remodeling complex (using IP/Western, GC-MS and other proteomic approaches); and 3) the genes that a CHD5-NuRD complex regulates. For the latter project, we plan to compare the gene expression pattern of CHD5-null and CHD5-transfected neuroblastoma cells, changes in gene expression in cells induced to overexpress CHD5 (compared to uninduced cells), and chromatin immunoprecipitation (ChIP-Seq) experiments, to identify the targets of CHD5-NuRD regulation. We will prioritize genes that are identified by 2 or more of these approaches. This information will help identify the genes, proteins and pathways regulated by CHD5, which we will validate by examining mRNA and protein expression, as well as up- or down-regulating these genes selectively in tumor cells. This in turn will provide insights into the role that CHD5 plays in normal neural development as well as neuroblastoma pathogenesis.

**Project 2: Role of TRK genes in Neuroblastoma Tumorigenesis**

Neuroblastoma is the most common solid tumor of childhood, accounting for 15% of deaths from childhood cancer. High-risk neuroblastomas are characterized by clinical heterogeneity, from spontaneous regression or differentiation in some cases, to relentless progression despite aggressive, multimodality therapy in others. We have determined that members of the TRK family of neurotrophin receptors play crucial roles in this behavior. Favorable neuroblastomas express high levels of TrkA, and these tumors are prone to differentiate or regress, depending on the presence (or absence) of NGF in their microenvironment. Conversely, unfavorable neuroblastomas overexpress TrkB and its ligand (BDNF), and this autocrine pathway makes these cells more invasive, angiogenic, metastatic and drug resistance. We are exploring differences between TrkA and TrkB structure, protein associations and signaling that may account for these dramatic differences in tumor behavior. We have shown consistent differences in the time-course of activation of TrkA (long) versus TrkB (short) following ligand activation. We plan to determine which structural features, protein interactions or signaling account for these differences. Furthermore, we are testing small-molecule inhibitors of TRK activation by ligand that represent an attractive approach to treatment of neuroblastomas using xenograft and

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transgenic mouse models of neuroblastomas. Our plan is to move these TRK-selective inhibitors into phase 1 clinical trials by the end of the year.

*Kristina Cole*

**Project 1: Chemotherapy sensitization in pediatric cancers**

Our laboratory is studying a new anti-cancer drug that could allow traditional chemotherapy to be more effective in treating patients with pediatric cancers. The student will perform supervised experiments testing the anti-tumor activity and downstream signaling of the agent alone, and in combination with chemotherapy in several different pediatric cancer cell line models. The student will also have the opportunity to learn about pediatric cancers in general and the clinical trials process.

*Sharon Diskin*

**Project 1: Recurrent structural variation (SV) and the functional significance of SHANK2 in neuroblastoma**

Our long term goal is to define the role of structural variation (SV) in susceptibility, malignant progression, and patient outcomes in neuroblastoma (NB). Structural variations (SVs) include translocations, inversions, duplications, deletions, and other complex events that can occur in germline DNA or be acquired somatically in tumors. We analyzed whole genome sequencing data from 106 matched tumor-normal pairs from high-risk NB patients through the NCI-TARGET initiative to map SV breakpoints to single base resolution. We observed 14.4% of the MYCN non-amplified tumors (11/76) harbored breakpoints disrupting SHANK2 at chromosome 11q13, a region of recurrent loss of heterozygosity (LOH) in NB that is independently predictive of poor outcome. Our objective here is to assess the functional significance of SHANK2 in neuroblastoma. First, we will perform an integrative in silico characterization of SHANK2 utilizing existing sequence- and array-based genomic, transcriptomic and epigenetic data from thousands of well characterized germline samples and primary NBs obtained at diagnosis. Second, we will modulate SHANK2 expression and perform in vitro functional studies using human derived neuroblastoma cell lines to determine the role of SHANK2 in cell proliferation, viability and differentiation. Completion of this project will provide important insights into the biological significance of SHANK2 disruption in NB and identify pathways that may be exploitable therapeutically in this important childhood cancer. Students will culture NB cells and perform cell proliferation and viability assays to assess the function of SHANK2. Experience in an interdisciplinary laboratory setting that performs both computational and wet-bench based research will be obtained.

*Andrew Glatz*

**Project 1: The effect of cardiac catheterization on outcomes in children with moderate asymptomatic aortic stenosis**

Congenital aortic stenosis is a childhood condition in which there is obstruction of outflow across the aortic valve, the structure that separates the left ventricle from the aorta, the major artery supplying the body. This condition is often progressive, and in severe cases can lead to heart failure or sudden death. Standard treatment of severe aortic stenosis involves balloon dilation of the valve in the cardiac catheterization laboratory. Controversy exists regarding when to refer patients to the catheterization laboratory who have less severe disease and do not have symptoms, and physicians vary in their practices. We propose to study how referral to the catheterization laboratory affects outcomes in this important disease. We seek a motivated, detail-oriented student to create the study database. This work will involve reviewing medical records to identify study subjects and abstracting clinical and outcomes data about selected subjects. The student will have regular meetings with the study team and have close supervision from the senior cardiology fellow who is the lead investigator on the project. As per the student's interests, educational conferences may be attended within CHOP cardiology or general pediatrics, and observer experiences can be arranged in the cardiac catheterization laboratory, echocardiography laboratory, inpatient units or outpatient clinic. We hope to provide the student with an introduction to clinical research methods and databases, using the electronic medical record, anatomy and physiology in congenital heart disease, and clinical care in pediatric cardiology.

**Project 2: Determinants of freedom from aortic valve replacement in children with severe aortic stenosis**

Aortic stenosis is a condition marked by obstruction across the aortic valve which lies between the left heart and the aorta, the major artery supplying the body with blood. This condition often worsens over time, and the obstruction to blood leaving the heart can lead to progressive heart failure or even sudden death. While this condition may become apparent at any age, the congenital form of this disease may be severe enough to require an intervention in the first year of life. The typical treatment of aortic stenosis is a transcatheter balloon dilation, a procedure in which a narrow balloon is threaded through the leg vessels into position across the valve within the heart and inflated in order to open the stenotic valve. During the past few decades of experience in performing this procedure, certain variables in technique as well as in the anatomical details of the patients themselves have come to be recognized as risk factors for worse outcomes. An ideal outcome of this early intervention would be freedom from needing either another balloon procedure or surgical valve replacement, but it has become clear that certain factors seem to be associated with the need for earlier future interventions. We seek a motivated student to assist us in studying the effect of these variables on such outcomes in our patient group. We believe there are important anatomical factors which have not yet been

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identified as carrying risk for poorer outcomes that we may be able to identify through this work. This work will involve reviewing medical records, essentially to associate preoperative and intraoperative parameters with clinical outcomes. The student will have regular meetings with the study team and have close supervision from the cardiology fellow who is the lead investigator on the project. In addition to this introduction to clinical research methodology, this is also an opportunity for the student to attend educational conferences within our cardiology division or within general pediatrics. Observer experiences may be arranged in the cardiac catheterization laboratory, echocardiography laboratory, inpatient units or outpatient clinic.

*John Maris*

**Project 1: Immunogenomics for pediatric cancers.**

The student would work within a large multi-institutional collaborative research project designed to discover and develop new immunotherapies for children with high-risk cancers.

**Project 2: Molecular Pediatric Oncology**

The student would work within an academic lab with industry collaborators to discover new mutations that drive aggressive neuroblastomas and design molecular intervention strategies that would be tested in the lab prior to clinical trials.

**Project 3: Targeted radiotherapy for neuroblastoma.**

The student would work with cancer researchers and radiochemists to develop new methods to target childhood neuroblastoma with potent systemically administered radiation therapies.

*Laura Mercer-Rosa*

**Project 1: Outcome and Right Ventricular Remodeling in tetralogy of Fallot**

This clinical research project focuses on outcomes after surgical repair for tetralogy of Fallot (TOF), the most common form of cyanotic congenital heart defect. The goals of project focus on two main questions related to TOF. First, surgical repair (mandatory in TOF) is electively performed in the first few months of life to avoid cardiac surgery in the neonatal period. However, the severely cyanotic patient that requires intervention in the neonatal period (first month of life) can undergo either a complete surgical repair or a staged repair. The staged repair consists of a neonatal palliative procedure followed by complete repair in subsequent months. Each approach has advantages and disadvantages, and the choice is center-dependent and highly debated. We propose to address this debate by conducting a retrospective cohort study using data from 42 children's hospitals to examine the outcome associated with the two approaches. Second, the right ventricle (RV) in TOF changes in size, geometry and function after surgery in

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response to surgery itself and from residual lesions resulting from the repair, such as pulmonary insufficiency. The clinical response to the RV remodeling is quite variable and the determining mechanisms are poorly understood. We are conducting a prospective cohort study of TOF patients to detect adverse RV remodeling in the post-operative period with sensitive imaging markers and circulating biomarkers. We will set up future studies that will lead to improved outcomes in children with TOF.

### **Project 2: Effect of Peak Exercise on Right ventricular Function and pulmonary insufficiency in children and adolescents operated for total**

This project will investigate the response of the right ventricle to peak physical activity in patients operated for tetralogy of Fallot. In this disease, the right ventricle suffers from leaking of the pulmonary valve and gets dilated over time and patients do not exercise well. We have never investigated the changes that occur in the right ventricle at peak exercise, to ascertain whether the right ventricle responds well to physical activity or not. We will use echocardiograms performed at rest and at peak exercise in patients presenting to the exercise laboratory at CHOP. We will do measurements of pulmonary insufficiency and right ventricular function and compare those changes.

*Laura Phillips*

### **Project 1: Predicting Bacteremia in Children with a Central Venous Line**

Many chronically ill children, such as children with cancer or intestinal failure, must live with central venous lines in place. These central venous lines provide life-saving treatments, but they also increase the risk of serious bacterial bloodstream infections. Given this risk, children with central venous lines are required to report to the hospital for admission and broad-spectrum antibiotics every time they develop a fever. The majority of the time, however, their fever is not the result of a bloodstream infection, but instead is due to a virus, ear infection, or other common, mild pediatric illness. These unnecessary admissions and treatments disrupt family life, expose already ill patients to the risk of secondary infections during hospitalization, and contribute to antibiotic resistance. My project aims to identify factors, such as height of fever, type of central line, patient age, etc., which could be used to predict when a particular child who develops a fever may safely avoid hospital admission and exposure to antibiotics. This patient-centered project will involve retrospective data collection and interviews of families admitted to CHOP for central line-fever “rule-out.” The participating student(s) will be involved in data collection and chart review and will recruit patients and staff for interviews. Highly motivated students could develop their own secondary project using the data collected or could continue working on this project after the summer, earning a position on the final publication. Students applying should have good interpersonal skills, be highly detail oriented, and have an interest in medicine as a career.

*Richard Rutstein*

**Project 1: Hepatitis B immunity in HIV infected children**

HIV-infected youth may have blunted responses to Hepatitis B infection, putting them at risk for acquisition of infection in adolescence. Co-infection with HIV and Hepatitis B is common, and can lead ultimately need for liver transplantation. The aim of the study is to document need for booster Hepatitis B shots in this population to prevent acute and chronic Hepatitis B infection. Student will be involved in chart abstraction, data entry and data analysis. Subjects are HIV-infected youth, from birth to 24, followed a tertiary care site. Student will learn basics of HIV infection (monitoring via CD4 counts and viral studies), immunity based on immunizations (following of antibody titers) and aspects of chart review studies (both written and electronic charts). Data will be entered into Excel data base, and analyzed using STATA data analysis software. The student will be involved in chart review (electronic and written), development of case report forms, data entry and data analysis. The student will learn the basics of developing and implementing retrospective studies in this population.

**Project 2: Incidence of Sexually Transmitted Infections among HIV-infected youth**

Urban youth are at high risk for acquiring sexually transmitted infections, and in turn are at risk for transmitting HIV to their partners (and the risk of transmission of HIV is increased in those with other STIs). The study aim is to document the incidence of STI infections in HIV-infected youth (both perinatally acquired and in those with behaviorally acquired HIV infection). The study will be directed by Dr. Rutstein (Perinatally Acquired HIV subjects ) and Dr. Nadia Dowshen (subjects with non-perinatally acquired infection). The student will be involved in chart review (electronic and written), development of case report forms, data entry and data analysis. The student will learn the basics of developing and implementing retrospective studies in this population.

*Lisa Schwartz*

**Project 1: Technology-Focused Intervention for Adolescents and Young Adults Completing Treatment for Cancer**

Adolescents and young adults (AYA) completing treatment for cancer are at risk for relapse, poor engagement in follow-up care, and poor quality of life as they work to balance “normalcy” with continued health vulnerability. I am currently piloting a texting intervention for AYA completing treatment for cancer. The study is randomized controlled trial whereby AYA are randomized to receive daily texts about ways to stay healthy, adapt to life after cancer, and engaged in their follow-up care, or they receive a AYA survivorship handbook with similar information. By June, the pilot intervention will be complete and we will begin planning for the

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next phase of the program of research. A summer intern would be able to assist with a subsequent study that would elicit feedback from the AYA participants about the intervention and ways to improve it, both in terms of content and technology used. Specifically, the intern would help to contact participants, interview them, and summarize the qualitative data. The intern would also assist with a comprehensive review of the literature and review of other related interventions in order to guide development of the next iteration of the intervention. The long-term goal of this program of research, of which a summer intern would be a part, is to develop an updated intervention that includes tailored educational, motivational and behavioral strategies delivered through text messages and modules accessible on a mobile phone, tablet, or computer. There will also be opportunities to be involved in other behavioral oncology research. The intern should have strong interpersonal, organizational, and analytic skills. Comfort working in a hospital setting and with pediatric oncology patients is also necessary.

*Flaura Winston*

**Project 1: Simulated Driving Assessment as an Adjunct to Driver Licensing and Training**  
**Rising Juniors only**

Motor vehicle crashes involving young drivers is the leading cause of death for 15- to 20-year-olds and although young drivers account for only 6% of licensed drivers, they contribute to nearly 10 percent of drivers in fatal crashes and 13 percent of drivers in police-reported crashes. Driving simulators offer a safe complement to on-road driving for the evaluation of driving performance, and allow for controlled manipulations of traffic situations that can be replicated across participants for consistent exposure and reliable assessment. In addition to age, a wide range of acute and chronic conditions can exacerbate deficits in driving ability yet no current test accurately quantifies driving risk for any population, particularly for adolescent drivers, the population most at risk for crashing. The primary objectives of this exploratory project are: (1) to examine the relationships between performance in the Simulated Driving Assessment (SDA) and driving performance on a practice on-road licensure exam routinely administered by a certified driving school and (2) to identify opportunities to enhance driver training [ADD the following] with the simulated driving assessment.

**Project 2: mHealth: Evaluating apps that improve health**    **Rising Juniors only**

The rapid emergence of mobile health applications (“mHealth apps”) has disrupted the “standard” process of medical vetting and testing before distribution, and currently many mHealth apps are developed outside of the healthcare arena with limited access to healthcare expertise, medical evidence or evaluation. As the mHealth market matures, the need to prove effectiveness and healthcare value will be essential in order to integrate these innovative mHealth apps into practice. The objective of this project is to contribute to the development of analytical tools and support research studies that utilize a new Software-as-a-Service platform for

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use in evaluating apps, website and other digital health tools. By integrating scientifically based evaluation methods and metrics valued and commonly recognized by the healthcare industry, your work will guide further development of our evaluation platform and that of apps to ensure that they have optimal benefits on health and wellness.

**Project 3: Diagnosing Driving - Simulators, Measures and Outcomes**     **Rising Juniors**  
**only**

Motor vehicle crashes are a leading cause of mortality and morbidity in the US with annual deaths exceeding 30,000 and injuries exceeding 2.2 million in more than 5 million police-reported crashes. Safe driving and crash avoidance rely on driver physical and emotional health, judgment, attention, perception, cognition, memory, skill and response time. Clinical tests, fitness to drive protocols and on-road tests are used to determine license issuance, renewal and revocation yet these tests have little or no scientific foundation or validation regarding crash risk; none can define level and nature of safe driving risk to inform remedial management plans, and as most are specific to conditions, none can assess safe driving among adolescent drivers, the age group with the highest crash risk. There is no evidence that passing a state licensing exam is related to safer driving. Further, there are reports of crashes during on-road examinations, putting examiners at risk. The need is great for a valid, widely available method for assessing driver performance as it relates to ability to avoid crashes. The objective of this project is to advance the technology and analytical tools of our Simulated Driving Assessment (utilizing a state-of-the-art driving simulator, head/eye-tracking and other tools to enhance its utility as a functional measure of driving performance for deployment in state Department of Motor Vehicle offices, clinical settings and schools.

## PSYCHIATRY

*Kelly Allison*

**Project 1: Effect of Delayed Eating on Weight and Metabolism**

Of the many factors contributing to the obesity epidemic, the timing of food consumption is now recognized as a significant contributor to body weight regulation. Disruption of the normal timing of feeding in mice has been found to promote weight gain, alter serum leptin levels, and induce hypothalamic leptin resistance. Delays in daytime eating have also been found to increase the risk of obesity and metabolic syndrome in humans. Disrupting normally-timed sleep-wake cycles produces major effects on body weight, adiposity, and metabolism, but it remains unclear whether meal timing independently plays a causal role in metabolic dysregulation when sleep-wake cycles are unaltered. The purpose of this study is to determine if daytime vs. delayed eating affects body mass, adiposity, and energy metabolism in healthy adults, while controlling for eating and sleep timing, caloric intake, and exercise. All food will be provided to the participants

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through HUP's metabolic kitchen during the study to control for caloric and macronutrient content. In this project, the student will help with several aspects of the study, including recruiting and screening participants, setting up for inpatient assessment visits, delivering food and study supplies to participants, data entry, and attending study meetings. The student will be encouraged to write a chapter, peer-reviewed paper, and/or abstract for a presentation with the investigators based on this area of research. Strong self-initiation and organization skills, along with excellent verbal and written communication skills, are required.

### ***C. Neill Epperson***

#### **Project 1: Impact of Early Life Adversity on Cognitive Aging at Menopause**

Stress/adversity do not always lead to disease, indicating there are critical individual and environmental factors that promote risk and resilience. In preclinical studies, the specific impact and degree of "impairment" due to early life stress depended on multiple factors including timing with respect to developmental and reproductive windows, severity and degree of individual control over stress, the type of stress, outcomes, and genetics/epigenetics of the animal. Behavioral, endocrine, immune or brain changes observed in stress sensitive animals are generally lacking or reduced in their resilient counterparts. Importantly, stress exposure early in life appears to "inoculate" individuals to the sequelae of stress and creates a "resilient" phenotype if the stressor is relatively mild, intermittent and the individual is allowed the "support" of the mother or social group upon completion of the stress or is provided environmental enrichment later in life. Active coping such as using less submissive posturing during the social defeat stress paradigm have been associated with a more resilient phenotype when tested later in life. McEwen and others have proposed that similar phenomenon holds true for humans, although the specifics of such, meaning the degree of stress that is tolerable and which coping, environmental or other mitigating psychosocial or biologic factors most predict risk and resilience remain unclear. This project will shed light on these factors by taking advantage of a well-characterized sample of AA and Caucasian women [Penn Ovarian Aging Study (POAS) Cohort] who have undergone yearly psychosocial, behavioral and endocrine evaluations across menopause. We will examine these data in relation to important endocrine (menopause transition) and immune (cytokines, markers of inflammation) factors as they are known to impact mood and cognition and may be targets for intervention development. Students involved with this project would be responsible for accompanying research staff on home visits to collect additional cognitive, behavioral and biological samples from POAS participants. Students would gain experience using standardized psychiatric assessments, as well as, paper and pencil and computer administered cognitive testing. This project is ideal for a student who is interested in the effects of early life stress on adult health outcomes and the impact of reproductive changes on mood and cognition. Students would participate in this and other studies within the Center should they find other projects also of interest. The Penn Center for Women's

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Behavioral Wellness typically hosts several summer interns each year, providing a community of learners for PURM students. The Center is also open to having PURM students continue their scientific pursuits during the academic year. In the past PURM students and other interns in the Center have completed independent studies, published manuscripts, presented at national meetings and conducted honors level research. The Center seeks highly dedicated individuals who are sincerely interested in scientific inquiry for the sake of learning and not simply as a stepping stone to medical school.

### **Project 2: Multi-Modal Brain Imaging: Application to Nicotine Dependence and/or Cognitive Decline with Menopause**

Multi-modal brain imaging is increasingly used to simultaneously collect information regarding brain neurochemistry, structure and function within an individual's subject. Our laboratory utilizes both functional magnetic resonance imaging (fMRI) and proton magnetic resonance imaging (1H-MRS) in two different studies, both available to PURM students. The first study focuses on sex and gender differences in smoking cessation and the impact of the neurosteroid allopregnanolone (ALLO) on brain gamma aminobutyric acid (GABA) levels and brain activity at rest and during performance of a working memory task. ALLO levels are manipulated by the administration of progesterone to both male and female smokers while they are abstinent from smoking for 3.5 days. Students would learn about underlying neurochemical effects of nicotine and the evidence for gender/sex differences in nicotine dependence and its treatment. Students would be expected to help recruit and screen smokers for participation, accompany smokers to brain imaging studies, help smokers maintain abstinence through contingency management, conduct behavioral assessments and smoking sessions. The second study to utilize multi-modal imaging focuses on the cognitive effects of abrupt, premature menopause due to cancer risk reduction procedures in women who are BRCA1 and BRCA2 mutation positive. The overarching goal of this project is to determine the impact of the psychostimulant lisdexamfetamine (LDX) on executive functions and brain chemistry and function among women who have undergone risk reduction salpingo-oophorectomy and are experiencing significant cognitive difficulties. Students would learn about the role of ovarian hormones in cognition, the impact of LDX on brain chemistry and how to screen women for executive function difficulties. Students would be involved in recruitment and managing participants through this study in addition to the Center's other brain imaging study focusing on estradiol's effects on brain function and cognition at menopause. Both projects are on-going and offer the opportunity for continued academic pursuits throughout the year.

### **Project 3: Psychophysiology of Premenstrual Dysphoric Disorder**

Premenstrual dysphoric disorder (PMDD) is a behavioral disturbance that is entrained to the menstrual cycle, with significant negative mood symptoms occurring consistently during the premenstrual phase and resolving within a few days of onset of menstruation. This project focuses on the pathophysiology and mechanism of treatment of PMDD, specifically the role of

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gamma aminobutyric acid and specific brain regions on arousal regulation and response to treatment with the selective serotonin reuptake inhibitor sertraline (Zoloft). Students would learn about psychophysiology and how to utilize various acoustic startle techniques to assess arousal regulation. Students would learn about reproductive neuroendocrinology across the female lifespan and in particular during the reproductive years when up to 8% of women experience the symptoms of PMDD. Again, there is opportunity for continued scientific inquiry during the academic year as this project is on-going.

***Deborah Kim***

**Project 1: Transcranial Magnetic Stimulation in Depressed, Pregnant Women**

Pregnant women with major depressive disorder are randomized to active or sham TMS. We are preparing to put in a larger, multi-site grant. We are adding a fMRI option to this study for 2 women to show the feasibility of a biological target for this grant. The student would be involved in recruiting and working with subjects under the guidance of a senior research coordinator. They would learn about antenatal depression, potential treatments and the use of TMS. I would meet weekly with the student to talk about papers or other issues of interest. I have been a PURM mentor in the past and continue to have a mentoring relationship with this student. If the student is interested in working longer with our group, sometimes that is an option.

**Project 2: The Impact of Early Life Adversity During Pregnancy and Postpartum**

This is a large study with multiple components which looks at the effect of early maternal stress and trauma on the pregnancy, fetal adrenal gland growth and infant outcomes. The student would pick a particular part of the project that interests them most. They could be involved in recruitment and working with subjects. They could focus more on database work and learning to read medical records if preferred. All work is done under the guidance of a research coordinator. I would meet weekly with the student to talk about papers or other issues of interest. I have been a PURM mentor in the past and continue to have a mentoring relationship with this student. If the student is interested in working longer with our group, sometimes that is an option.

***R. Christopher Pierce***

**Project 1: Transgenerational influence of paternal cocaine self-administration on behavior and physiology**

We recently established a rat model to examine the influence of paternal cocaine self-administration on the behavior of progeny. In our paradigm, male rats self-administered cocaine for 60 days; controls were administered saline. The day after the last self-administration session, they were paired with naïve females. The offspring of these matings were tested for acquisition

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of cocaine self-administration and memory formation. Our results indicated that the male offspring, but not the female offspring of cocaine-experienced sires acquired cocaine self-administration more slowly and had decreased levels of cocaine intake relative to controls. Moreover, control animals were willing to work significantly harder for single cocaine infusions than the cocaine-sired rats, suggesting that the rewarding effect of cocaine was decreased. In addition, some forms of learning also appear to be impaired in cocaine-sired offspring. The goal of this project is to further define potential learning deficits in cocaine-sired offspring using memory tasks such as the Morris water maze, and novel object recognition. These experiments will be combined with molecular approaches to examine the cellular and molecular mechanisms underlying the observed learning impairments.

*Theodore Satterthwaite*

### **Project 1: Exploring Reward System Dysfunction in Psychiatric Disease Using Behavioral Economics and Functional MRI**

The lack of ability to experience pleasure, or anhedonia, is at the center of multiple devastating psychiatric conditions. In addition to depressed mood, it is a core symptom of a major depressive episode in the context of either unipolar major depressive disorder or bipolar affective disorder. Anhedonia is also one of the cardinal negative symptoms in schizophrenia, which substantially worsen long-term outcomes in affected patients. Regardless of the underlying clinical diagnosis, the presence of anhedonia has been shown to be associated with poor treatment response. Despite this, the neurobiological substrates of anhedonia have received relatively sparse attention in clinical populations. In collaboration Dr. Joseph Kable (Department of Psychology), we have recently completed a study examining anhedonia and dimensional reward system impairment in multiple psychiatric populations using a combination of techniques including behavioral economic paradigms, detailed clinical assessments, and functional (task-based) MRI. We open to having a motivated undergraduate join our research team this summer. The primary responsibilities would be working with post-doctoral fellows, research staff, and faculty to conduct both basic and more advanced analyses of this rich dataset. As such, experience with statistics, fMRI analysis software, data analysis packages (e.g., R or Matlab), and basic scripting languages (e.g., Unix shell) is highly desirable. However, this is not an absolute pre-requisite and highly motivated students who are interested in pursuing a career in behavioral/cognitive neuroscience or academic psychiatry (Ph.D., M.D./Ph.D.) should consider applying. The successful student will have the opportunity to write manuscripts and present data at regional and national meetings.

### **Project 2: Exploring Anhedonia Across Psychiatric Syndromes Structural MRI**

The lack of ability to experience pleasure, or anhedonia, is at the center of multiple devastating psychiatric conditions. In addition to depressed mood, it is a core symptom of a major depressive

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episode in the context of either unipolar major depressive disorder or bipolar affective disorder. Anhedonia is also one of the cardinal negative symptoms in schizophrenia, which substantially worsen long-term outcomes in affected patients. Regardless of the underlying clinical diagnosis, the presence of anhedonia has been shown to be associated with poor treatment response. Despite this, the neurobiological substrates of anhedonia have received relatively sparse attention in clinical populations. We have recently completed a study examining anhedonia in a large sample of patients across psychiatric conditions (schizophrenia, bipolar disorder, major depression) who also were imaged using structural MRI. We open to having a motivated undergraduate join our research team this summer. The primary responsibilities would be working with post-doctoral fellows, research staff, and faculty to conduct both basic and more advanced analyses of this rich dataset. As such, experience with statistics, structural MRI analysis software, data analysis packages (e.g., R or Matlab), and basic scripting languages (e.g., Unix shell) is highly desirable. However, this is not an absolute pre-requisite and highly motivated students who are interested in pursuing a career in behavioral/cognitive neuroscience or academic psychiatry (Ph.D., M.D./Ph.D.) should consider applying. The successful student will have the opportunity to write manuscripts and present data at regional and national meetings.

***Robert Schultz***

**Project 1: Validating a new, online IQ test for use with children with autism**

Individuals with Autism Spectrum Disorders have a broad range of cognitive functioning, and diagnostic assessments almost always include an IQ assessment. Current IQ tests require families to come to the lab in order for a clinician to administer an hour-long IQ test. We are developing a computer-adaptive IQ test that children can take online at home. This would be much more convenient for families and cost-effective for researchers. We plan to use this test in many future studies of children and adults with autism. The goal of this project is to compare our new, online IQ test to the standard, clinician-administered IQ test. Student Research Assistant (RA) responsibilities will include recruiting adults and children from the community to come to the Center for Autism Research to take both the new and old IQ tests. The RA will screen people for eligibility, schedule appointments, meet participants and obtain their consent to participate in the study, work with clinicians who administer the IQ test, enter data and maintain all study-related materials. The RA will participate in twice-weekly lab meetings at the Center for Autism Research (CAR) with Dr. Schultz and other researchers and work closely with a graduate student in clinical psychology. At the end of the summer, the RA will analyze the data and present the findings of the study at a lab meeting or department poster session.

*Steve Siegel*

**Project 1: Animal Models of Brain Abnormalities in Schizophrenia**

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

*Michael These*

**Project 1: Multicomponent Yoga Intervention for Major Depressive Disorder Study**

According to the World Health Organization, compared to two hundred health conditions, depression is ranked as the second leading cause of disability worldwide. The annual prevalence of Major Depressive Disorder (MDD) in the United States is estimated at 7% and the lifetime risk approximately 17%. Psychopharmacology and psychotherapy are effective treatments for MDD, but only in 35%-50% of cases. Furthermore, 50% of patients treated with two trials of antidepressant interventions do not achieve clinical remission. Thus, additional evidence-based treatment modalities that can further treat this devastating disorder are needed. Mind-body interventions constitute a large and diverse group of practices that are increasingly being evaluated in the treatment of MDD. While a number of initial studies demonstrate positive effects of these interventions for MDD, much is unknown about the mechanistic features of these and other mind-body interventions. We are currently conducting a research study evaluating a multicomponent yoga intervention for MDD. This study evaluates the effects of the intervention on both clinical symptoms of depression and anxiety as well as biochemical markers of stress and inflammation. Interested undergraduate students will work with faculty, staff and fellows. They will learn about clinical trial design and implementation, support study recruitment and patient screening and assist in data entry and analysis.

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

*Michael Shashaty*

### **Project 1: Adipose inflammation as a cause of organ dysfunction in critically ill trauma patients**

This project is a great opportunity for students interested in a clinical or research career. Students will gain experience in clinical and translational research, have the opportunity to work with human subjects, and have the chance to witness various aspects of care for trauma patients including acute resuscitation, operations, and ICU care. This translational human cohort study aims to determine the molecular mechanisms underlying the association of obesity with acute renal failure (also known as acute kidney injury, or AKI) in trauma patients requiring intensive care. Obese patients are at significantly higher risk of AKI after major trauma, and we hypothesize that a profound inflammatory response in adipose tissue, with subsequent inflammatory insult to the kidneys, may be responsible. In order to test this hypothesis, we are obtaining blood, urine, and subcutaneous fat samples from trauma patients shortly after emergency department arrival. Expression of key inflammatory genes in fat and blood will be tested and compared with healthy controls to determine the extent of adipose inflammation in response to trauma, and if this correlates with the development of AKI. Students will have the opportunity to: evaluate patients in the emergency department trauma bay and in the trauma ICU for potential study enrollment, assist with obtaining patient or family consent, assist with acquisition and processing of fat, blood, and urine specimens in the operating room and the ICU, and collect patient information from the electronic medical record into a computerized database. In tandem with the adipose study, students will screen new trauma patients for possible enrollment in a clinical trial designed to test the effectiveness of a novel therapy for patients with acute massive blood loss. The opportunity to work on these projects may be extendable into the school year. Prerequisites: Students should be enthusiastic about biomedical research, be ready to adhere to patient privacy standards, and be interested in working collaboratively with our research team.

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

This project is, similar to Project 1, a great opportunity for students interested in a clinical or research career. Students will gain experience in clinical and translational research, have the opportunity to work with a longitudinal human cohort study, and have the chance to witness various aspects of care for trauma patients including acute resuscitation, operations, and ICU care. This human cohort study is an ongoing project designed to determine clinical and molecular/genetic risk factors for the development of organ dysfunction, such as acute kidney injury (AKI) and the acute respiratory distress syndrome (ARDS), after major trauma. The cohort has been the source of numerous prior publications in the critical care literature including

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studies identifying obesity and race as risk factors for AKI, blood type as a risk factor for ARDS, and certain genetic variations as conferring risk for organ dysfunction. Ongoing projects include studies of the association of intraabdominal pressure and muscle damage with AKI after trauma as well as molecular studies investigating why type A blood confers increased risk of ARDS after trauma. The opportunity to work on this project may be extendable into the school year. Students will have the opportunity to: collect patient information from the electronic medical record into a computerized database, gain experience reading medical charts, collect and process blood specimens from the clinical lab, participate in weekly meetings to learn about the conduct of a clinical research study. Through the connections made in this study, opportunities may be available for shadowing physicians working in the ICU setting. The opportunity to work on this project may be extendable into the school year.

## **RADIATION ONCOLOGY**

*Surbhi Grover*

### **Project 1: Subtypes of HPV and outcomes of patients with HPV related cancers in Botswana Project *Rising Juniors only***

This project will be studying HPV subtypes found in patients with HPV related cancers in Botswana (with or without HIV.) This is a prospective study and patients will be followed in oncology clinic during treatment and for 2-3 years after treatment.

Student duties: consenting patients, data collection at initial visit and on treatment visits, making follow up phone call and data entry into redcap.

Prerequisites: Pre-medical students interested in research, medical writing. Basic understanding of statistics would be helpful. Interest in living in Botswana over the summer.

### **Project 2: Presentation and outcomes of patients with Breast Cancer in Botswana *Rising Juniors only***

This study will be looking at presentation and outcomes of patients with breast cancer in Botswana. We are particularly interested in interaction of HIV and breast cancer biology.

Student duties: consenting patients, data collection at initial visit and on treatment visits, making follow up phone call and data entry into redcap.

Prerequisites: Pre-medical students interested in research, medical writing. Basic understanding of statistics would be helpful. Interest in living in Botswana over the summer.

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**Project 3: Delays in Cancer Treatment in Botswana** ***Rising Juniors only***

This is a survey study focused at understanding causes of delays in presentation and treatment in patients with cancer presenting in Botswana.

Student duties: consenting patients, treatment delays survey at initial visit, entering data entry into redcap.

Prerequisites: Pre-medical students interested in research, medical writing. Basic understanding of statistics would be helpful. Interest in living in Botswana over the summer.

*Neha Vapiwala*

**Project 1: Impact of Breast MRI on Long-term Outcomes in Breast Cancer Patients**  
***Rising Juniors only***

Use of MRI for Breast Cancer patients. We wish to update a previously studied patient population of breast cancer patients who have undergone breast conservation treatment at University of Pennsylvania. Our primary goal is to evaluate long-term local disease control as a function of the use of MRI vs no MRI during patient workup. Secondary aims will include rates of contralateral breast cancer, overall survival, and distant metastatic disease between these two groups. We also wish to integrate more recently treated breast cancer pts, to evaluate the potential effect of (presumptively) improving MRI technology over time.

**Project 2: Post-prostatectomy Radiation Outcomes** ***Rising Juniors only***

Prostate cancer patients who undergo primary surgical treatment with prostatectomy may require radiation in the adjuvant (upfront) or salvage (at time of recurrence) setting. We wish to analyze our post-prostatectomy prostate cancer patient population to determine the long-term outcomes in terms of disease control as well as genitourinary and gastrointestinal toxicities.

## **SURGERY**

*Pavan Atluri*

**Project 1: Bioengineered shear-thinning gels deliver endothelial progenitor cells, and stabilize regional ischemic myocardium**

Ischemic heart disease is a leading cause of death, and current therapies fail to address the microvascular deficiencies that patients face. We have previously demonstrated the efficacy of endothelial progenitor cells in revascularizing ischemic myocardium, and thereby improving heart function. However, the translatability of cell based therapy for ischemic heart disease has

been limited due to low cell retention and poor targeting to ischemic myocardium. We have developed a novel injectable shear-thinning hyaluronic acid hydrogel (STG) and endothelial progenitor cell construct (STG-EPC) to overcome these barriers. This directed therapy to the ischemic myocardial borderzone enables direct cell suspension delivery and stabilization of infarcted myocardium to minimize adverse ventricular remodeling. We hypothesize that this system provides a clinically translatable therapy for robust vasculogenesis and myocardial stabilization. The project will entail harvesting primary cells, making the tissue-engineered construct, using a rat model of ischemic cardiomyopathy to test the efficacy of the cell-delivery platform. The student will actively participate in all stages of the research, including methods formulation, experimentation, and data interpretation and reporting. Specifically, the student will gain experience in small animal cardiac surgery, sectioning and staining of post-surgical tissues, isolating and culturing primary cells, and acquiring and analyzing hemodynamic data.

### **Project 2: Tissue-engineered hydrogel as a platform for delivering cardiac stem cells to repopulate ischemic myocardium**

Following a myocardial infarction which leads to cell death, the ischemic myocardium has a very poor capacity for regeneration. A small percentage of cells in the myocardium are resident cardiac stem cells, which have the capacity to differentiate into cardiomyocytes, and therefore provide a functional benefit by ultimately repopulating the area of ischemia. We hypothesize that delivering these cells by way of a hydrogel construct will overcome the limitations of cell dispersion and retention, improve functional outcomes, and ultimately limit ventricular remodeling. The project will entail isolating and characterizing primary cardiac stem cells in rats, making the hydrogel construct, using a rat model of ischemic cardiomyopathy to test the efficacy of the cell-delivery platform. The student will actively participate in all stages of the research, including methods formulation, experimentation, and data interpretation and reporting. Specifically, the student will gain experience in small animal cardiac surgery, sectioning and staining of post-surgical tissues, isolating and culturing primary cells, performing flow cytometry, and acquiring and analyzing hemodynamic data.

### **Project 3: Sustained release of miRNAs in injectable hydrogels induce cardiac regeneration**

Following a myocardial infarction which leads to cell death, the ischemic myocardium has a very poor capacity for regeneration. Natively, cardiomyocytes have a very low turnover rate. Recently, research in the field has focused on miRNAs that can induce cardiomyocytes to proliferate in vitro. We hypothesize that delivering these miRNAs in a sustained release hydrogel construct will limit degradation of the miRNAs while inducing cardiomyocytes in the area of ischemia to proliferate. The project will entail isolating and characterizing primary cardiomyocytes in rats, making the hydrogel construct, using a rat model of ischemic cardiomyopathy to test the efficacy of the drug delivery platform. The student will actively participate in all stages of the research, including methods formulation, experimentation, and data interpretation and reporting. Specifically, the student will gain experience in small animal

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cardiac surgery, sectioning and staining of post-surgical tissues, isolating and culturing primary cells, performing flow cytometry, and acquiring and analyzing hemodynamic data.

## **Nursing**

### **BIOBEHAVIORAL HEALTH SCIENCES**

*Bart De Jonghe*

#### **Project 1: The Neurobiology of Nausea**

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

*Lea Ann Matura*

#### **Project 1: Feasibility of slow-paced respiration therapy for treatment of a symptom cluster in Pulmonary Arterial Hypertension**

Pulmonary arterial hypertension (PAH) is a chronic illness characterized by increased pulmonary pressures resulting in right heart failure and premature death. Common symptoms that impair quality of life and functioning are dyspnea, fatigue and sleep disturbance. This trio of symptoms is highly prevalent and forms a symptom cluster (2 or more symptoms that co-occur) in PAH. From a biological, proinflammatory cytokines are implicated in dyspnea, fatigue and sleep disturbance; there is activation of the sympathetic nervous system (SNS) and an inherent

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inflammatory process in PAH that contributes to the pathophysiology, but the link to this symptom cluster has not been investigated. One novel, treatment for symptom clusters is slow-paced respiration therapy using the FDA-approved device, RESPeRATE. The device contains headphones and a sensor that attaches to the chest to detect inhalation and exhalation. Musical tones synchronize with the respiratory cycle to slowly guide the user to decrease respirations. RESPeRATE moderates effects of the SNS; lowers blood pressure; improves functional capacity and ejection fraction; and significantly decreases pulmonary pressures in left heart failure. Participants will use the RESPeRATE device to perform slow-paced respiration for 15 minutes per day for 8 weeks to determine the feasibility and effects on the SNS and inflammatory activity and the symptom cluster. Our overall hypothesis is that, as compared to baseline, after eight weeks of therapy participants who receive slow-based respiration therapy will have lower SNS activity and inflammatory levels, and improved dyspnea, fatigue and sleep disturbance. Students will need to know basic library research skills and knowledge of working with Microsoft office.

### **Project 2: Mechanisms of a Symptom Cluster: Dyspnea, Fatigue and Sleep Disturbance in Chronic Illness**

Symptom clusters are the co-occurrence of two or more symptoms that are related. The symptom cluster dyspnea, fatigue and sleep disturbance is common and negatively affects health-related quality of life in people with pulmonary arterial hypertension (PAH). Determining underlying biological mechanisms is essential to develop and test biobehavioral interventions to target these mechanisms and alleviate symptoms. The pathobiology involved in PAH includes activation of the sympathetic nervous system (SNS) and inflammatory pathways which may prove to impact the symptom cluster in PAH. Inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- alpha) have been associated with symptoms (dyspnea, fatigue and sleep disturbance) in other disorders. We will determine if activation of the SNS and inflammatory biomarker levels are associated with symptom cluster severity (dyspnea, fatigue, sleep disturbance). We will enroll 60 women with PAH. Our overall hypothesis is increased levels of plasma norepinephrine, IL-6 and TNF-alpha levels will be associated with symptom cluster severity in women with PAH. Students will need to know basic library research skills and knowledge of working with Microsoft office.

*Therese Richmond*

### **Project 1: Emotional responses and recovery after injury in urban Black men**

This study provides an important opportunity for a student interested reducing health disparities and improving the health of urban Black men to join an established study team in a large NIH-funded study. The purpose of this study is to examine individual, institutional, and environmental risk and protective factors from across the life trajectory in the development of psychological consequences of acute traumatic injury. Our participants are injured from a variety of mechanism

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that include motor vehicle crashes, pedestrian injuries, falls, and interpersonal violence. In our study we collect biomarkers of cellular aging, individual survey data, and geospatial variables to help us better predict our key outcomes of depression and posttraumatic stress disorder. Our intent is to better predict which subset of men will most likely develop depression and PTSD in order to design effective interventions to mitigate these sub-optimal outcomes. We currently have enrolled 400 men and plan to enroll at least another 200. A student would join our team and participate in enrollment and data collection during the time men are hospitalized in the trauma center and will accompany our team for follow-up interviews that are conducted in the men's homes at 3 months post-discharge. Opportunities to conduct literature reviews, enter quantitative data, transcribe and conduct initial analyses of qualitative interviews, and geocode current and childhood addresses are some of the activities in which a student would participate.

## **FAMILY AND COMMUNITY HEALTH**

*Catherine McDonald*

### **Project 1: Web-based Intervention for Risky Driving**

Motor vehicle crashes are the leading cause of death in teens. Passengers, texting, phone calls and mobile phone apps can take a teen's attention away from the roadway. Our research team has combined a web-based intervention with a state-of-the-art high fidelity driving simulator to help us identify whether we can help decrease teen driver inattention to the roadway. We seek a well-organized and self-directed student to assist in our recruitment, enrollment and data collection with newly licensed teen drivers for our web-based intervention and driving simulator study. Data analysis will also be started. Training will be provided and the candidate will gain skills in human subjects research, web-based intervention delivery, driving simulation, interdisciplinary communication, and scholarly presentation. We are excited to welcome a student to our team that combines nursing, medicine, engineering and public health.

## **NURSING**

*Salimah Meghani*

### **Project 1: Mechanisms of Clinical Disparities in Cancer Pain and Symptom Outcomes**

Disparities in clinical pain management and cancer symptom outcomes are well-documented, although the sources of these disparities are not fully elucidated. The goal of this summer study is to advance research on understanding sources of disparities in cancer pain and symptom outcomes using a rich clinical dataset stemming from an NIH challenge grant awarded to Dr.

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Meghani (A Novel Approach to Elucidate Mechanisms for Disparity in Cancer Pain Outcomes; 1RC1NR011591). The dataset contains variables on race (African Americans and Whites), socio-demographics, social support, health literacy, clinical status (including cancer type and stage), symptoms, and use of complementary and alternative medicine (CAM) in adult patients with solid tumors who were recruited from two outpatient medical oncology clinics in Philadelphia. The dataset also contains novel measures (e.g., choice-based conjoint analysis to understand trade-offs patients use under perceived risks in making cancer pain management decisions and MEMS® – an electronic device that captures patients' adherence /compliance to prescribed pain medications in real time). This dataset will allow asking a number of novel questions that remained unanswered and have not been analyzed before using this dataset. The PURM fellow will learn the following skills: 1) Analyze existing clinical datasets 2) Learn to navigate Institutional Review Board (IRB) process for establishing ethical conduct of a study and asking new questions of an existing dataset. 3) Learn to use data analysis software (specifically SPSS) 4) Learn to generate and interpret data outputs from statistical analysis 5) The mentee(s) will have opportunities of co-authorship on scientific posters and papers

## **Social Policy and Practice**

### **SOCIAL WORK**

*Allison Werner-Lin*

**Project 1: Applying genomic sequencing to pediatrics: An examination of the ethical, social, and relationship challenges** ***Rising Juniors only***

This study examines the ethical and social challenges of offering complex, cutting edge genetic testing to five pediatric disease cohorts receiving care at Children’s Hospital of Philadelphia as part of the National Institutes of Health’s Clinical Sequencing Exploratory Research program. This technology enables examination of most human genes to identify the cause of a condition. In the research context, informed consent for genomic sequencing requires that providers introduce procedures, complex genomic concepts, and risks and benefits of participation to families who are often struggling with poor health literacy, limited resources, and very sick children. Of particular interest are informed consent procedures for families with child and adolescent patients who cannot legally consent to the research process, but who may experience distinct risks as a result of participating in such research. This summer the research team will: examine data from informed consent sessions with children and families; continue dissemination of research findings in the form of academic papers and conference presentations; and begin analysis on data regarding sessions in which families learn their child’s genetic testing results. Students will learn the fundamentals of qualitative data analysis and will participate actively in coding interview data with the research team. Students will attend monthly meetings with the interdisciplinary team of researchers, which includes genetic counseling, social work, psychology, medical genetics, and bioethics. Students will be exposed to the inner workings of a national funded research project and will acquire basic proficiency in genetic terminology.

## **Veterinary Medicine**

### **CLINICAL STUDIES/NEW BOLTON CENTER**

*Zhengxia Dou*

#### **Project 1: Dining hall food waste stream**

The AIM of this project is to research campus dining hall food wastage and affecting factors. BACKGROUND: Food loss and waste in America is huge, 90 billion lbs. annually at the consumer level alone. Wasted food means wasted resources (land, water, nutrients, energy, labor, etc.) and lost opportunities to feed hungry people. Further, wasted food decays and emits methane, the latter is roughly 30 times more potent as a heat-trapping gas than CO<sub>2</sub>. Consumer level food wastage occurs at homes, restaurants, and institutional eateries such as campus dining halls. This project focuses on characterizing food waste at college campus dining places. SPECIFIC TASKS: The student will (i) review and synthesize relevant literature, (ii) analyze data of food waste streams collected on Penn campus and compare it with data obtained in the literature, and (iii) prepare a manuscript for scientific publication. BENEFITS: The student will be guided carrying out each task, gain basic research skills in critical literature review, and learn how to put the “nuts and bolts” together for a scientific paper through vigorous review-revision processes. He/she will also gain exposure to broader issues relating food wastage with global food security, sustainability, hunger and poverty. Strong organization skills and excellent communication and writing skills are necessary. (Co-mentor: Dr. Jane Kauer, Penn Anthropology)

#### **Project 2: Consumer food behavior survey**

The GOAL of this project is to identify applicable survey instrument regarding consumer food behavior. BACKGROUND: A typical American family of four wastes 1,164 lb. of food a year, worth \$2,085 in retail value. Why such a horrendous thing occurs in our daily life is a question with no simple answer. Many factors e.g. social, cultural, economic, psychological interact and influence our food behavior - whether it is making purchasing decisions at the grocery store, cooking in the kitchen, or eating habits within or outside of the home. Cutting down consumer-level food wastage for a sustainable future requires in-depth understanding of the range of consumer food behavior and major affecting factors. This project seeks to find effective ways to gain such knowledge. SPECIFIC TASKS: The student will (i) research existing surveys relevant to the topic and synthesize the findings, (ii) compare survey methodologies and modalities and identify pros and cons regarding coverage, cost, resource requirement, response rate, etc. He/she may also help faculty compile questionnaire entries and conduct a test-run survey for feedback. BENEFITS: The student will gain basic research skills involving critical literature review, learn

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to read and digest a broad range of materials and distill the essence. He/she will interact with staff and faculty of multi-disciplinary nature and gain exposure to broader issues relating food wastage with global food security, sustainability, hunger and poverty. Strong organization skills and excellent communication and writing skills are necessary. (Co-mentor: Dr. Jane Kauer, Penn Anthropology)

## **PENN VET WORKING DOG CENTER**

*Cynthia Otto*

### **Project 1: Ovarian Cancer Detection: canine biosensors**

Dogs have a keen sense of smell. There are odors associated with diseases in humans that can be detected by dogs. These volatile organic chemicals represent a potential biomarker that may be a novel way for early cancer detection. Dogs trained on plasma samples from patients with ovarian cancer will be tested to determine how sensitive and specific their ability to recognize the odor is. The goals will be to determine the limits of detection and then use that information to assist in the development of an electronic nose (with Dr. AT Johnson at Penn and Dr. G Preti at Monell). Students should have a keen interest in biology, behavior and olfaction. Basic understanding of data collection and analysis is important.

## **Wharton**

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

*Judd Kessler*

#### **Project 1: Behavioral Economics to Promote Medication Adherence and Habit Formation**

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

*Corinne Low*

#### **Project 1: Never Audit Again: Learning About Hiring Preferences without Deception**

##### ***Rising Juniors only***

The student would help coordinate a lab experiment evaluating what characteristics make job candidates appealing to firms. One problem with studying this topic is that firms may not be willing to reveal socially unacceptable preferences, such as racial or gender biases, when asked in surveys. Most measures to get around this involve trying to "trick" firms into believing they are evaluating real applicants, such as by sending out fake resumes, to see how firms behave in the real world. We have designed a new methodology that will encourage firms to be truthful about their preferences without using deception, and that can be carried out on a larger scale, thus yielding more data on firm preferences. The student will have the opportunity to work with

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real employee-seeking firms (who will be the subjects of the experiment) and headhunting organizations. This study aims to identify such things as the benefit of greater education for job candidates and the impact of demographic characteristics such as age and gender. The student would help with all parts of the experiment, from designing instruments to identifying and recruiting subjects to coordinating sessions and managing incoming data. This is a unique opportunity to launch a “live” experiment and engage with research as it happens!

*Katja Seim*

### **Project 1: The Strategic Value of Online Price Discrimination**

This project measures the value of price discrimination to online retailers. We study how online prices by a large office supplies retailer vary with attributes of its consumers' locations, including offline alternatives and consumer proximity to brick-and-mortar outlets. We then assess how online price discrimination would respond to a merger between office supply retailers. The research assistant will help with cleaning and analyzing data, background research such as literature searches, and report writing. Experience with R or Stata programming or a willingness to learn to use a statistical software package would be a plus.

### **Project 2: Sales Taxes and Distribution Networks in Internet Commerce**

This project studies the extent to which variation in state-level sales taxes and policies affects distribution networks by online retailers, using Amazon.com as a case study. In most states, online retailers are only required to charge consumers sales taxes on their purchases if the retailer has a physical presence in the state, such as a distribution warehouse. We study the supply chain distortions and inefficiencies that these tax policies induce: how do retailers trade off the loss of revenue due to higher sales-tax-adjusted prices if they open an in-state warehouse against possible cost savings from being able to serve consumers more quickly? The research assistant will help with cleaning and analyzing data, background research such as literature searches, and report writing. Experience with R or Stata programming or a willingness to learn to use a statistical software package would be a plus.

*Jeremy Tobacman*

### **Project 1: Microinsurance Against Rainfall Risk**

Uncertain rainfall is the most important risk faced by many agricultural households around the world. An ongoing research project studies the adoption and impact of new microinsurance products that protect against drought and flood in India. We seek to understand how short-run and long-run impacts of coverage differ on many dimensions, including input choices, productivity, consumption/savings, and proxies for well-being. Depending on timing details and

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skill matches, the student might help with data analysis in Stata and/or editing of text, tables, and figures. This would be an especially good project for a student who wants to see the full sweep of a large project and is interested in a mix of development economics, field experiments, behavioral economics, microfinance, and insurance. Basic panel regression knowledge (e.g., fixed effects vs random effects) or a willingness to learn these tools would be very useful.

### **Project 2: Consumer Credit and its Discontents**

Standard consumption models imply that credit demand will rise in response to adverse transitory shocks. However, the effect of adverse shocks on equilibrium credit utilization is ambiguous, because adverse shocks increase default risk and lenders may have limited capacity to distinguish between transitory and persistent shocks to borrower creditworthiness. In the Great Recession, revolving credit outstanding in the United States fell 15% from its June 2008 (nominal, seasonally-adjusted) peak and has barely begun to recover. In this project we seek to investigate and quantify how much self-insurance via credit card borrowing was demanded and supplied, during this time of so much human economic distress. Crisis conservatism is one possible (behavioral) explanation for the change in consumer credit utilization. The student would primarily help with data analysis in Stata, and this would be an especially good project for a student keen to develop and practice technical skills. As time permits, other work on consumer credit and the effects of liquidity shocks might also be among the student's responsibilities.

## **HEALTH CARE MANAGEMENT**

*Amanda Starc*

### **Project 1: Pass-Through in a Highly Regulated Supply Chain**

We estimate the incidence effects of two types of exogenous shocks to the U.S. pharmaceutical market – supply shocks due to nationwide changes in pharmaceutical production market structure, and demand shocks further along in the supply chain induced by changes in regulated prescription drug coverage requirements. We study these effects in the market for prescription drugs purchased by enrollees in Medicare Part D. Pharmaceuticals manufacturers are charged with developing, obtaining approval for, and producing drug molecules; drugs are then distributed by wholesalers to pharmacies and consumers. Demand for drugs is, in turn, determined by pharmacy pricing and stocking decisions, physician prescribing behavior, prescription drug plan benefit design, and patient diagnoses and preferences. In Medicare Part D, prescription drug plans are offered by private insurers, and the plan benefit designs are highly restricted, with changing requirements year to year. The first goal of this study is to estimate the impact of changes in wholesale drug prices on short- and long-run consumer out-of-pocket prices. We identify causal estimates of pass-through using variation in exposure to wholesale price increases across Part D plans and regions. Our data allow us to directly observe plan

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benefit design, so that we can distinguish price pass-through with and without plan benefit adjustments (in the latter case, this will comprise immediate pass-through from the supply chain upstream of the Part D plan; in the former, this will comprise pass-through accounting for subsequent Part D plan alterations to premiums, copays, and coinsurances). The second goal of this study is to estimate the equilibrium price effects induced by changes in coverage requirements in the Part D donut hole that increase plan costs. Causal effects on retail prices are again identified using variation in exposure to the regulatory change across plan-drug pairs. Taken together, these estimates will allow us to explore a number of counterfactuals relevant to current policy debates. We consider the impact of large increases in wholesale generic drug prices, pay-for-delay agreements, and additional changes to the Part D program. Completion of STAT 101 and STAT 102 or STAT 111 and STAT 112, preference for Wharton students.

*Ashley Swanson*

**Project 1: Pass-Through in a Highly Regulated Supply Chain – The Who, What, and When of the US Drug Market** ***Rising Juniors only***

In this paper, my coauthor, Professor Amanda Starc, and I will estimate the incidence effects of two types of exogenous shocks to the U.S. pharmaceutical market – supply shocks due to nationwide changes in pharmaceutical production market structure, and demand shocks further along in the supply chain induced by changes in regulated prescription drug coverage requirements. We study these effects in the market for prescription drugs purchased by enrollees in Medicare Part D. The first goal of this study is to estimate the impact of changes in wholesale drug prices on short- and long-run consumer out-of-pocket prices. The second goal of this study is to estimate the equilibrium price effects induced by changes in coverage requirements in the Part D donut hole that increase plan costs. Causal effects on retail prices and demand will be identified using variation in exposure to price and regulatory changes across plan-drug pairs. Taken together, these estimates will allow us to explore a number of counterfactuals relevant to current policy debates. We consider the impact of large increases in wholesale generic drug prices, pay-for-delay agreements, and additional changes to the Part D program. Our student research assistant will build expertise in statistical programming and econometrics by performing quantitative analyses in Stata. He or she will also learn the institutional details of the Medicare Part D program and biopharmaceuticals market. The work he or she will perform on this project will be highly relevant to future careers in consulting and economics or policy research.

*Robert Town*

**Project 1: Integration, Spillovers and Plan Design in Medicare Part D**

This project examines the incentives health plans face in designing their benefit packages. If consumers do not utilize health care in perfectly rational way, health insurers can address this irrationality through benefit design. These plans will have the incentive to do so if they reap some of the benefits from more optimal consumption. We examine this issue in the Medicare Part D program -- the program that provides prescription drug coverage for seniors and the disabled. In Medicare Part D different plans have differential incentives to take into account the impact of enrollee drug consumption on medical care expenditures. We use a large database of Part D administrative claims to study how plans respond to these different incentives.

## **LEGAL STUDIES AND BUSINESS ETHICS**

*Philip Nichols*

**Project 1: The Morality of Westphalian Sovereignty**

The concept of sovereignty, sometimes called Westphalian Sovereignty, holds that each nation is equal and each nation has absolute control over everything that happens inside its borders. This concept is the foundation of international relations and of public international law. The legal principle of sovereignty has engendered a great deal of critical discussion, but few plausible alternatives have been offered. This project is part of an effort to do so. This project has four parts: (1) develop an accurate description of the theory of Westphalian sovereignty, (2) develop an accurate description of sovereignty as it actually is used in the world, (3) determine the most fruitful moral scheme for evaluating sovereignty, and (4) create an alternate theory of sovereignty that is accurate, useful, and moral. The research for this project involves primary and secondary sources. A research assistant will become very knowledgeable about the very important concept of sovereignty.

**Project 2: Self Enforcing Rules**

Self-enforcing rules are rules or laws that are easy to enforce and that do not require a great deal of interpretation. The simple rules for a pick-up game of basketball are self-enforcing rules, as are the far more rigorous rules for the sales of pharmaceuticals. Self-enforcing rules are useful when the enforcing body is inexperienced or lacks resources, but because by nature the rules are simple they do not allow for sophisticated relationships or for complicated facts. Self-enforcing rules are all around us, but no one has comprehensively described or analyzed these rules. This project is part of a project to do so. This project has four parts: (1) developing a description of self-enforcing rules, (2) using that description to find and catalogue examples of self-enforcing

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rules in the U.S. legal system, (3) analyzing in a general, theoretical manner the utility or disutility of self-enforcing laws, and (4) analyzing the usefulness of self-enforcing rules in the context of corruption. The research for this project involves primary and secondary sources. A research assistant will acquire knowledge and experience in the critical analysis of rules and laws.

### **Project 3: The APEC Principles for the Medical Devices Industry**

The medical devices industry presents very complicated questions regarding control of corruption. Medical devices are a critical (and incredibly diverse) component of healthcare. Unlike pharmaceuticals, the proper development and use of a medical device often requires close collaboration between a supplier and a health care provider. Like pharmaceuticals, suppliers might provide health care providers with incentives that are not in patients' best interests. The Asia Pacific Economic Cooperation (an awkwardly named organization) is at the forefront of developing international rules to manage this problem. Those rules have received no scholarly analysis. Moreover, the problems posed by the medical devices industry have also not been analyzed and are usually overshadowed by discussions of pharmaceuticals. This project is part of an effort to fill those gaps. The project has four parts: (1) develop a description of APEC and the principles, (2) develop a thorough description of the unique problem posed by medical devices, (3) catalogue the implementation of the rules by signatory nations, and (4) projecting the effectiveness of the rules. The research for this project will involve primary and secondary sources and possibly interviews with people in the medical devices industry. A research assistant will acquire knowledge of international regulation and of the medical devices industry.

## **MANAGEMENT**

*Laura Huang*

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

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

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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 although some experience with mathematics or statistics and/or facility with MS Excel or Atlas.ti is a plus.

**Project 2: Where did Robo-signing come from?**

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

**Project 3: How to make oil companies safer?**

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

*Minyuan Zhao*

**Project 1: Entry as a Bargaining Chip**

The institutional environments in emerging markets are often characterized by opaqueness and uncertainty. Without clearly spelled-out rules and conditions, the actual treatment that a multinational enterprise (MNE) receives in a host country is the result of an implicit negotiation between the firm and local policy makers. In this study, we track the entry strategies of global pharmaceutical firms, and analyze the relationship between entry decisions and their experience with the policy levers most critical to pharmaceutical firms, such as patent approvals and intellectual property (IP) litigations. All students interested in global strategy or IP strategy are

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encouraged to apply, although strong Excel/Stata skill is a plus. Participants in this project will learn how to process information from first- and second-hand data sources, manage large datasets, and conduct basic empirical analysis.

### **Project 2: Learning by Buying: A Study of Cross-border MandAs and Integration Strategies of Emerging Market Multinationals**

Multinational enterprises (MNEs) from emerging markets have been in a shopping spree in recent years. From Geely's acquisition of Volvo to Tata's acquisition of Jaguar, the claim is that these newly minted MNEs need the technologies, brand names, and market expertise to compete in the global market. However, little is known about their integration strategies after the acquisitions. In this study, we will try to identify the key factors behind different integration strategies. In particular, we will compare the integration strategies of emerging market MNEs with those of traditional MNEs – firms that bring their own technologies and brand names with them when entering new markets. All students interested in global strategy are encouraged to apply, although strong Excel/Stata skill is a plus.. Participants in this project will learn how to process information from first- and second-hand data sources, manage large datasets, and conduct basic empirical analysis.

## **MARKETING**

*Peter Fader*

### **Project 1: Customer-based corporate valuation for publicly traded companies**

Our research goal is to value companies from the "bottom up," i.e., by valuing the company's present and future customers, because most (if not all) of a company's true value emerges from its customers. Building a good customer-based valuation model makes it possible to tie metrics driving the health of the customer base, which are under the control of the marketing department and company management, to the overall valuation of the firm. The biggest challenge when performing customer-base valuation arises in projecting how many customers a company will have in the future. We propose a novel way of addressing this difficult problem, and will systematically comb through publicly available financial disclosure data to bring our new method to life. We need your help in finding and collecting this important data from SEC filings. Your data will breathe life into the model -- the more relevant data we can feed it, the stronger it will become. You will develop new perspectives about company valuation and what drives it, and improve your ability to analyze public filings of publicly traded companies. You will work with one of the world's leading experts in this type of valuation model, and a former hedge fund analyst turned Wharton doctoral student with over 5 years of more traditional valuation analysis in a professional setting.

## *Jerry Wind*

### **Project 1: Personalized Marketing @ Scale: Increasing Message Relevance and Value**

This project supports the research and publishing on the topic of Personalized Marketing at Scale of the Wharton Future of Advertising Program, directed by Professor Jerry Wind, in partnership with Facebook. Consumers want personalization and customization. Even in 2000, we found this (Convergence Marketing: Strategies for Reaching the New Hybrid Consumer, 2000, Yoram (Jerry) R. Wind, Vijay Mahajan) and today, in 2015, it is on steroids. The challenges are figuring out how to implement personalization at scale and calculating the added value of personalized vs. non personalized advertising. The Wharton Future of Advertising Program and Facebook's Marketing Science Group have teamed up in order to address these challenges. Using a robust platform recently developed by Facebook, a select group of brands will conduct large scale test(s) to understand the impacts of personalized marketing vs. generic marketing. The results of these experiments will create understanding about how personalization can benefit brands and their audiences – raising awareness and generating knowledge about personalization across platforms, industry categories and audiences. The student will be responsible for conducting secondary research on Personalization as well as working with the research teams to conduct the primary research and evaluate the findings across the tests. This project presents an exciting opportunity for a student to engage with one of the senior members of the Marketing department as well as the Facebook Marketing Science Group on a relevant business topic. Qualities that a successful student can contribute include strong communication, analysis, writing, and research abilities.

### **Project 2: How Cognitive Computing Can Help Creatives**

This project supports the development of a cognitive-computing powered system designed to help Creatives identify the themes and approaches that have the highest likelihood of success by the Wharton Future of Advertising Program, directed by Professor Jerry Wind, in partnership with IBM Watson. 25 years ago, Professor Wind was among a group of Wharton faculty who developed ADCAD (1), a knowledge based system for advertising design which was created to help guide Creatives in developing effective campaigns, an inherently complex and uncertain process given the nearly endless variety of creative options and the wide range of factors that influence effectiveness. Recently, the Wharton Future of Advertising Program partnered with IBM Watson to harness the power of cognitive computing to improve this system. The tool he and the IBM Watson team are developing utilizes Watson's enormous capability to analyze all available knowledge in a given domain to help advertisers design the most effective advertising. The student will be responsible for conducting secondary research on advertising effectiveness and working with the IBM Watson team to conduct primary research. This project presents an exciting opportunity for a student to engage with one of the senior members of the Marketing department as well as the IBM Watson team on a relevant business topic. Qualities that a successful student can contribute include strong communication, analysis, writing, and research

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abilities. (1) Raymond R. Burke, Arvind Rangaswamy, Jerry Wind and Jehoshua Eliashberg. "A Knowledge-Based System for Advertising Design." *Marketing Science* Vol. 9, No. 3 (1990): 212-229.

### **Project 3: From Media Mix to a Portfolio of Touch Points**

This project supports the research and publishing on the topic of All Touch Points Orchestration (ATPO) of the Wharton Future of Advertising Program (WFOA), directed by Professor Jerry Wind, in partnership with IBM Watson. The findings of WFOA show that a traditional Media Mix approach, even if it is expanded to include Paid, Owned, and Earned channels, is not as effective as a portfolio of touch points approach, in which advertisers take into account all relevant points of contact between the brand and the consumer, from media, to package design, to customer service, to store design, etc., as well as the interactions between all touch points. Furthermore, rather than focusing their attention and resources on attribution models, advertisers should focus on continuously experimenting with different touch point portfolios, assessing effectiveness for objectives, contexts, competitive environments, audience characteristics (including purchase journey and mood) and many other variables in a process known as adaptive experimentation. To help them do this, WFOA has partnered with IBM Watson to harness the power of cognitive computing to design these experiments. The student will be responsible for conducting secondary research on ATPO and working with the IBM Watson team to conduct primary research. This project presents an exciting opportunity for a student to engage with one of the senior members of the Marketing department as well as the IBM Watson team on a relevant business topic. Qualities that a successful student can contribute include strong communication, analysis, writing, and research abilities.

## **OPERATIONS AND INFORMATION MANAGEMENT**

*Alex Rees-Jones*

### **Project 1: Understanding tax misunderstanding**

This project explores psychological factors which influence how individuals respond to income taxes, and how these factors influence the efficacy of tax incentives. To that end, we study individuals' (mis)understanding of the tax system faced when filing annual tax returns, and the mental shortcuts that are used to simplify and approximate this complex system when taxpayers make tax-relevant decisions. To study these issues empirically, we are conducting large-scale and nationally representative surveys to elicit taxpayers' knowledge of the tax code. We seek undergraduate research assistants interested in participating in the design and administration of these surveys, as well as the analysis of the resulting data. Coursework or other experience in economics, statistics, or statistical programming (e.g., Stata or Matlab) is desirable, but not

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mandatory. Attention to detail and general interest in using psychology to influence policy is essential.

### **Project 2: The welfare effects of heterogeneous tax salience**

This project studies consumer inattention to sales taxes, and how taking into account consumer differences in attention impacts the distortionary effects of taxation. The data-driven portion of this project is centered on a large-scale online experiment, in which we sell various household goods while varying the presented tax-relevant information. We seek undergraduate research assistants interested in assisting with the design and administration of this experiment, as well as the analysis of the resulting data. Research assistants will receive hands-on training in the administration of field experiments and the analysis of the resulting data. Coursework or other experience in economics, statistics, or statistical programming (e.g., Stata or Matlab) is desirable, but not mandatory. Attention to detail and general interest in using psychology to influence policy is essential.

*Maurice Schweitzer*

### **Project 1: Humor and Negotiations**

Though a growing literature has explored what makes something funny, there are many open questions with respect to what humor actually does. For example, what role does humor play in complex interpersonal interactions, such as negotiations? In this project, we will explore the mechanics of humor and investigate the role of humor in conflict and conflict resolution. Students engaged in this research will help to run experiments, code and analyze data, and participate in brainstorming and research meetings.

### **Project 2: Reappraising Emotions**

How we feel can profoundly influence how we perform. For example, anxiety can significantly harm our ability to succeed on tests or deliver presentations. There are many things we can do to shift how we feel, but we know surprisingly little about how effective different strategies are for different emotions. This project explores emotion reappraisal-- the ability to use different strategies to shift how we feel and how we perform. Students engaged in this research will help to run experiments, code and analyze data, and participate in research meetings.

*Lynn Wu*

### **Project 1: Big Data, Information Technology and Firm Productivity**

Despite the rapid increase in the spending of new technologies, most firms could not quantify the return to investing these new technologies. Thus, understanding new technologies such as

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social/mobile media can have a productivity impact on firms has become an increasingly important question. In this project, we aim to understand how firm's existing capabilities, such as the skill composition of the labor workforce, management characteristics (both at mid-level and C-level) as well as board compositions can affect the return investing technologies. We seek to understand why some firms can reap greater return to investing in technologies while others are not. With the rapid changes in information technologies that are currently disrupting many industries, we hope to identify key characteristics that helps firm leverage these technologies to the best of their abilities. Ideal candidate must have strong capabilities to collect data and process raw text. Skills such as REGEX or python would be very helpful.

### **Project 2: Emerging Technologies**

This project aims to survey all important technology developments in the recent years in the high tech industry (MOOC, Big Data, social/mobile platforms, crowdsourcing, deep learning, peer-to-peer economy etc.). We seek to understand the fundamental differences these technologies are bringing and how they are disrupting or have the potential to disrupt any industries. Students are expected to survey the fundamentals behind the technology, what makes it disruptive, what industry the technology has the most impact on and how individuals, firms and the society could take advantage of these new technologies. Through the exercise, we will also be exploring the dark side these technologies could bring such as income inequality. If you are an avid reader of Techcrunch, Hacker News, or various technology related blogs and have a strong interests in firm strategy, venture capital and start-ups, this is an ideal position for you.