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2019

Thirteenth Annual Summer Undergraduate Research Symposium

Friday, August 2, 2019

WELCOME TO THE THIRTEENTH ANNUAL

UNIVERSITY OF CALIFORNIA
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SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM

AUGUST 2, 2019

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Accelerated STEM Pathways through Internships, Research, Engagement, and Support

ASPIRES
Accelerated STEM Pathways through Internships, Research, Engagement, and Support

The Accelerated STEM Pathways through Internships, Research, Engagement, and Support (ASPIRES) program is a collaboration between Canada College's Engineering Department, San Francisco State University of Engineering, and UC Merced. The project is supported by a grant from the US Department of Education through the Minority Science and Engineering Improvement Program (MSEIP), Grant No. P120A150014.

1. The overarching goals of the ASPIRES program are: to increase the retention and success in STEM courses among community college students from traditionally underrepresented minority (URM) groups in STEM;

2. To increase awareness of and interest in STEM careers among k-12 and community college URM students; and;

3. To increase the number of URM students receiving AS degrees and transferring to four-year institutions to pursue STEM degrees.

Human-Automation Study by Using a Smart Phone Controlled Inverted Pendulum Using Motorized Potentiometer

Hadi Asemi, Jairo Viola, MD, YangQuang Chen, PhD
School of Engineering, University of California, Merced

Humans are an active component in the Automation process, performing complex and repetitive tasks as assembling or quality inspection in production lines, showing that the process quality is related to the human operators performance. For this reason, it is crucial assessing the human behavior inside the automation loop developing complex tasks. This research proposes a methodology to evaluate the human behavior in the automation loop through a performance assessment performing a complex task, which is the position control of an inverted pendulum system using a smartphone application as the human-machine interface. In this experiment, the control command signal is given by the human operator, the angular position of the pendulum and its relative error are employed as metrics for the human response. The inverted pendulum system prototype employed in this experiment is built using 3D printing. Likewise, the pendulum is controlled using Matlab with an Android mobile application. The performance evaluation consists of keeping the pendulum straight while the human testing subject operates the system. In this experiment, 20 test subjects are evaluated, and the proposed metrics are acquired for each test person. Obtained Results shows a relationship between task performance and human behavior, indicating that not only human beings are inuenced by external factors performing the task, but also requires extensive training to complete the task satisfactorily.

Exploring the Effect of Oscillating Boundary on Two-Dimensional Fluid Flow Using Soap Film

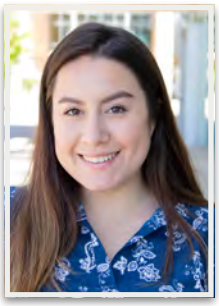
Krystal Kyain, Ahmad Elhares, and Yanbao Ma, PhD
School of Engineering, University of California, Merced

Soap films have shown to effectively provide a physical approximation of two-dimensional fluid behavior. In this study, the length and width of the film is significantly larger than the thickness that this can be considered two-dimensional. This particular film is on a vertical set up made up of a pulling mechanism with fishing wire. A Schlieren setup is utilized to visualize the disturbance in the film and demonstrate the effects of external factors, such as acoustics. The film will react to external factors by varying the thickness as a result of deformations within it. Sinusoidal oscillations on the soap film boundary with different frequencies and amplitudes are applied to study the effect on the flow. The soap fluid flow method has shown to demonstrate how two-dimensional fluids should preform by analyzing the thickness variation in the film. Studies of fluid flow can be applied at both a macro and micro level that impact a variety of natural and engineering systems such as the human circulatory system and the design of hydraulic structures.

California Alliance for Minority Participation

The following student scholars are participants in UC Merced's CAMP program. The Louis Stokes California Alliance for Minority Participation (CAMP) in Science, Technology, Engineering and Math, is a statewide initiative funded by the National Science Foundation (NSF) to strengthen the quality and quantity of underrepresented students receiving baccalaureate degrees in science, technology, engineering and mathematics studies at the University of California (UC). CAMP offers extensive resources and unique opportunities for students to excel in their respective fields of study. The CAMP program began at UC Irvine in 1991; currently, nine UC campuses participate in the program.

For more information, please visit http://uroc.ucmerced.edu/camp



Perturbation of Hematopoiesis in the Bone Marrow May Heighten Allergic Asthma Susceptibility

Angelica Castillo, Diego A. López, Anna E. Beaudin, PhD
School of Natural Sciences, University of California, Merced

In the United States, childhood asthma is the leading chronic disease affecting millions under the age of 18 and is responsible for the majority of childhood hospitalizations. Although the symptoms and progression of disease are relatively well characterized, our understanding of the mechanism that predisposes young children to a higher risk of developing asthma is still limited. Recently, type-2 innate lymphoid cells (ILC2s) have been shown to play a role in allergic asthma susceptibility. We hypothesize that immune activation during early fetal development may increase susceptibility to allergic asthma in offspring by altering the establishment of ILC2s and their progenitor cells, common helper innate lymphoid progenitors (ChILPs), in the neonatal bone marrow (BM). To evaluate this, we administered an intraperitoneal (IP) injection of viral mimetic poly (I:C) at embryonic day (E) 14.5. We then isolated the BM from postnatal day (P)14 offspring to identify whether there were differences in ILC2 and ChILP cell number & frequency. Our preliminary data demonstrates an increase in BM ChILPs of perturbed offspring compared to saline treated controls, which agrees with our previous ILC2 data in the lung. Overall, this suggests that early maternal perturbation can induce changes in hematopoiesis, including changes in BM ChILPs, which in turn may lead to overproduction of ILC2s in the lung and an increased risk for developing allergic asthma.

Traction Forces Generated by Differentiating Endothelial and Smooth Muscle Cells

Jacob Espinosa, Jose Zamora, and Kara E. McCloskey, PhD
School of Engineering, University of California, Merced

It has long been known that stem cells will differentially differentiate in response to the mechanical stiffness of their substrates. It has been recently shown that more vascular progenitor cells are directed into endothelial cells (ECs) on lower stiffnesses, while smooth muscle cells (SMCs) are generated on higher stiffnesses. One question that has not been addressed is the directionality of the traction forces produced by these differentiating stem cells. Using our two-step serum-free induction protocol, we have differentiated mouse embryonic stem cells (ESCs) on mechanically controlled polyacrylamide hydrogels (1kPa, 5kPa, 10kPa, and 40kPa) to examine their traction force speed and direction of movement. Based on literature, we expect that the ECs will exhibit non-directional radial traction forces, whereas SMCs will undergo polarized tractions. Primary ECs and SMCs will simultaneously be checked on these mechanically stiff hydrogels. This research has the potential to provide insight into how these cell types are able to co-differentiate and self-organize during early development.

Methods to collect Preserve and Prepare Japanese Deep Sea Elasmobranch Liver and Muscle Tissue for Stable Isotope Analysis

Leslie Jimenez, and Sora L. Kim, PhD
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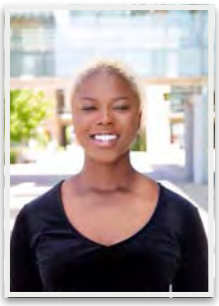
The diet of many deep-sea sharks is not well known because these predators are elusive to study. Sharks do not need to surface for breathing and often their stomachs evacuate while they are pulled to the surface once caught. The method of stable isotope analysis can help us gain insight on deep sea elasmobranch ecology because it relies on the biochemical composition of tissues rather than observation. Due to the unique traits of elasmobranch species (i.e., retention of urea and lack of adipose tissue), which can convolute diet interpretations, modified methods are needed for stable isotope analysis preparation. Elasmobranch muscle and liver tissue were collected, frozen, and dried from 96 specimens of deep sea sharks caught off the coast of Japan. Lipids and urea were removed with petroleum ether or a 2 chloroform:1 metanhol solution and deionized water, repsectively. Then, subsamples of elasmobranch tissue were frozen and dried via lyophillization. Dried samples were homogenized, weighed to 0.5mg in tin capsules, and analyzed for stable isotope composition via Elemental Analyzer coupled to an Isotope Ratio Mass Spectrometer with a Conflo IV. We expect high variability in diet among individual sharks and similarities within species or size classes.



Error and Interactive Segmentation Interfaces: A Step Towards Optimization

Habibatu K. Mboka, Guoxiang Zhang, MD, YangQuan Chen, PhD
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Interactive segmentation tools are a key part of visual recognition, and one of the key ingredients to segmentation is rich datasets with ground truth labeled by human annotators. This ultimately allows for easier and faster data labeling. Recent work on interactive segmentation interfaces has used convolutional neural networks (CNNs) to greatly improve the accuracy or reduced number of clicks required; however, the performance accuracy of these networks is confounded by the variables which make up an image--such as resolution or background complexities--which cause an in increase in the total amount of clicks required. Our intuition is that by feeding images which contain variables such as these through an interactive segmentation interface, we can then find what variables cause the interface to fail, and ultimately get a better understanding of how to improve the accuracy and usability of interactive segmentation as a whole. To find the effect of these unknown variables, we create a dataset containing altered images of various resolutions, tints, and background complexities. We then feed these complex or altered images through the CNNs to calculate what causes such an increase for the total click amount. From this process, our results have shown that the networks often fail to segment objects in front of complex backgrounds and images that have poor resolution with less than five clicks.

Energy Harvesting of Highway Traffic Through Piezoelectricity

Steven Ortiz-Donato, Cheng Chen, and Jian-Qiao Sun, PhD
School of Engineering, University of California, Merced

Vehicle traffic on California highways can provide a significant source of electric energy by converting mechanical energy in the form of vibration of vehicles into electricity by piezoelectrics. This energy can be used to charge electric vehicles, illuminate highways, and feed the grid. Different from other projects of a similar focus, we designed a nonlinear mechanical structure that amplifies mechanical force by 10 times and used multilayer PZT (lead zirconate titanate, piezo ceramics) stacks for an exponential energy growth. In this project, we constructed 360 mechanical amplifiers which were stacked on top of each other in groups of three to make 120 power-generating towers. With an assumption that the average vehicle provides 120 psi of downward stress, our current design can reach to 233.6Wh/(m^2.year) and this energy outcome will be greater with heavier vehicles. In comparison, mass-produced solar modules creates 216 kWh/(m^2.year) on average in California. This energy harvesting method is advantageous because it can be integrated into the pavement, it works24/7 under any weather condition, it has high potential with 164,000 miles of highways in the USA, and it requires low manufacturing costs compared to other clean energy sources. The next step in this research is to conduct tests to optimize parameters of the generator to improve outcome.

Extracting Giant Unilamellar Vesicles from Cellulose Substrates by Vortex Mixing

Breanna Paredes, Vaishnavi Girish, and Anand B. Subramaniam, PhD
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The Paper-Abetted liPid hYdRation in aqUeous Solutions (PAPYRUS) method is a simple approach of growing giant unilamellar vesicles on cellulose based substrates. The current method uses a piece of paper that is 9.5 mm in diameter. Since the paper is relatively small, vesicles can be harvested by manually aspirating across the surface of the paper with a micropipette. However, manual aspiration with a pipette over the surface of a larger sheet of paper is challenging. This is a crucial limitation because if we wanted to encapsulate proteins or medicine for drug delivery usage, then it must be produced at a larger scale. We performed systematic experiments to determine if automated shaking using a vortex mixer of vesicle-covered papers in custom-made Polydimethylsiloxane (PDMS) chambers is a viable method for a larger scale harvesting of vesicles. We find that shaking solutions after vesicle growth results in similar vesicle sizes and quantities as the results of manual aspiration. Future work will be to reapply the shaking method onto a larger cellulose substrates in order to produce a large amount of vesicles.

Detecting LEAP2 Levels in GHSR Knockout Rat

Michelle Perez-Arreola, Hualing Peng, Xuecai Ge, PhD
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GHSR (growth hormone secretagogue receptor) is the receptor for ghrelin, an appetite-stimulatory hormone that is secreted by the stomach. The GHSR-ghrelin signal is involved in multiple metabolic processes, including food intake and protection of animals from starvation-induced hypoglycemia. Our previous studies discovered liver-expressed antimicrobial peptide 2 (LEAP2) as an endogenous antagonist for GHSR. LEAP2 is produced in the liver and small intestine. LEAP2 expression is related in vivo will provide valuable insights in the control of GHSR-ghrelin signaling. In collaboration with the Leggio's group at NIAAA, we detected the expression levels of LEAP2 in multiple tissues in GHSR knockout rats. We found LEAP2 expression levels varies significantly between different tissues and between different genotypes in rats. Our results may help deepen our understanding between LEAP2 expression and the GHSR-ghrelin signaling.

Utilizing CRISPR-Cas9 to Validate Gene Addbacks to their Native Locus in *Candida albicans*

Diana Ramos, Namkha Nguyen, Aaron D. Hernday, PhD
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Candida albicans is the most common opportunistic human fungal pathogen and is associated with mortality rates in excess of 50%. Recent development of precision genome editing techniques have accelerated the pace of molecular genetic studies of this pathogen, allowing researchers to quickly and easily edit virtually any location in the *C. albicans* genome. A common application is to generate homozygous deletions of a gene of interest, however, methods for restoring a knocked-out gene to its native locus – an important experimental control – require improvement. The Hernday lab demonstrated a proof-of-concept technique using "Add-tags", which are unique target sites that can be integrated into the locus where a gene was knockout, these "landing pads" can be used for re-integration of the native gene at the native locus. We will be validating and optimizing this proof-of-concept approach by using our CRISPR-mediated genome editing system to delete and replace several genes with Add-tags and then restoring their native gene. Then we will test if the original phenotype is better restored than previous addback methods which rely on single-copy genes added at a non-native locus. Not only does this Add-tag approach serve as an important experimental control, but can help demonstrate the ability to perform precise edits at the native loci that are not directly targetable by CRISPR.

Conservation of Momentum in Second-Harmonic Generation

Adrian Sanchez Magana, Jonathan Daniel, and Jay E. Sharping, PhD
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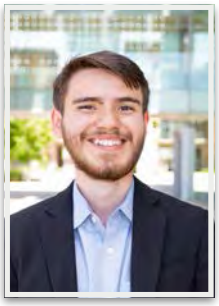
Second-harmonic generation occurs when photons interact within a nonlinear crystal that allows photon frequency conversion. This phenomenon occurs when multiple photons enter a virtual state, an unobservable quantum state, and due to energy conservation laws, a new photon is generated with equal energy from the photons in the virtual state. The purpose of this investigation is to deduce if the second-harmonic generation also follows the conservation of momentum law. Utilizing an infrared 1064nm pulsed LYNX laser and a nonlinear Barium Borate crystal, the pulsed beam was split into a "pump" and "escort" beam and aimed at different angles into the crystal. By varying the intensities, intercepting angle, and polarization of both beams then the intensity of the generated 532nm will show dependency. If momentum conservation laws apply, then a 532nm beam should be seen between the two noninteracting 1064nm beams. It is expected that the conservation of momentum applies due to the wave-particle property of light and could lead to improved quantum information sources without cryogenic systems.



Objects Detection from Point Clouds: Optimize Raw Data Loading and Preprocessing

Pedro Torres, Guoxiang Zhang, YangQuan Chen, PhD
School of Engineering, University of California, Merced

An ongoing issue with Computer visualization is capturing patterns in data sets due to the lack of the complexity of an object and variety input point sets. Due to distance and image detail being a form of error in image visualization, in this study we propose a solution by evaluating the percentage of error and determine the cause. When inputting the data in the training algorithm the goal is understanding how accurate datasets are. The algorithm will gather set points from a data set, each group will correlate to a local region and form “K” the number of points in a grouped portion of an image a neighborhood. The overall goal of the project is for this algorithm to automate the cave mapping via drones. Using a small dataset of images results in a low accuracy and a large error. Each time the algorithm trains shows an improvement in defining an object to a class and determining the object itself, while the mean loss decreased in identifying each image as the algorithm progressed. The training algorithm will have a higher percentage of accuracy when the data set is larger.

The Development of a Quantum-Optical Apparatus used in the Evaluation of Photon Statistics

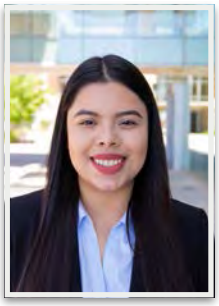
Christina Valletta, Jonathan Daniel, Jay Sharping, PhD
School of Natural Sciences, University of California, Merced

One of the most interesting and principle pieces to quantum optics is photon statistics; more descriptively, the optical setup used to measure photon statistics. In this experiment, an optical setup for observing the second order correlation coefficient, otherwise known as the intensity coefficient, was developed. The intensity coefficient is used to determine if a light source is bunching, coherent or anti-bunching; this coefficient can determine what type of source light the photons are being produced by. Here, the 2nd order coefficient was calculated from a Hanbury-Brown Twiss interferometer with an inferred laser source. Near the end of our optical setup, the photons entered two dark boxes where their presence was recorded with photon counters. By recording the photons counts over a time scale of half a millisecond concurrently for both dark boxes, the second order coefficient will be able to be calculated. With a coefficient of near one, it will be shown that the laser used in this experiment produces coherent light leading the way for other quantum optic experiments.

Identifying GeneFlow Patterns in African Cattle

Joseline M. Velasquez-Reyes, Lesly Lopez Fang, and Emily Jane McTavish
School of Natural Sciences, University of California, Merced

Cattle have played an important role throughout history serving as laborers, sustenance, and a resource for tool making thus affecting cultural and economic aspects in our society. There were two original domestication events occurring in Europe/Middle East and India creating, respectively, *Bos taurus* and *Bos indicus.* Both subspecies have been studied extensively however the African Cattle has yet to be fully understood. The African cattle, often referred to as Sanga cattle, are evolutionary interesting as they are often considered an intermediate subspecies. Since, geographically, Africa is right in between the two original domestication events we infer that Sanga are a product of hybridization between the two subspecies of cattle. The Sanga cattle are more closely related to *Bos taurus* than the *Bos indicus;* however, we hypothesize that there is gene flow from the *Bos indicus* to the Sanga cattle. We compare the variant sites between six sample genomes of *Bos taurus, Bos indicus, Bison bison,* and three different Sanga cattle taken from GenBank. Analyzing these variant sites will allow us to understand the gene flow expressed by hybrids and understand which genes are more probable to be inherited.



Application of Electric Stimulation in Damaged Tissues Enhances Stem Cell Repopulation in Planarians

Andie Venegas, Peter T. Karabinis, and Nestor J. Oviedo, PhD
School of Natural Sciences, University of California, Merced

Electrical stimulation can enhance tissue repair when applied locally to a tissue. However, the underlying mechanism is not fully understood. The Oviedo lab has developed a strategy for applying steady-state direct electrical stimulation and tracking the effects on different tissues. This methodology uses the planarian model organism, *Schmidtea mediterranea* and the technique is termed planarian Direct Current Stimulation (pDCS). Planarians contain stem cells, called neoblasts, that regenerate every tissue in the body. Exposure to ionizing radiation eliminates neoblasts, and regenerative properties in planarians. However, treatment with pDCS is capable of recovering stem cells in tissues previously exposed to lethal doses of ionizing radiation. Short period of treatment with pDCS (>15 minutes) enhances DNA repair, gene expression, and stem cell division. These effects are mediated by the expression of immediate early genes and calcium signaling. Furthermore, the findings suggest pDCS treatment alters the identity of differentiated cells to re-establish neoblast populations in lethally irradiated tissues. The cellular targets are not entirely clear, but this novel method of restoring stem cells in irradiated tissue may have important implications for patients exposed to radiotherapy in cancer treatment and could improve our understanding about the molecular mechanisms mediating effects of applied electric fields in adult tissues.

Identification of Transcription Factors Regulating Caspofungin-induced Flocculation

Gabriel A. Viramontes, Craig L. Ennis, and Carissa J. Nobile, PhD
School of Natural Sciences, University of California, Merced

Candida albicans is a commensal of the human microbiota and also the most common human fungal pathogen. Changes to the host immune system, pH, and microbiota can lead to *C. albicans* overgrowth, causing life-threatening, disseminated infections. One treatment for invasive *Candida* infections is the commonly prescribed drug Caspofungin. This drug treats the infection via the inhibition of β-(1,3)-D-glucan synthesis, causing fungal cell wall repair to halt, resulting in cell death. Interestingly, *C. albicans* yeast cells will flocculate, tightly adhering to one another, in response to Caspofungin treatment. We hypothesize that flocculation is a fungal stress response that increases *C. albicans* resistance and survival to Caspofungin, and that this phenomenon is regulated by several transcription factors. We took a forward genetic screening approach using a transcription factor (TF) deletion mutant library to identify TFs with altered abilities to flocculate. Thus far, we have identified that deletion of transcription factors *EFG1*, *FLO8*, *CAS5*, and *ACE2*, resulted in aberrant flocculation after exposure to Caspofungin. Based on these results, we are beginning to mechanistically understand the regulation of this drug response at the molecular level. In the future, this work has the potential to lead to the development of new therapeutic solutions against pathogenic fungi.

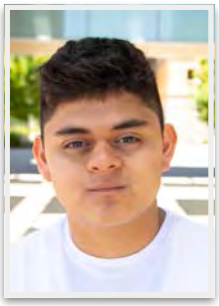
Center for Cellular and Biomedical Machines

The Center for Cellular and Biomolecular Machines (CCBM) is a National Science Foundation (NSF) Center of Research Excellence in Science and Technology (CREST) at the University of California, Merced. The NSF-CREST CCBM uses an interdisciplinary approach cutting across scientific and engineering methodologies to: 1) Pursue a fundamental understanding of the structure, dynamics and functioning of multi-scale biomolecular and cellular assemblies with the goal of enabling control of function in vivo; 2) Use these fundamental principles to design and develop novel bio-inspired functioning machines ranging from designer cells and tissue to diagnostic and therapeutic devices, and 3) Host an integrated, interdisciplinary training program for graduate students that uniquely emphasizes both physical and biological components and provides research and training experiences for undergraduate and high school students that will enhance the recruitment of those traditionally underrepresented in STEM research.

Expression and Purification of Recombinant Calnuc-WC Protein to Design a Calcium Biosensor

Marissa Anaya, Jesse Rodriguez Reyes, Abhigyan Sengupta, Mourad Sadqui, and Victor Muñoz
School of Engineering, University of California, Merced

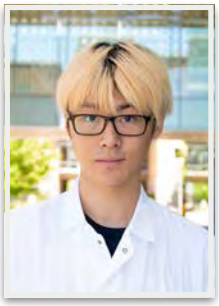
Recombinant protein-based sensor designing is a burgeoning topic of interest. Proteins being highly specific and selective to ligand binding compared to chemically modified sensors are a potential choice for next generation biosensor designing. We used Calnuc-WC (introducing two mutations, TRP, and an isolated Ca^{+2} binding domain of Calbindin) to design a biosensor for calcium. In this project, our objective was to express and purify Calnuc-WC with the intent of studying the Calnuc interaction with Ca^{+2}. From these studies, we will estimate the selectivity and specificity of Calnuc-WC to bivalent metal ions. We expressed the SUMO tagged Calnuc-WC in *E. coli* cells and used a homogenizer to lyse cells to extract the protein. After separating the proteins from the cell debris through ultracentrifugation, we purified the SUMO-Calnuc-WC using an affinity chromatography column by HPLC technique. The SUMO-Calnuc contains 6-histidine residues, which were utilized to bind with a Ni-column during purification. After purification, we used the UPL1 enzyme to cleave the SUMO from Calnuc-WC and re-purified it through an affinity column followed by reverse phase HPLC. Electrospray ionization mass spectrometry was used to confirm the purity of the protein. We then tested the purified Calnuc-WC's affinity for bivalent metal ions, such as Ca^{+2}, Zn^{+2} and Mg^{+2}, using the intrinsic fluorescence of the tryptophan moiety, which was pre-grafted in Calnuc-WC mutant.



Evolutionary Adaptation Depends on the Way a Biological Population Spreads Its Territory

Giancarlo Garcia Deleon, Madhuvanthi Athani, and Daniel Beller, PhD
School of Natural Sciences, University of California, Merced

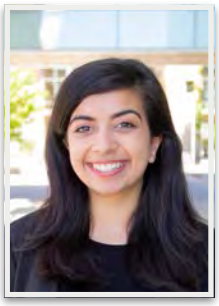
Antimicrobial resistance is an immense problem for humans, and these problems exist in environments that are not always perfectly well mixed. The dynamics of evolving antibiotic resistance should be investigated in more realistic models of changing environments, such as in the human immune system. Simulations are used to model how evolution changes when the environment is varying spatially rather than temporally. The stepping-stone model is employed to model adaptations in bacterial range expansions in the presence of antibiotics. As the population encounters a higher concentration of antibiotics after growing some distance, the relative growth rates of the subpopulations change. Our investigation tests whether adaptive mutations are less prominent in spatially heterogeneous environments because it is much easier for populations to be lost to the front where all the growth of populations occurs. Our findings apply more generally to studies of spatially expanding populations in various contexts, examples of which include invasive species, biofilms, and tumor growth.



Fluorescent Dye Concentration has a Significant Effect on Sizes and Yields of Vesicles Grown on Cellulose Paper

XiaoYang Calvin Hu, Joseph Pazzi, and Anand Subramaniam, PhD
School of Engineering, University of California, Merced

The production of lipid vesicles is a prominent area of biochemical research due to the potential of vesicles in drug delivery, making artificial cells, and simulating the mechanisms and conditions within a cell. One simple but effective way of producing giant unilamellar vesicles (GUVs) is to deposit lipids on cellulose paper and then hydrate the lipid-coated paper. Over the course of 2 hours, the lipid membranes bud off from the paper forming vesicles which are harvested into solution. Quantifying results requires characterizing the size distributions and yields of vesicles which is currently done through sedimentation followed by confocal microscopy. The purpose of this study is to determine if the choice and concentration of fluorescent lipids can have an effect on these size distributions and yields. The experiment used 1.0 mg/mL lipid samples with non-fluorescent lipids to fluorescent lipids molar ratios of 99:1, 99.5:0.5, and 99.75:0.25. The preliminary results suggest that even at these small differences in molar ratios, the GUV size distributions and yields vary significantly due to the concentration of the dye present in the lipid mixture. This suggests that for accurate comparisons and consistent results between experiments the concentration of fluorescent molecules present should remain consistent.



Tracking the Motion of Myosin Motors into Perpendicular Stack Formation

Gargee R. Khaparde, and Kinjal Dabiswas, PhD
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The cytoskeleton is a network of filaments in eukaryotic cells responsible for maintaining the cell's shape and structural integrity. It generates forces through the action of the molecular motor, myosin, on actin filaments. While the structural order of muscle myosin has been heavily studied, it has been recently observed that non-muscle myosin II in fibroblasts move into a stacked formation perpendicular to and across bundles of actin filaments. The cellular components, actin and myosin, which are responsible for this movement are observed with super-resolution microscopy studies of cultured fibroblasts. Based on these observations, we hypothesize that the non-muscle myosin II move under forces transmitted along actin filamentous networks in order to achieve perpendicular stacking. We study this movement through the use of tracking software, to obtain data sets of relative location of individual myosin, which can then be analyzed to find relative velocity of movement of the myosin filaments. This velocity of the motor behind the propagation can then be compared with known velocities of different mechanisms of motor motion, to determine or rule out potential mechanisms that could be responsible for myosin stacking. Analyzed velocities of microns in tens of minutes point to attractive forces between myosin motors and show that the mechanism cannot simply be motors "walking" on actin filaments, which are known to result in significantly higher speeds.

Preparation of DNA Functionalized Quantum Dots for Nanoscale Placement on Origami Tile

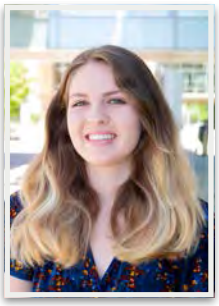
Joshua Marquez, Melissa Goodlad, Paniz Rahmani, Yehan Zhang, Tao Ye, PhD
School of Natural Sciences, University of California, Merced

The unique photophysical properties of colloidal semiconductor nanocrystals or "quantum dots" (QDs) make them of high interest in fields ranging from biosensing to energy harvesting. QDs exhibit broad spectral absorption combined with tunable narrow emission wavelengths, photobleaching resistance, and are brighter than typical organic dyes. Despite these promising properties researchers have struggled to develop self-assembly methods capable of nanometer precision. A key method to accurately and precisely control the distance between these nanoparticles is to anneal them to a DNA origami tile. Typical streptavidin-biotin conjugations used to accomplish this create bulky QDs inappropriate for nanometer distance separations and do not allow arrangement of multiple types of QDs on a single interface. To solve this, we have created a single-step ligand exchange method to functionalize QDs with thiolated single stranded DNA (ssDNA) complementary to capture sequences on a DNA origami tile. These ssDNA functionalized QDs (ssD-QD) are stable in ionic buffered solutions, and a range of temperatures. Here we describe this method of functionalizing, purifying and annealing ssD-QDs to a DNA origami tile.

Labeling Strategies of the Inflammasome Adapter, ASC, for Fluorescece Spectroscopy Analysis of Self-Association

Melissa Mendez, Andrea Gould, Eva de Alba, PhD
School of Natural Sciences, University of California, Merced

The ASC protein (apoptosis-associated speck-like protein containing a caspase activation and recruitment domain) functions as an adaptor molecule, mediating assembly of the inflammasome complex and promoting the organism inflammatory response. ASC is comprised of two Death Domains, PYD and CARD, connected by a linker region. Two splice variants of ASC capable of activating the inflammasome differ in linker length, with 23 amino acids and 3 amino acids, respectively. Cellular studies indicate that these ASC isoforms self associate into different supramolecular structures in the cytoplasm, pointing to potential regulation of inflammasome function. The present study uses an engineered ASC variant with a 69 residue-long linker (ASC3X) as an extreme case scenario of interdomain dynamics to characterize ASC's oligomerizing behavior. Here we show preliminary results for testing the creation of a fluorophore-protein conjugate, via a recombinant bacterial sortase-mediated transpeptidation reaction, to fluorescently label ASC3X for further study. This process of site specific enzymatic labeling has applications in future use of fluorescence polarization techniques to examine different factors involved in the kinetics of ASC selfassociation.



Tagging Tubulin With Split Fluorescent Proteins in Zebrafish

Kaitlyn A. Mesa, Stefan C. Materna, PhD, and Stephanie Woo, PhD
School of Natural Sciences, University of California, Merced

Fluorescent proteins (FPs) provide a way for scientists to study specific proteins of interest, allowing for temporal and spatial control over fluorescent expression. The most common shape for fluorescent proteins to take on is a beta-barrel composed of 11 strands. Monomeric Neon Green (mNG) for example can be broken up into two parts by removing the 11th strand (NG11). Alone, the two portions will not fluoresce but when fused together, they will create a functional fluorescent protein. Here, we use the CRISPR method to insert NG11 into tubulin genes. If successful, this technique will allow us to visualize the migration and adhesion of cells within zebrafish embryos.

Effect of Different Boundaries on Brownian motion of Particles

Sonia Shah, and Arvind Gopinath, PhD
School of Engineering, University of California, Merced

Brownian motion is the random movement of particles in a fluid. Each particle has its own direction of movement, but is also affected by the movement of particles around it. This random path of the particle is called a random walk. These particles and their movements have a lot of different applications in a various number of fields including physics and biology. Therefore, understanding random walks better is extremely important. This was done by simulating movement of particles in a box. Using Python code, particles were created inside of a box and coded in a way that allowed for random movement to occur. After that, boundary conditions of the box were adjusted to see how the random walk, or final positions, of the particles were affected by these different variables. Three different conditions were used including Periodic Boundary Conditions, Reflective Boundary Conditions, and Random Boundary Conditions. Along with changing the boundary conditions, the actual boundaries were also changed from a square box to a circle. By tracking particle movement with different boundary conditions, patterns of particles can be found or at least predicted based off different variables.

Intrinsically Disordered Protein Structure is Modulated by Solution Conditions

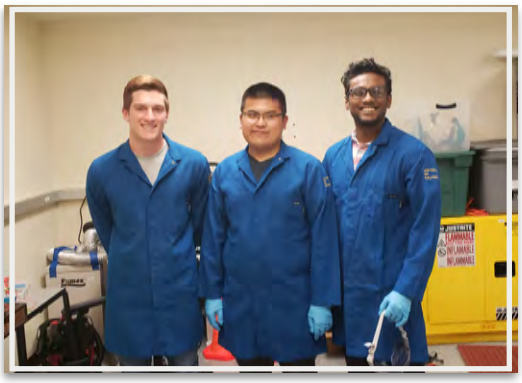
Nora M. Shamoon, Eduardo Flores, David Moses, Shahar Sukenik, PhD
School of Natural Sciences, University of California, Merced

Intrinsically disordered proteins (IDPs) play a vital role in health and disease. Their high surface area and low content of intramolecular bonds make them sensitive to commonly occurring changes in the cellular environment, yet little is known about how such changes affect IDP structure and function. We have developed a high-throughput method that places an IDP sequence between two flanking fluorescent proteins. The fluorescence signal from this construct reveals the ensemble changes that occur in the sequences as we place them in different naturally occurring and cell-mimicking solutions. Using this method, we have already tested 6 IDPs in over 200 solution conditions. Our dataset reveals a rich and complicated fluorescence signal, indicating that IDPs are highly sensitive to solution conditions. Our findings suggest that commonly occurring changes in the cellular environment can modulate IDP function.

Studying Collective Behavior of Autonomous Agents Through Experiment and Simulation

Jashandeep Singh, Imran Khan, and Ajay Gopinathan, PhD
School of Natural Sciences, University of California, Merced

Collective motion is a phenomenon where a large number of individuals come together to exhibit coordinated motion with examples ranging from cell clusters to bird flocks. Here we study how the geometry of confining boundaries affect collective motion using autonomous robots as a model system, coupled with simulations. Kilobots are 3 cm diameter robots which have differential drive locomotion, on-board computation power, neighbor-to-neighbor communication, and sensing. We use these Kilobots to study their behavior in different environments such as elliptical or circular boundaries along with comparisons to idealized agent based simulations to understand the role of naturally occurring noise or biases. Kilobots and agents are programmed to display soft short ranged repulsion with each other and boundaries. We tested the behavior of these agents around different obstacles and boundaries. We found that Kilobots show obstacle avoidance consistent with our simulation results. We intend to extend our study to different boundaries as well as different kinds of interactions. Our results will enhance our knowledge of processes ranging from intracellular transport to traffic flow.



Data-Enabled Science and Computational Analysis Research, Training, and Education for Students (DESCARTES)

The Data-Enabled Science and Computational Analysis Research, Training, and Education for Students (DESCARTES) Program is an NSF-funded four-year research, training, and education program for undergraduate applied math majors. DESCARTES Scholars are trained in state-of-the-art computational and data science. Using these skills, DESCARTES Scholars engage in research that reaches across a broad variety of disciplines.

Parameter Search in Framework for Detecting Structural Variants in Genomes

Xiaolong Chen, Melissa Spence, Roummel Marcia, PhD,
and Suzanne Sindi, PhD
School of Natural Sciences, University of California, Merced

Genomic variation shared by members of the same species that are longer than a single nucleotide are commonly called structural variants (SVs). Though relatively rare, they represent an increasingly important class of variation as SVs have been associated with diseases and susceptibility to some types of cancer. Computational approaches for detecting SVs often involve parameters that describe certain relevant biological phenomena. In our work, such parameters relate the incidence of inherited and novel SVs to probabilistic models of observing these SVs. In the work presented here, we investigate the sensitivity of our computational framework to these parameters. In particular, we demonstrate the robustness of our method by identifying a wide range of parameter values that lead to high-accuracy SV predictions in simulated data.

University Scheduling with Simulated Annealing

Daisy Durate, Anna Kucherova, Amitoj Kahlon, Tessa McIntire, Fabian Santiago
School of Natural Sciences, University of California, Merced

The NP-hard problem of scheduling is ubiquitous—extending across all disciplines and spheres of society. Intractable problems with NP-hard complexity entail a computation time that grows exponentially with problem size. In our work we attempt to develop an algorithm that solves a scheduling problem based on faculty preferences and availability data, a compendium of hard and soft administrative constraints, and thoroughly articulated concerns provided by the Merritt Writing Program at the University of California, Merced. The major components of a course timetabling problem are assessed, and unsupervised learning methods are employed to obtain an optimal schedule. An objective function is formulated that depends upon the number of fulfilled faculty preferences given a course timetable. We then employ simulated annealing algorithm and the objective function that quantifies faculty dissatisfaction to produce an optimal course timetable. With the application of these methods, creating a course timetable, a process that would otherwise take weeks and resources, becomes a more efficient process for generating unbiased schedules in a manner of minutes.

Minimizing of Faculty Dissatisfaction in University Scheduling

Alexis Kelley, Xiaolong Chen, Lydia Kim, Kayla Quinones, Tessa McIntire,
And Fabian Santiago
School of Natural Sciences, University of California, Merced

University course timetabling problems (UCTTP) are complicated, time, and resource consuming for a manual solution. Therefore, this type of problem requires either a systematic or an unsupervised method to produce an optimal schedule that minimizes dissatisfaction amongst faculty members' course assignment. In this work our aim is twofold, we aim to eliminate human bias and minimizes the faculty dissatisfaction with their assigned course. Given a fixed university schedule with randomly assigned faculty, our approach generates several schedules systematically and selects the schedule with the minimum number of penalties. Applying this algorithm, universities can unbiasedly assign faculty in an optimal manner.

Minimization of Faculty Dissatisfaction in University Scheduling

Lydia Kim, Xiaolong Chen, Alexis Kelley, Kayla Quinones, Tessa McIntire, And Fabian Santiago
School of Natural Sciences, University of California, Merced

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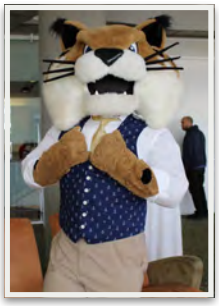

Minimization of Faculty Dissatisfaction in University Scheduling

Kayla Quinones, Xiaolong Chen, Lydia Kim, Alexis Kelley, Tessa McIntire, And Fabian Santiago
School of Natural Sciences, University of California, Merced

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Joint Genome Institute

The following student scholars are participants in UC Merced's NSF CAMP partnership with the Joint Genome Institute, located in Walnut Creek, CA. The Department of Energy's Joint Genome Institute (DOE JGI) is managed but the Department of Energy's Office of Biological and Environment Research (OBER) to produce high-throughput DNA sequencing and analysis in support of its missions in alternative energy, global carbon cycling, and biogeochemistry. CAMP offers extensive resources and unique opportunities for students to excel in their respective fields of study. This valuable partnership provides UC Merced students with the opportunity to experience research in a national laboratory setting.

Evaluating Taxonomy Classification Methods on Metagenome Assembled Genomes (MAGs)

Ricky Yan, Harrison Ho, Zhong Wang, PhD
School of Natural Sciences, University of California, Merced

Metagenomics is the study of microbial genomes recovered directly from an environmental sample. Taxonomy classification on metagenome assembled genomes is a challenging problem due to the incomplete reference database and low quality of the query genomes. The aim of this study is to evaluate four existing methods for taxonomy classification, including CheckM, BAT (Binning Annotation Tool), LastTaxa, and GTDB-TK(Genome Taxonomy Database Tool Kit). Each of the methods will be benchmarked on control reference datasets from NCBI and an unknown Antarctica dataset, respectively. Their classification accuracy and computational efficiency will be systematically evaluated.

Merced Nanomaterials Center for Energy and Sensing

MACES

MERCED NANOMATERIALS CENTER FOR ENERGY AND SENSING

MACES Summer Undergraduate Research Fellowship Program: MACES (Merced Nanomaterials Center for Energy and Sensing) was established with support from NASA in the fall of 2015. Our educational mission is to establish a vertically integrated STEM program that will produce a highly skilled and diverse workforce for NASA missions and beyond. One of the key components of the program is a 9-week long summer undergraduate research program that recruits students from local community colleges and nearby CSU campuses. Students will work side by side with UC Merced graduate students and faculty. Through structured mentoring and intensive hands-on training, students in the program will gain the experimental skills that allow them to effectively and safely work in a laboratory setting. This will be complemented by a weekly seminar series that introduces students to different research topics conducted in MACES and at NASA. Upon completion, students will be able to demonstrate basic knowledge of their research area and to summarize their own research.

The Effects of Mechanical Strain on Photoluminescence of Quantum Dot Emission

Alejandro Arellano, Mark Woodall, and Michael Scheibner, PhD
School of Natural Sciences, University of California, Merced

This project focuses on the photoluminescence (PL) of individual self-assembled quantum dots (QDs) within a semiconductor heterostructure, with and without mechanical strain applied to etched microstructures. The molecular beam epitaxy process allows small wells of material to be grown on a strained layer of non-lattice-matched substrate. The different band gap of the embedded material from its bulk substrate gives rise to quantum dots. For these samples, made by collaborators at the Naval Research Institute, Indium Arsenide (InAs) dots are grown in diode structures on Gallium Arsenide (GaAs) substrates. PL in QDs is driven by the recombination of electron-hole pairs that are created using laser radiation emitting photon energy higher than the band gap of InAs, which in turn causes the excited QDs to emit near-infrared radiation. These dots are further embedded in mechanical microresonators that can exert strain on the dots themselves generating changes in their emissions. Experimentation with the QDs occurs at near-zero Kelvin to minimize phonon effects. A spectrometer and liquid-nitrogen cooled camera are used to the collect and observe the infrared emissions of the QDs. A laser-induced interferometric setup allows indication of vibrational modes that can be generated in the microresonators on the sample and create strain for the emissions. The interferometric setup is coupled with the spectroscopy setup to simultaneously measure strained and unstrained emissions.

The Doppler Effect: A Study

Mary E. Cavanaugh, Boaz Ilan, PhD
School of Natural Sciences, University of California, Merced

The Doppler effect is an everyday phenomenon that explains the relationship between the harmonic waves of two bodies moving at different velocities from one another, usually when one body is at rest and the other body is moving. It applies through light and sound waves and has been studied and analyzed through mathematical and experimental means of observations and uses of technology such as applications that record sound, furthermore investigating other researchers' work and articles. Procedures show that, for example, a siren going down the street will sound higher in pitch when approaching a resting body than moving away. This provides insight as to how evident the Doppler effect is in common, everyday situations.

Synthesis of an Organic Negative Thermal Expansion Unit

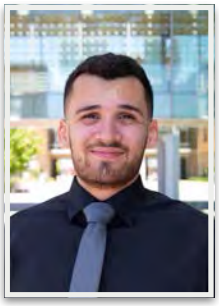
Mariposa Janelle Cox, Jackie Bustamante, Wexin Fu, PhD, and Jennifer Lu, PhD
School of Engineering, University of California, Merced

Negative thermal expansion (NTE) is a rare phenomenon which enables a myriad of applications: aerospace engineering, near-infrared-based macro-, micro- or molecular switches. NTE can be used for the development of zero thermal expansion for either optics or mirrors. Most materials have a positive thermal expansion coefficient and increase in volume when apply heat to the materials. We have decided to study and synthesize a polymer that exhibits an NTE coefficient. However, since most NTE coefficients are -20 ppm/K or less, we plan to synthesize a polymer that exhibits a much larger NTE coefficient around the -1000 ppm/K range. Dibenzocyclooctadiene (DBCOD) is an eight membered ring sandwiched by two rigid phenyl rings which undergoes a conformational change at ambient conditions. The conformational change allows the eight membered ring change from a "twist-boat" into a "chair" (a global minimum to a local minimum respectively), allowing for the NTE upon applying heat. This allows us to synthesize DBCOD and DBCOD derivatives for the fundamental investigations for technological development.

A First-Step Dibromination of Dibenzosuberone towards the Synthesis of 2,9-Functionalized Tetrahydrodibenzocyclooctadienes for use in Polymers Exhibiting Negative Thermal Expansion

Huong Do, Thanh Lien, and Benjamin J. Stokes, PhD
School of Natural Sciences, University of California, Merced

Materials exhibiting negative thermal expansion (NTE) contract upon heating and expand upon cooling. NTE materials may be useful for space travel and exploration applications in which temperature extremes are pervasive. Polymer films containing tetrahydrodibenzocyclooctadiene (DBCOD) subunits contract upon heating as the eight-membered ring move from a twist-boat to a chair conformation. We have shown that DBCOD must be incorporated into polymers via attachment at the C2 and C9 arene C–H bonds in order to exhibit NTE, but there are eight arene C–H functionalization sites available, making selective 2,9-difunctionalization extremely challenging. Previous attempts at late-stage formylation of C2 and C9 were low yielding, so we hypothesized that an early stage difunctionalization would enable a more economical reactions sequence. Herein we describe our efforts towards 2,9-difunctionalized DBCOD's using an initial electrophilic dibromination of dibenzosuberone using molecular bromine mediated by aluminum chloride.



Gold Nanosphere Photocatalysis: The Effect of Incident Light on Redox Potential

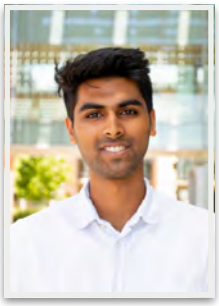
Adrian Enwright, Randy Espinoza, Son C. Nguyen, PhD, Ziliang Mao, PhD
School of Natural Sciences, University of California, Merced

Photocatalysis is the direct utilization of renewable solar energy to drive chemical reactions. Due to their strong light absorption and high surface-area-to-volume ratio, metallic nanoparticles are gaining interest for applications in photocatalysis. Light excitation of gold nanoparticles generates high-energy electrons named "hot carriers" in the nanoparticles which can be used for redox reactions. However, the redox potentials of these hot carriers are still difficult to determine, setting a roadblock to understanding the catalytic mechanism and expanding the scope of catalytic reactions. To better understand the photocatalytic properties of gold nanospheres, we determined the redox potential for gold nanospheres by analyzing the oxidative etching of gold nanospheres by $FeCl_3$ under plasmon and interband excitation. We also investigated the influence of the power and wavelength of the incident light on the redox potential. Our results indicate the efficiency of hot electron generation is not dependent on power but strongly dependent on wavelength. With these findings, we can alter the thermodynamic favorability of the hot electron transfer and the physical size of the nanoparticles by simply changing the incident light wavelength.

Temperature Dependent Photoluminescence and Time-Resolved Photoluminescence on Ligand Functionalized Methylammonium Lead Bromide Perovskite Quantum Dots

Isaak Hernandez, Albert C. DiBenedetto
School of Natural Sciences, University of California, Merced

Organo-metallic hybrid perovskite materials are one of the most promising candidates that may allow for the creation of lightweight solar cells, which would be ideal for deployment in space travel. However, these materials degrade over time, as moisture and thermal variations cause chemical degradation. In order to ensure that these solar cells are suited for space travel, it is imperative that their components can handle extreme temperatures and resist moisture driven loss of efficiency. Our approach consists of focusing on methylammonium lead bromide (MAPbBr3) perovskite quantum dots (PQDs), which are ideally suited to study surface-related phenomena, functionalized with specialized ligands that can enhance their stability. To characterize their capabilities as a function of temperature, we performed temperature-dependent static, and time-resolved photoluminescence (PL) experiments on PQDs functionalized with three distinct pairs of ligand molecules. Using optical excitation at a wavelength of 430 nanometers, we performed these experiments in high vacuum with temperature ranging from 20 K to 290 K. By characterizing and comparing the emission properties (PL intensity, emission energy and carrier recombination lifetime) of these PQDs, we will optimize the ligand type that satisfies both the necessities of high stability and power conversion efficiencies needed in high perfuming solar cells.



Simulating the Signaling and Target Binding of SERS Substrates

Devanshu Kumar, Yehan Zhang, Tao Ye, PhD
School of Engineering, University of California, Merced

Having a good mechanism of detecting biomolecules is essential for understanding their properties. This can be monitored by examining the surface's Enhancement Factors (EF). The EF can be measured by Finite-Difference Time Domain (FDTD) or Discrete Dipole Approximation (DDA) simulations however, they are computationally time-taking and expensive, thus being a limitation factor. Therefore, it is necessary to efficiently determine the region of the substrate where the EF is highest. In this study, the structure being studied consists of a trimeric substrate of a 10nm gold nanoparticle situated between two 30nm gold nanoparticle. The EF is obtained by using FDTD simulation from the Surface-Enhanced Raman Spectroscopy (SERS). We have a SERS heat map that displays the EF on various points on and around the surface. The previous average EF simulation was lower than expected because there was no defined algorithm to accurately extract EF values around the nanoparticle, thus including several outliers to provide an inaccurate average EF. In this study, however, we extracted the EF values on the surface of the nanoparticles by calculating the mesh size of pixels and using mathematical properties like the distance formula. We simulated two cases: biomolecules preferentially binding to the surface of 10nm nanoparticle and randomly binding on the surface of the trimeric substrate. The simulation results were recorded by writing a program on MATLAB to extract the EF values around the circumference of each nanoparticle and simulate the two cases with a sample size of 5 analytes.

Generalizing a Code for 3D Printing Fermi Surfaces

Juan Martinez, and David Stubbe, PhD
School of Natural Sciences, University of California, Merced

A surface in reciprocal space that separates occupied from unoccupied electron states at absolute zero, is known as a Fermi surface. Through their specific shape and volume, these surfaces govern the physical properties of metals and semiconductors. Magnetic, electrical, thermal and optical properties within semiconductors and metals can all be derived and predicted through the analysis of a Fermi surface. The visualization of these surfaces in literature remains mostly bound to a two-dimensional space, a limitation that hinders further research. In its current state, our Fortran code allows for the rendering and 3D printing of closed Fermi surfaces such as lead. However, in order to print open surfaces that intersect the face of a Brillouin zone, we must identify the edge points of every hole and close the gaps. This is accomplished by noting that each of these points is equally far from two lattice points; thus, the "marching cubes" algorithm can be applied to connect these points and fill the holes using triangles. The result is a generalized code capable of creating 3D printable files for a larger range of Fermi surfaces. Our finalized program will act as a stepping stone for researchers and students interested in investigating the properties of a metal and its corresponding Fermi surface.

Tribological Properties of Bulk Metallic Glass (BMG) Investigated via Micro-Tribometry and Atomic Force Microscopy (AFM)

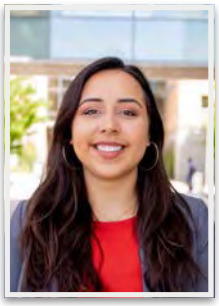
Marco Medina, and Mehmet Z. Baykara
School of Engineering, University of California, Merced

Bulk metallic glasses (BMG) are amorphous metals that are known for their glass-like structure and impressive properties such as high strength, high toughness and resistance to corrosion. On the other hand, much work needs to be done to characterize their tribological properties. In this project, we have utilized micro-tribometry and atomic force microscopy (AFM) toward this goal. In particular, a micro-tribometer has been used to probe two different types of BMG samples (Zr-based, BMG-Zr and Pt-based, BMG-Pt) with a 52100 steel ball in order to obtain the coefficient of friction (COF). In addition, AFM has been employed to obtain topographic maps of BMG surfaces with nanometer-scale spatial resolution in order to characterize their roughness. The COF measured on BMG-Zr was 0.118±.01, whereas the COF measured on BMG-Pt was 0.619±.06. The COF value measured on a 52100 steel reference sample was 0.52±.01 The images attained via AFM show that both BMG samples have similar surface roughness which means that differences in topographical roughness cannot explain the significant gap in COF values. Future work will (i) investigate the potential reasons behind the significantly low COF value for BMG-Zr and (ii) focus on the characterization of wear resistance via investigation of wear scars using interferometry.

Synthetic Oil Blends and Their Contribution to Aerospace Technology

Jose A. Morales, and Ashlie Martini, PhD
School of Engineering, University of California, Merced

Lubricants are essential in the aerospace industry as they contribute directly to the proper functionality and performance of aerospace machines, but they do not last long enough for space missions because of their instability. This instability is caused by the separation of the lubricant into its components, which could affect its ability to prevent wear in mechanical components as well as many other problems. The purpose of this research is to find a longer-lasting lubricant solution that is capable of maintaining high levels of stability even when stored for long periods of time. To develop a sample of lubricant, several procedures must be performed. In the blending station, a new lubricant is produced by mixing additives, an oil base, and other components. Eventually, the new lubricant is summitted to a foam test, where it is tested by evaluating how the foam disperses to avoid air particles in the mixture. Next, the mixture is evaluated in a visual test to determine its color, appearance, and cloudiness. Then, the lubricant is tested for its surface tension. Lastly, the solution passes through a filtration process, where their particles are evaluated to meet the required standards before storing it. Although the final results have demonstrating significant progress in terms of stability and quality, further investigation needs to be performed before the lubricant samples reach their maximum potential.



Bromination Promoted by Halogen Bonding

Savannah L. Pierce, Sarah I. Baker, Ryan Baxter, PhD
School of Natural Sciences, University of California, Merced

Hydrogen bonding is an essential non-covalent bonding interaction that can be utilized in organic reactions to facilitate and improve their efficiency. Halogen bonding is another electrostatic interaction that was first observed in 1927 by Robert S. Mulliken through his work with delocalized molecular orbitals. These key interactions allow for the formation of diverse, responsive intermediates that help lower the activation energy in reactions. Through recent work with Selectfluor and pyridine additives, the Baxter lab has found evidence of halogen bound intermediates. They found that these intermediates can facilitate single electron transfer and initiate radical halogenation. The evidence of halogen bonding interactions found between [N−Halogen−N]+ for fluorination will be applied using N-bromosuccinimde, leading to brominated arenes through an electrophilic aromatic substitution pathway. Electrophilic aromatic substitution is important because it allows for functionalization of C−H bonds. This functionalization can then be used to form more complex molecules and highly desired new target compounds. Currently, electrophilic aromatic bromination methods are limited to expensive reagents and often use harsh conditions. Our lab is currently in the process of developing a user-friendly, greener method for bromination.

Modeling Friction on the Nanometer Scale

Alejandro Sanchez, Oğulcan Açıkgöz, and Mehmet Z. Baykara, PhD
School of Engineering, University of California, Merced

Friction is particularly important for mechanical systems as it constitutes the main source of energy dissipation. In order to understand the fundamental properties of materials, such as friction, Atomic Force Microscopy (AFM) is frequently utilized to image surfaces on the nanoscale while simultaneously measuring friction forces. On the other hand, ambiguities regarding the atomic-scale structure of AFM probes complicate the interpretation of experimental results. In this project, our goal is to develop a computational model that simulates friction experiments performed via AFM, by means of calculating the energy barriers experienced by an atomic-scale slider moving across the surface of a two-dimensional (2D) material, e.g. graphene or molybdenum disulfide. As changes in energy barriers experienced by AFM probes of different structures have been found to correlate with friction forces in prior experiments, this model will facilitate the interpretation of data obtained via AFM and allow us to make conclusions on their accuracy.

Instrumentational Aspects of Atomic Force Microscopy

Anthony Rodriguez, Oğulcan Açıkgöz , and Mehmet Z. Baykara, PhD
School of Engineering, University of California, Merced

Unlike conventional microscopes, an atomic force microscope (AFM) that was recently procured by Baykara Lab allows the topographical measurement of many types of materials down to the nanometer scale, with the additional capability of measuring mechanical properties, for instance those related to friction. Despite its rather straightforward principle of operation, the AFM consists of many components such as the lateral scanner stage along the X & Y axis, the probe head that houses the cantilever tip and allows precise motion along the Z axis, and a laser beam deflection (LBD) system to detect cantilever deflection and twisting. As is the case for every scientific instrument, the AFM is affected by a variety of noise sources which require detailed investigation. In order to do this, different types of AFM cantilevers will be calibrated in terms of their spring constant via measurement of their resonance frequencies, and the LBD signal output will be analyzed in order to characterize the extent of the noise caused by seismic or acoustic vibrations that limit measurement precision. This will enable more accurate tests and high-resolution measurements on reference samples, on which topographical roughness and friction forces will be measured. To conclude, the activities undertaken in this summer project will allow us to get a better understanding of the operating principles and the individual components of a commercial AFM and give us the ability to optimize these properties for future use.

Metal Electrode Deformations After Electrodeposition and Dissolution

Carson JP. Whitt, Muhammad R. Shattique, James W. Palko, PhD
School of Engineering, University of California, Merced

Electrochemical systems are very important for a variety of applications with one of the most important being energy storage. Alkaline batteries are a highly common form of energy storage that people deal with everyday, mainly due to their excellent performance when compared to non alkaline batteries. These would be much more versatile and cost effective if they were truly rechargeable, but due to the process of electrodeposition alkaline batteries have issues charging after going through a full discharge cycle. By analyzing electrodeposition through simulations and experiments we hope to find solutions that mitigate the faults that primary cell batteries experience during charging. Analysis of the electrodeposition process is done through the use of a physics simulation software called Comsol. Using the Tertiary Current Distribution module, our research group created a physics simulation environment that accurately replicated real life experiments under the same conditions. We performed electrodeposition and electrodissolution cycles on a geometry that represented only a small partition of our real life copper mesh used in experiments. From this we were able to draw many important observations on the nature of the geometry deformation that took place after multiple cycles. We expect to see very similar results from our experiments that will have profound impacts on cooling technologies as well as energy storage solutions.

Metal Organic Framework Derived Carbon Scaffold to Support Metal Oxide Synthesized by Atomic Layer Deposition to Improve Electrocatalysis of Oxygen Reduction Reactions (ORR) and Oxygen Evolution Reactions (OER)

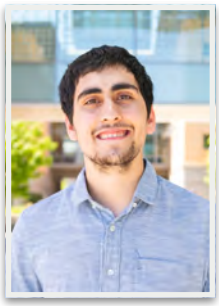
Cindy Wong, Angela Macedo Andrade, Min Hwan Lee, PhD
School of Engineering, University of California, Merced

Electrocatalytically active materials composed of noble metals are used to enhance the performance of fuel cells and metal-air batteries. Though because of their cost, scarcity and low stability there is a search for other alternative materials. Metal oxides on the surface of carbon structures have shown promise as a cost-effective alternative that exhibits the same or even enhanced catalytic activity in comparison to noble metals. One method that has garnered a lot of interest for the development of metal oxides on the surface of carbon structures has been atomic layer deposition (ALD). ALD has the ability of providing controlled growth at the atomic level. In this study, we will look at the electrocatalytic properties of titanium oxide on the surface of porous carbon structure derived from zinc-based metal organic framework (MOF). The porous carbon structure was synthesized via wet chemical synthesis, carbonized at high temperatures and then acid treated to remove any remaining metal and to oxidize its surface for ALD. After ALD, we will study the effect of the acid treatment on the porous carbon structure and optimize the ALD parameters such as number of cycles, temperature and pressure to enhance the electrocatalytic properties of titanium oxide supported on a MOF derived carbon structure.

Minority Serving Institutions Partnership Program

This research program is supported by U.S. Department of Energy's Office of Environmental Management (DOE-EM) Minority Serving Institutions Partnership Program (MSIPP). Its aim is to promote enhanced training experiences for the next generation of scientists and engineers by exposing them to research challenges associated with environmental remediation science, engineering, technology, and management.






Manganese and Iron Oxide-Modified Activated Carbon for the Remediation of Mercury-Contaminated Sediment and Water

Briana Aguilar, Tyler Anderson, Santiago Cisneros Castillo, Fidel Machado-Perez, Daniela Martinez, Julia Ramos Martinez, Jesus Mercado, Hiroto Muranaka
Peggy O'Day, PhD, Marc Beutel, PhD, Sam Traina, PhD
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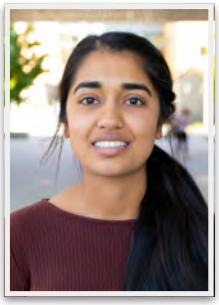
Mercury (Hg) contamination of the environment poses a significant health threat to humans and wildlife. Human and wildlife exposure to Hg is primarily through fish consumption and mostly in the form of toxic methylmercury (MeHg), which bioaccumulates in higher trophic levels. The primary pathway for methylation of inorganic Hg to MeHg is by bacteria during sulfate reduction under anaerobic conditions. Therefore, the reduction-oxidation (redox) potential of the sediment-water system is a key control on processes associated with Hg methylation. In this project, we are assessing the capacity of manganese/iron oxide and activated carbon to suppress MeHg production in Hg-contaminated sediments. The novel solid-phase amendment thermodynamically "buffers" the redox state of the sediment-water interface to create conditions unfavorable for sulfate reduction, while also providing sorption capacity to limit Hg and MeHg bioavailability. The study includes evaluation of sediment from two sites impacted by historical Hg mining in California: profundal lake sediment in Guadalupe Reservoir, a water storage reservoir polluted by the historic New Almaden mercury mine south of San Jose; and sediment from Harley Gulch, a stream and wetland that receives run-off from a former mercury mine in Lake County and is a tributary to Cache Creek, a major contributor of Hg to the Sacramento-San Joaquin Delta. Time-series laboratory incubation experiments (0 to 20 days) with sediment and water from Guadalupe Reservoir, and either Mn-oxide or activated carbon, were compared to no-amendment controls to determine whether MeHg production was suppressed. Water chemistry and Mn-oxide solids were analyzed before and after incubation experiments to evaluate whether redox control from amendment addition could account for differences in MeHg concentrations. The long-term goals of the study are to develop and test innovative, cost-effective sediment amendment technology to lower Hg bioaccumulation in contaminated sediments. This project is funded by the Department of Energy's Minority Serving Institutions Partnership Program with the aim of enhancing the diversity of the STEM talent pool interested in research careers in environmental science and engineering.

NSF - Undergraduate Internship at UC Merced in Professor Petra's Research Group

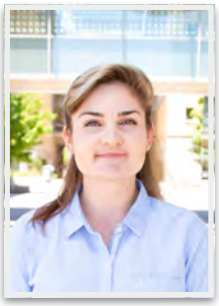
Model-based projections of complex systems will play a central role in prediction and decision-making, e.g., anticipate ice sheet contribution to sea level rise, or predict faults and assess dynamic stability in the power grid. However, models are typically subject to considerable uncertainties. Such uncertainties stem from unknown or uncertain coefficient fields, uncertain constitutive laws, source terms, geometries, and initial and/or boundary conditions in the model as well as from noisy and limited observational data. While many of these parameters cannot be directly observed, they can be interred from observational data, such as those of ice surface velocities in ice sheets or phasor measuring units in the power grid. This typically leads to a severely ill-posed inverse problem whose solution can be extremely challenging. The objectives of Prof. Petra's research are to 1) develop mathematically rigorous and computationally efficient and robust methods that overcome mathematical and computational barriers in solving large-scale inverse problems governed by differential equations, and 2) train undergraduate and graduate students in applied and computational mathematics with an emphasis in numerical linear algebra and optimization and scientific computing. This undergraduate internship is funded by NSF Computational Mathematics, Division of Mathematical Sciences DMS-CAREER-1654311.



The Influence of Data on the Reconstruction of Parameters in an Inverse Problem

Amitoj Kahlon, Anna Kucherova, Neomi Petra, PhD
School of Natural Sciences, University of California, Merced

Mathematical models governed by partial differential equations (PDEs) describing physical systems usually contain parameters that are unknown, due to either the inability to directly or fully observe them, or their role as phenomenological parameters. These can appear as coefficient fields, uncertain constitutive laws, source terms, geometries, and initial and/or boundary conditions in the PDE. While many of these parameters cannot be directly observed or measured, they can be estimated from available observations/data via inversion techniques. In this project we consider the estimation of the coefficient field in an elliptic PDE problem from noisy observations. The inverse problem is formulated as a least-squares optimization problem whose cost function is the misfit between observations and the model output. This inverse problem is solved via Newton's method that requires the first and second derivative—gradient and Hessian, respectively—of the optimization cost function. The Hessian (i.e., its eigenspectrum) reveals the influence of the data in reconstructing the parameters. Thus, we looked at a simple inverse problem for which we derived the Hessian and computed its eigenvalues and eigenfunctions analytically. The results divulge that the rate at which the spectrum decays (and the quality of the reconstruction) depends on the number of observations.



The Influence of Data on the Reconstruction of Parameter in an Inverse Problem

Anna Kucherova, Amitoj Kahlon, Noemi Petra, PhD
School of Natural Sciences, University of California, Merced

Mathematical models governed by partial differential equations (PDEs) describing physical systems usually contain parameters that are unknown, due to either the inability to directly or fully observe them, or their role as phenomenological parameters. These can appear as coefficient fields, uncertain constitutive laws, source terms, geometries, and initial and/or boundary conditions in the PDE. While many of these parameters cannot be directly observed or measured, they can be estimated from available observations/data via inversion techniques. In this project we consider the estimation of the coefficient field in an elliptic PDE problem from noisy observations. The inverse problem is formulated as a least-squares optimization problem whose cost function is the misfit between observations and the model output. This inverse problem is solved via Newton's method that requires the first and second derivative—gradient and Hessian, respectively—of the optimization cost function. The Hessian (i.e., its eigenspectrum) reveals the influence of the data in reconstructing the parameters. Thus, we looked at a simple inverse problem for which we derived the Hessian and computed its eigenvalues and eigenfunctions analytically. The results divulge that the rate at which the spectrum decays (and the quality of the reconstruction) depends on the number of observations.

Summer Opportunity for Advanced Research

The following student scholars are participants in UC Merced's SOAR program. The Summer Opportunity for Advanced Research provides funding for UC Merced Undergraduates with prior research experience to continue their projects at UC Merced. Qualified students with interest in pursuing graduate school are especially encouraged to apply. This program is funded directly through the Office of Undergraduate Education.

For more information, please visit https://uroc.ucmerced.edu/soar

Living Black in the Field of Brown

Nonzenzele I. Aldonza, and Whitney Pirtle, PhD
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A study measuring graduation rates shows that only 70 percent of black students at UC Merced graduate as compared to comparable public research institutions and other public universities. What could we attest to these findings? In 2014 we opened a living learning community built on pillars of mentorship, community outreach, and academic workshops. Additionally, we asked for contact information of the prospective black students to start formulating a relationship with them prior to them coming to campus. After the establishment of Afro Hall, it was discovered that black students' retention rates increased, becoming the highest of any single demographic group on campus. That data illustrated a direct correlation between increased support, and performance. After conducting focus groups with black students about their black experience both in Afro and on campus, that information was used as the primary data. Secondly, interviewing the institutional supporters was vital information to provide a unique experience. In conclusion, the typical student who steps into AFRO are students seeking that community away from home but also a student who absorbs all the information that is given to them. This data will help us advocate for more black student spaces on campus.

Incorporating Tunability In Three-Dimensional Radio Frequency (3D-RF) Cavities

Florence Lucey, Jeffery Miller, Jay Sharping, PhD
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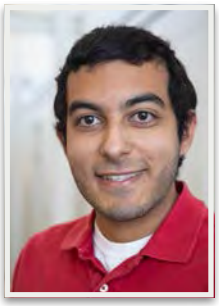
A radio frequency (RF) stub cavity is a hollow, closed metal structure; In this case made of aluminum, that has a metal stub on the bottom and functions as a resonator. The geometry of the stub affects the way the electric field forms inside the cavity. These cavities are useful for their ability to contain electromagnetic fields. Cavities that dissipate energy slowly, are called high-Q. Q is a unitless ration of the resonance frequency and the full width at half-maximum bandwidth of the resonance. High-Q RF cavities are known for their use in particle accelerators. Accelerators contain these chambers because they can transfer energy from the electromagnetic field to charge particles. The field inside the cavity oscillates at resonance, which is the natural frequency of the cavity dependent on physical parameters. In the following experiments, the designs of two high-Q 3-dimensional quarter-wave stub cavities are tested in efforts to incorporate a mechanical frequency tuning element. We investigate how Q is affected when a mechanical tuning element disturbs the electric field inside stub cavities of varying geometry.



Reframing Food Production: A Comparative Analysis of Family Farms and Agribusiness

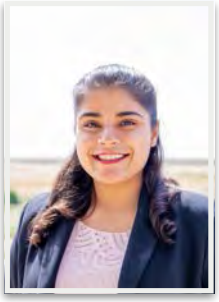
Omar Gonzalez, Mario Sifuentez, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

Corporate farms have a long history of dominating California's agricultural production; however, this was never intended to occur by the US Congress. As early as 1902, Congress attempted to limit agricultural production in the US west to family farms with the passage of the Reclamation Act. This law limited recipients of irrigation water to individuals who owned and lived on a 160-acre farm. Unfortunately for farmworkers, this law was never fully enforced and was scrapped by 1982 with the passage of the Reclamation Reform Act. Although recent discourse favors agribusiness governing our food production, the prospect of family farms remains a promising prospect for the marginalized communities of California. Studies comparing family farms to agribusiness are used alongside environmental history theories to reframe the economic debate surrounding family farms and agribusiness. Furthermore, newspaper articles, letters between government officials, and the election history of the Westlands Water District are utilized to highlight the harm agribusiness brings on democracy. These main points come together in order to argue that family farms are more beneficial to a democracy's ability to properly represent its people. Family farms are also shown to be more beneficial for the economy than agribusiness. Recent discourse has written off family farms as a harmful fantasy. This research, breaks away from this discourse by placing the advantages of family farms in the foreground.

Understanding How Sclerostin Deficiency Promotes Extramedullary Hematopoiesis

Shawn Ignacio, Cristine Donham, and Jennifer O. Manilay, PhD
School of Natural Sciences, University of California, Merced

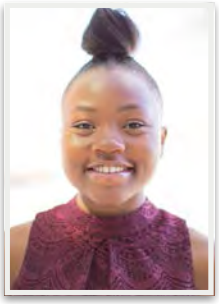
Sclerostin (*Sost*) is a protein secreted predominantly by osteocytes that inhibits bone formation by blocking *Wnt*/β-catenin signaling in osteoblasts. The loss of sclerostin results in increased bone formation and reduction in bone marrow (BM) volume and cellularity. Our goal is to understand how alterations within the BM microenvironment affects hematopoietic stem cell (HSC) behavior and homeostasis. We observe evidence of splenic extramedullary hematopoiesis (EMH) in *Sost*-knockout ($Sost^{-/-}$) mice and aim to understand the connections between changes in BM and EMH in the spleen. HSCs normally circulate through the peripheral blood to the splenic red pulp. During EMH, *CXCR4* and *CXCL12* interactions mediate HSC migration. In $Sost^{-/-}$ mice, we observed decreased *CXCL12* expression in $Sost^{-/-}$ bones, increased red pulp mass, and higher *CXCL12* levels in the spleen than in $Sost^{-/-}$ bones (but unchanged compared to WT control spleens). We hypothesize that EMH in $Sost^{-/-}$ mice occurs because HSCs are migrating away from the altered BM in response to high *CXCL12* levels in the spleen. Additionally, HSCs may be retained in the spleen by adhesion via *VCAM-1* protein expressed on splenic red pulp macrophages. Studies to quantify *CXCL12*, *CXCR4*, and *VCAM-1* expression on HSCs and macrophages, as well as histological analysis of spleens are ongoing. Our results will help define changes in HSC behavior in altered bone microenvironments and contribute to understanding the basic mechanisms underlying splenic EMH.



The Relationship Between Experiencing Personal Hardships and Undergraduate Students' Grade Point Averages

Harmeet K. Kalsi, Heather Daniels, MA, and IRenee Beattie, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

Prior research shows that college students who experience personal hardships may suffer academically. However, it is not clear how these effects may vary by the different number of and types of hardships students experience. This study seeks to fill this gap by focusing on the impact of experiencing personal hardships on students' college GPA and how it differs across the variety and the accumulation of hardships students experience. Hardships in this study are categorized as health, housing, financial, and divorce. Quantitative methods were used to analyze raw survey data collected from a diverse four-year institution in the U.S in 2011. SPSS was used to calculate descriptive statistics, bivariate, and multiple regression. Preliminary results reveal that students who indicated they experienced any personal hardships had significantly lower GPAs than their peers who did not report experiencing any hardships at all. There is also a decrease in GPA based on the number of hardships students experience. Subsequent analyses will examine the impact of different types of hardships on GPA. This study contributes to the literature by exploring differential impacts of personal hardships on students' success in college, as well as how the effects of hardship vary based on the number and types of hardships they face. The results will inform efforts to make higher education more accessible.



Living Black in a Field of Brown

Kaline M. Leke, Whitney Pirtle, PhD
School of Social Science, Humanites, and Arts, University of California, Merced

Understanding the constant debate for resources and affinity spaces for students within college campuses requires analysis of multiple perspectives from the population themselves. This research project will explore on the retention rates and academic success of Black students at University of California, Merced (UCM). I seek to understand how involvement in black organizations, environmental climate and presence of black spaces help with student success academically & socially. We will study a sample of current Black college students at UC Merced, by conducting online surveys, interviews and focus groups. We will speak to key founding members and members of AFRO (Afrikans For Retention and Outreach) a black living and learning community at UC Merced.

Neuronal rRNA is Inherited from Neuronal Stem Cells

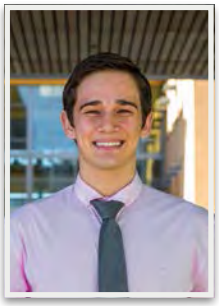
Edgar B. Marquez, and Michael D. Cleary, PhD
School of Natural Sciences, University of California, Merced

Neural stem cells (NSCs) are self-renewing multipotent cells with the capability to differentiate into multiple cell types. These cells generate the progenitor cells that subsequently give rise to neurons and the glia of the nervous system during embryonic development. Neurons on the other hand, are the basic functional units of the nervous system. These specialized cells constitute the body's messaging system, transmitting information via electrical and chemical signals throughout the body. Ribosomal RNA (rRNA) makes up the ribosome, a protein-synthesizing organelle responsible for the translation of mRNA into proteins. Molecules of rRNA are synthesized in the nucleolus which contains the genes that encode rRNA. The extreme specialization of neurons suggests that rRNA is not synthesized in neurons but rather inherited from the parental stem cell. Using EUd antibody staining and distinct neuron and rRNA markers we identified rRNA present in neurons was inherited from parental stem cells. additionally, by upregulating rRNA genes, we suspect that we can jumpstart transcription of rRNA in specialized neurons where transcription would otherwise not happen. Our studies have implication and provide insight into neuronal development.

OTUD6 Plays a Catalytic Role in DNA Alkylation Repair Response

Anika P. Padala, Sammy Villa, and Fred Wolf, PhD
School of Natural Sciences, University of California, Merced

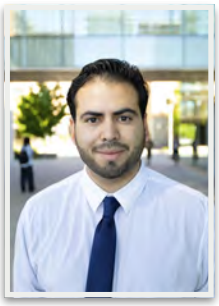
OTUD6 is a deubiquintinase (DUB) of the Ovarian tumor (OTU) family. Deubiquitinases are proteases that cleave ubiquitin from substrates to regulate cellular pathways. OTUD6 has no known substrates or molecular mechanism. The human ortholog, OTUD6B, is known to interact with OTUB1 and ASCC3. Both proteins are known to play a role in DNA damage repair. In order to see if OTUD6 plays a role in DNA damage repair as well, we decided to expose OTUD6 mutants to DNA damaging agents. Catalytically inactive OTUD6 (C183A) and heterozyous OTUD6 null were exposed to Methyl Methanesulfonate (MMS), a DNA alkylating agent. During the exposure, the mutant flies died expeditiously than the wild type control flies. This MMS sensitivity of the mutants implies that the OTUD6 catalytic activity is necessary for its response to DNA alkylation.. Next we decided to test whether OTUB1 and ASCC3 have similar sensitivities to MMS. I obtained two ASCC3 mutant fly lines and one OTUB1 mutant fly lines. I exposed these mutants to MMS and found that ASCC3 mutants are also sensitive to DNA alkylation, whereas OTUB1 mutants are not. mutants compared to the control flies. ASCC3 is a DNA helicase that is known to play a role in DNA alkylation repair in humans. The MMS sensitivity and known interaction of both mutants could mean they interact in the same pathway. Future studies will look to determine if OTUD6 and ASCC3 physically interact in Drosophila, and will assess if OTUD6 regulates ASCC3 in response to DNA alkylation.



Conservation and Diversity of the Variable Lymphocyte Receptor (VLR) in *Lampetra hubbsi*

Kyle Rekedal, Leesa A. Hagerman, Khan MA Hassan, MD, PhD,
and Chris T. Amemiya, PhD
School of Natural Sciences, University of California, Merced

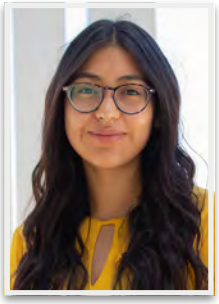
It has been previously reported that agnathans, for example, lampreys and hagfish possess a unique adaptive immune system which produces single chain protein effector molecules consisting of imperfect leucine rich repeats, or LRRs. These molecules, termed variable lymphocyte receptors (VLRs), are selected polyclonally in response to immunization of the lamprey with proteins, oligosaccharides, and whole cells. *Lampetra hubbsi* from the Merced River, California has been previously characterized by sequencing the mitochondrial cytochrome *b* gene. We obtained lampreys from the Kings River, and after sequencing the cytochrome *b* gene, we found that they were identical to *L. hubbsi* from the Merced River. We hypothesize that *L. hubbsi* would have the VLR based adaptive immune system and accordingly we were able to isolate VLRB transcripts from the species. These molecules were unique and showed a high homology among themselves and with those in the non-redundant database. Furthermore, immunohistochemistry performed on microscopic sections of *L. hubbsi* ammocoete showed presence of VLRB proteins. It would be interesting to see if *L. hubbsi* could generate VLRs the same way as that seen in *Petromyzon marinus*. In that case, this local species can be utilized as an alternative to *P. marinus* from Lake Michigan for the production monoclonal lampribodies.



Energy Harvesting from Road Traffic

David O. Sagastume, Jian Qiao-Sun, MD, PhD
School of Engineering, University of California, Merced

The integration of Piezoelectric Ceramic technology (P.Z.T) for sustainable and renewable energy is a vital subject of this research project. PZT's function to convert mechanical stress to electrical current. Given this relationship, the project consists of implementing these PZT's to harvest electricity from the mechanical stimulations of ongoing traffic. Individually, PZT's function to provide a proportional relation between the inputting mechanical stresses and the outputting electric current. To increase voltage outputs, designing a mechanical amplifier that increases the inputting mechanical stresses can increase the electrical output rather than directly stimulating the PZT's. The individual research focuses on the designing and optimization of the mechanical stress amplifier. By changing the design and manipulating its parameters, dimensions, and material properties of the device, it can increase the device's stress amplification factor, resulting in greater voltage outputs from each PZT. Safety and cost mitigation is critical for the development of this project; the modifications and designing of the amplification device must account for stress analysis to prevent exceeding the maximum loading input that may damage the device while being able to continuously maximize the voltage output.



Hemispheric Sensorimotor Synchronization in Auditory Rhythm Perception

Alejandra Santoyo, Daniel Comstock, Ramesh Balasubramanian, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

The act of perceiving a rhythm as a rhythm requires prediction of the timing of the rhythmic events. Previous research has shown that the motor system is involved in the timing of rhythm perception (Patel & Iversen, 2014). Additionally, there is a reported hemispheric asymmetry for music perception in the motor system, with the right primary motor cortex showing activity related to active music listening (Gordon et al., 2018). Our recent work has shown the frequency bands of entrainment shift when tapping to a rhythm compared to listening to a rhythm without moving, yet the specific role of the left and right motor cortices in rhythm processing remains unclear. We use EEG time-frequency analysis to investigate the role of task specificity in rhythm processing for the left and right motor cortices by using both left and right-hand motor tasks with an isochronous and a metered rhythm. We expect differences due to hemispheric asymmetry in the tap motor tasks, but more importantly we hypothesize differences due to hemispheric specialization in rhythm perception in the right hemisphere.

Investigation of a Simple, Scalable and Sustainable Synthesis for Nanophotocatalysts as an Alternative to the Haber-Bosch Process for Ammonia Production

Sam T. Schroeder, and Valerie Leppert, PhD
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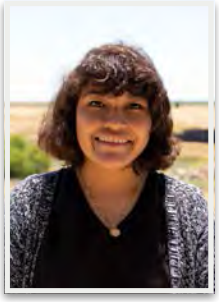
The unique layered structure of bismuth oxybromides make them a promising candidate as a nanoscale photocatalyst with a tunable electronic structure that is environmentally benign. Their band gaps of 2.3 – 2.9 eV, depending on stoichiometry, allow for photocatalytic activity under visible light, making them potential candidates for solar photocatalysis. Their photocatalytic efficiency is dependent on a number of factors; including particle surface area, facets, and chemistry. Here, we investigated a simple, scalable aqueous synthesis at room temperature for the production of bismuth oxybromide nanosheets from β-Bi_2O_3. The produced morphology of the nanosheets was varied by altering the equimolar reagent concentrations of potassium bromide and acetic acid, as well as the allotted synthesis time. Scanning electron microscopy and x-ray diffraction revealed that nanosheet phase and thickness could be controlled through manipulation of the synthesis conditions. Lower concentrations produced thinner nanosheets (11 ± 3 nm), while higher concentrations produced thicker nanosheets (16 ± 5 nm). Longer synthesis times produced fully brominated BiOBr. Lattice expansion was observed along all three dimensions of the nanosheet and was greatest (0.85%) for the (001) BiOBr planes, which lie parallel to the thin dimension of the nanosheets. These results demonstrate the promise of this synthesis approach for easily obtaining tailored nanophotocatalysts for ammonia production, as an alternative to the energy intensive Haber-Bosch process.



Angiotensin and Aldosterone Receptor Antagonism Attenuates Angiotensin II- Induced Hypertension in Sprague Dawley Rats

Stacy Tletlepantzi[1], Debye Conte[1], Ruben Rodriguez[1], Mouhamed S. Awayda[2], and Rudy M. Ortiz, PhD[1]
School of Natural Sciences, University of California, Merced[1]; Department of Physiology & Biophysics, State University of New York[2]

The blockade of the Ang II receptor ameliorates hypertension, more so than the antagonism of the mineralocorticoid receptor. However, the combined effects of ARB and MRb simultaneously on arterial pressure and renal Na^+ regulation are not well-defined during Ang II-induced hypertension. Therefore, we hypothesized the addition of MRb would have increased $U_{Na}V$. To test our hypothesis, SBP and urinary Na^+ were measured in five groups of Sprague- Dawley male rats: **(1)** untreated controls, **(2)** Ang II infused, **(3)** Ang II + ARB, **(4)** Ang II + Epl and **(5)** Ang II + ARB + Epl. Both the ARB and combo group attenuated Ang II- induced hypertension. The Epl treatment exacerbated urinary aldosterone excretion over the 21 days (Epl: 275 119; Control: 64 18 pmol/d), which was confirmed by plasma aldo on day 28. However, the exacerbation of aldo was abolished with the co-treatment with ARB. Despite some group effects in $U_{Na}V$ early in the study, there were no detectable group effects by the end. This lack of a change in $U_{Na}V$ was consistent with a lack of a change in -ENaC content. Furthermore, these results suggest the contribution of aldosterone to the volume-dependent effects of hypertension appear to be minimal in the ENaC-mediated component of renal Na^+ regulation.

The Effect of Silica Nanoparticles in a Water-Induced Catalytic Reaction

Hnubci Vang, Duy Nguyen, and Son Nguyen, PhD
School of Natural Sciences, University of California, Merced

The “on water" reaction is considered an inexpensive and eco-friendly method for organic synthesis; however, the kinetics have not been fully uncovered. Utilizing porous silica nanoparticles (SNPs), the focus of this research is to study the kinetics for the "on water” reaction. SNPs have free OH groups on the surface making them highly compatible for the "on water" reaction. In this work, porous SNPs have been used as a catalyst in the model reaction between quadricyclane and diethyl azodicarboxylate. These SNPs were synthesized and characterized by TEM. Water on silica is a crucial variable. The amounts of adsorbed water on silica were quantified by FTIR. In this finding, water adsorbed porous SNPs have greater acceleration rate than dry SNPs. These studies expand the scope of "on water” reaction and establishes an understanding of the catalytic mechanism of silica nanoparticles as primary catalysts.

The Complex Health Issues of Hmong Shamans

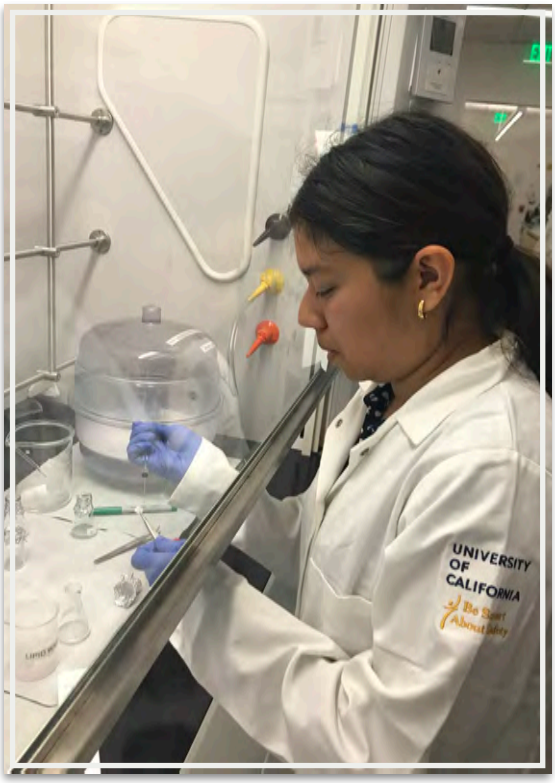
Ya Yang, Linda-Anne Rebhun, PhD, and Nancy Burke, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

The Hmong are an ethnic group from Southeast Asia who have lived as forced political refugees for the past several hundred years. In the Hmong culture, healing is, and always has been, the main work of the shaman (Pinzon-Perez, 2005). Hmong shamans do not treat physical illness as practiced by western medicine, rather they center their practice around spiritual maladies (Fontaine, 2000). The shamanic practice cannot be learned; shamans are spiritually chosen by their ancestors. Although Hmong shamans are well-respected within the community as healers, the health issues that they have to experience and the changes in their lives are not addressed. Semi-structured in-depth interviews were conducted with 15 Hmong shamans from the Central Valley, Minnesota, Wisconsin, Thailand, and Laos to explore their health, diet and relationships. Findings revealed that (1) shamans experienced at least an illness, physically or mentally, before they became a shaman (2) after one becomes shaman, they must cleanse their physical bodies by consuming products that are pure both in preparation and content (3) the healing process exposes shamans to spiritual risks that can potentially end their lives (4) most of their relationships with family and community members became better.

Multiple Motors Mitigate the Shortening Effects of Thermal Diffusion of Single Kinesin Runs

Arturo Zaragoza, John Wilson, and Jing Xu, PhD
School of Natural Sciences, University of California, Merced

Long-range transportation is important for cells. Cells are organized structures where different organelles perform different tasks. Molecular motors help this organization by transporting necessary material between organelles. In my research, I study kinesin, which walks on top of microtubules for its transportation of cargo. Importantly, kinesin can only walk so far before they detach from the microtubule. This distance depends on the force applied on kinesin: forces in the direction of kinesin's motion lead to shorter travel distances than forces against the motor's motion. Recent work in the Xu lab has shown, using Monte Carlo-based stochastic simulations, the thermal motion of the cargo shortens the motors travel distance. Interestingly, they found that a slightly higher viscous drag increases the travel distance. In these simulations, the cargos were transported with a single kinesin motor. However, in actual experiments, not all cargos are transported with a single motor but with two or more motors. I am interested in how this increase in the number of motors will alleviate the shortening effect found at a low viscosity. Specifically, I am using the same Monte Carlo based simulation but will allow for the possibility of multiple motors. Results from my work will lead to an increased understanding of the tunability of motor-based transport.



Summer Undergraduate Research Fellowship

SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

The following student fellows are part of UC Merced's Summer Undergraduate Research Fellowship (SURF) Program. SURF is a fellowship that is offered to all undergraduate students in any discipline. This 9-week summer fellowship offers our students the opportunity to work alongside faculty and graduate student mentors and provides graduate school preparation.

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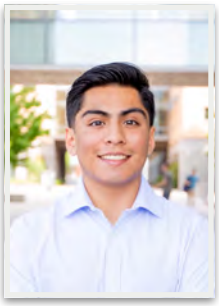

The Relation Between Perceived Stress, Burnout and Worry on Sleep Quality

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Ample research links stress with poor sleep quality. Several conceptualizations of stress exist: *perceived stress* is the extent to which an individual perceives a situation as stressful, *burnout* is the state of emotional/physical/mental exhaustion caused by prolonged/excessive stress, and *worry* is the state of mental distress due to an anticipated event. Little research has tested whether these types of stress are unique or are different ways of assessing the same construct. The purpose of this study is to examine whether perceived stress, burnout, and worry independently predict sleep quality. We collected data from 280 employees from the University of California, Merced (71 males, 208 females) with a mean age of 37.3 years. Participants filled out the following measures online using the online platform Qualtrics: Perceived Stress Scale, Bergen Burnout Inventory, the Penn State Worry Questionnaire, and the Pittsburgh Sleep Quantity Index (we focused on the component assessing overall sleep quality over the last month). First, we expect to see an inverse relationship between each of the three types of stress and sleep quality. We also anticipate that perceived stress, burnout, and worry will be independently correlated with sleep quality. These findings will aid in developing treatments/habits to diminish stress levels and improve individual's health-related quality of life.

Housing Insecurity and Health Outcomes in Rural United States

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Housing related disparities are of great concern in rural communities. A lack of stable, affordable and adequate housing can have severe implications for a person's health. In this review of literature, I seek to understand what current research shows the health consequences of housing insecurity in rural areas are. Through the Social Sciences Combined database, I gathered and analyzed peer reviewed articles that researched housing insecurity, health outcomes, and rural health. From my review of literature, the majority of the articles discussing racial disparities found health outcomes stem from differences in social and physical environment. Many of the risk factors for health are inherent in the conditions in which people live. My literature review revealed more research needs to identify how to reduce the negative effects of housing instability on health outcomes. Understanding the severity of housing insecurity can inform the development of policy solutions that target assistance appropriately and meet varying needs of populations.

Exposure to Secondhand Smoke in San Joaquin Valley

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Research shows that exposure to secondhand smoke (SHS) poses significant health risks, however, there is a lack of research on where the general public is exposed to SHS or the general publics' support for smoke-free air laws (SAL) not covered by state law in the San Joaquin Valley (SJV). We hypothesize that the pattern of exposure to SHS and support for SAL will differ by sex, race, ethnicity, age, sexual minority status, and county. We surveyed residents from 11 counties in the SJV in the Spring and Summer of 2019. Frequencies and cross tabs would be used to examine data. Results are pending but approximately 200 individual responses have been collected. Results are to be determined. Results could determine which groups should be targeted for health interventions to prevent negative health outcomes in these communities. Conclusion will be determined based on results.

Stress Among College Students

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In the University of California, Merced it was reported in the 2018 year alone, 52.3% of students were struggling with handling financial stress and 42.1% were struggling with overall stress. In addition, evidence suggested that students tend to have trouble with adjusting and fully being able to finish college because of overall stress put upon them. The purpose of his research is to understand the importance of the stress in students in order to find methods of coping and adjusting resources. An analysis done through this research showed that college students under more stressful circumstances tend to be less academically successful then those with on-campus resource knowledge and use. Researchers job is to find the right mechanism to improve not only resources to deal with stress, but also how to adequately provide those resources to students.

Proving CRISPR Septin9b Gene Knockout through RT-qPCR

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The Septin family of proteins are fundamental for a variety of biological processes within the cell. These include acting as scaffolds and diffusion barriers, their contribution to the rigidity of the cell and vesicular fusion, as well as their interaction with phospholipid membranes, actin filaments and microtubules. Although the Septin family has been known for over forty years, much is yet to be discovered about their interaction and importance within living organisms, including the diseases associated with their malfunction. In an attempt to decipher its function within living organisms, the Woo lab successfully raised CRISPR mutants of the Septin9b gene in zebrafish by both the introduction of an early stop codon knock-in or short 5 base-pair deletion. However, no phenotypic changes were seen in the fish. Here, we attempt to prove that mRNA levels of Septin9b are much lower in those fish than those of a wild-type line through the use of techniques such as RNA extraction, synthesis of cDNA and RT-qPCR.

Oxalobacter spp. C1 Bacteriophage Isolation using Mitomycin C Induction

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The basal metazoan *Hydra* spp. Are freshwater animals that have a naturally occurring microbiota. To experimentally explore the symbiotic relationship between bacteria and viruses in *Hydra* spp., bacteria and bacteriophages to be used as experimental models must first be isolated. Prior to this study, a strain of bacteria *Oxalobacter* spp. C1.1 was isolated from the *Hydra vulgaris,* and therefore in the current work the objective was to isolate a bacteriophage associated with this organism. Bacteriophages can either lyse bacteria directly or integrate their genome into the bacterial genome as so-called prophages, where they remain at a silent state. By using of induction methods, this latter form of bacteriophage can be forced to excise from the bacterial chromosome forming viral progeny that can then be collected. Induction can be stimulated by stressful condition such as by damage to the bacterial DNA, this can be done with experimentally using DNA damaging antibiotics, such as mitomycin C. We therefore exposed Oxalobacter spp. C1.1 to three concentrations of mitomycin C (0.0156 µg/ mL, 0.0039 µg/ mL, and 0.000488 µg/ mL). At the higher concentration of mitomycin C (0.0156 µg/ mL) declines in bacterial density was observed, indicating the lysis of bacterial cells, and therefore possible bacteriophage induction. As the overall goal of this work is to identify bacteriophages for Oxalobacter spp. C1.1.

Finding Hyperbolic Plateaus of Topological Entropy in a Chaotic Rydberg Atom

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Placing a classical hydrogen atom in an external magnetic field creates a chaotic system. The dynamics of the electron can be described with a Hamiltonian. A surface of sections plot is created from the Hamiltonian to visualize the dynamics on a two-dimensional Poincaré surface with the magnitude of the external magnetic field and electron energy as parameters. Using a monte carlo simulation and millions of orbits the escape rate of the electron can be computed at different parameters; however, if a complete symbolic dynamics can be extracted from the system we can compute the same escape rate with only thousands of special, periodic orbits. But, at different parameter ranges the symbolic dynamics can either be clearly defined or become incredibly complicated. Using homotopic lobe dynamics we predict what the symbolic dynamics will be at one of the hyperbolic plateaus. By analyzing the topology of the unstable manifold at different parameter values we conduct a binary search of the parameter space to find these regions of relatively stable topological entropy, called hyperbolic plateaus. We expect to find this region and then continue to search for additional plateaus with different predictions. In the future we will compute the periodic orbits in these regions and use them to calculate escape rates.

The Physical Signs of Gentrification and Racial Turnover in Washington, D.C.

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In 1970, 70% of the population of Washington, DC identified as Black. The Black population has steadily declined since, and in 2014, Black people were no longer the majority in the capital city. Since the beginning of the 21st century, the city has seen an increase in median household income and housing prices. This study sets out to identify the change in physical appearance in the city as it gentrifies and experiences racial turnover. The data was collected through a housing survey and was analyzed through ArcGIS, a geographic information analysis tool, to visualize the variables and create a map that displays the area studied. The area under study is a census tract that has experienced a decline in Black residents since 1990 yet, has witnessed little change in median household income. This study focuses on the change in the physical characteristics of the neighborhood, despite the lack of change in median income. We plan to use these observations to develop a model to measure the correlation between public and private investment, racial turnover, and gentrification in Washington, DC.

Seasonality of *Aedes aegypti* Mosquito (The Zika Mosquito) in Merced

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Aedes aegypti is a species of mosquito which can transmit dengue, chikungunya and the Zika viruse. This mosquito is typically found in tropical areas, but has been introduced to California, and was detected in Merced County in the fall of 2017. Since the mosquito is new to Merced, it is important to understand the seasonal abundance of this mosquito and educate the public about its potential public health importance. The purpose of this study was to understand what months during the year the mosquito will be most abundant. This information will help to target control efforts to reduce mosquito populations. A study was conducted in Merced to monitor the year-round egg laying (oviposition) activity by this mosquito. Fifty egg traps (ovitraps) were set each week during the year, 2017-2018. Traps were checked each week for eggs. Eggs were photographed and counted to determine the average number of eggs oviposited each week. From this data, we will determine which weeks and months have mosquito activity and when the mosquito is most abundant. This will provide information to the Merced County Mosquito Abatement and the Department of Public Health, to help target control and education efforts against this mosquito.

Isolation of Temperate Bacteriophage in *Hydra*-Associated Bacteria *Acidovorax spp.*

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A provirus is a virus that interacts with the host cell it infects by integrating its viral genome into the host genome. Such infections in bacteria are caused by bacteriophage, which are called prophage when imbedded into the bacterial genome. However, if exposed to stress stimuli, such as mitomycin C, an antibiotic that inhibits bacterial growth through DNA damage, prophage can then lysis the infected bacteria. Therefore, stress stimuli, such as mitomycin C, can be used in the laboratory to isolate temperate bacteriophage inside bacterial genome. Here, *Acidovorax spp. AEP 1.4*, a bacterium extracted from *Hydra vulgaris*, was examined for the presence of temperate bacteriophage by the introduction of mitomycin C into cultures of the bacteria, with measurement of declines in bacterial density being used to indicate the presence of bacteriophage in the host. For this *Acidovorax spp. AEP 1.4* was exposed to three mitomycin C concentration (2 μg/mL, 0.5 μg/mL, and 0.0625 μg/mL), it was found that 2 μg/mL mitomycin C caused decline of bacterial growth after 10 hours, suggesting possible bacteriophage lysis. To confirm this observation examination of the filtrate form, these culture under TEM (transmission electron microscope) will be used to image any bacteriophage produced. In conclusion, the bacteria growth decline indicates potential bacteriophage lysis, and therefore possibly isolation of bacteriophage of *Acidovorax spp. AEP 1.4.*

Stock Prices and Investor Information Availability

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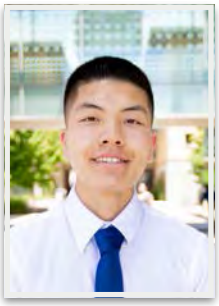
Information and investment decisions are directly related according to all fundamental models of corporate finance and economics. As such, this study proposes a direct measurement of capturing investor information with the use of Google Trends - Search Volume Index (SVI). We sampled the SVI of companies in the S&P 500 and their monthly stock prices; and monthly closing stock prices extracted from the University of Pennsylvania's Wharton Research Data Services database (WRDS). We ran a time-series regression from 2008 to 2018 and find that there is a significant relationship between SVI's web searches and the price of a stock 2 to 4 months from the time the search index makes a major change. The relationship between the SVI and the stock's monthly price is negative and statistically significant at the 2 month lag. In our findings, a 3 standard deviation increase in web searches leads to a 0.48 dollar decrease in stock price 2 months out, controlling all attributes of them firm. The implications of this research findings confirm that Google Trend's Search Volume Index can predict stock prices.



Geographic Variation and Trend in Adolescent ED Visits for Suicide Attempt, Alcohol Abuse, and Drug Abus wihin all Counties in California

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According to the CDC, suicide rates went up by 30% in half of the states since 1999. By looking at ED visits in 2009-2013 for self-harm, alcohol, and drug abuse, research is needed to provide a clearer understanding of whether county-level rurality, economic region, and median household income influence rates of ED visits for substance abuse and self-harm. Data from the Office of Statewide Health and Planning Department (OSHPD) was utilized for this study. 4 different quartiles were divided to examine the rate of median household income level in California. In addition, 9 different economic regions in California were explored. Lastly, urban areas by county was compared to rural areas. The results showed wealthier counties who had a median household income of $53,000 had higher rates of self harm, alcohol, and drug abuse related visits compared to low income counties. No significant differences in rates between urban and rural counties for these behaviors were observed. As far as regions, Northern California regions are more prone to self-harm, alcohol and drugs. Overall, it is important to examine these behaviors in order to pinpoint which counties in California should be focused on to prevent future substance abuse and self-harm from occurring again.

IL-7R Signaling Promotes Survival or Proliferation of Tissue Resident Macrophages

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IL-7R signaling has been shown as essential for the survival and proliferation of T cells as well as the proliferation of B cells. Our lab has found that IL-7R signaling is also required for tissue resident macrophage development, but the function of IL-7R signaling in tissue-resident macrophage development is still unknown. We hypothesize that tissue-resident macrophages may use the IL-7 receptor for both survival and proliferation because it has a similar function in lymphocyte development. To understand its function, we will block the receptor with an antibody treatment during the fetal developmental window when the receptor is expressed. The next day, at E16.5, tissue samples will be taken from the brain, liver, lung and skin and stained with either Ki67, a proliferation marker or Annexin V, which is a marker for apoptosis, and then analyzed by flow cytometry. After blocking the IL-7R we found that brain macrophages had increased Annexin V staining as well as decreased Ki67 staining, similarly liver macrophages had decreased Ki67 staining, but Annexin V staining was not increased. This data shows that IL-7R signaling regulates survival and proliferation of fetal brain macrophages, while Il-7R signaling regulates the proliferation but not survival of fetal liver macrophages.

A Qualitative Research Study Exploring Physician Decision-Making and Addressing the Physician Shortage in the Central Valley

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The physician shortage is a critical problem in the Central Valley contributing to delays in healthcare access and disparities among residents. To the best of our knowledge, research has not been conducted on solutions. Possibly the lack of support, attention, and finances may have been the factors as to why we are currently having this problem. In the literature, medical students and residents trained and exposed to rural settings are more likely to choose practice in the region and to specialize in family medicine. Among females, a partners' location is an identified barrier to practicing medicine in rural settings. This qualitative study explores barriers and facilitators influencing medical students' decisions to work in the Central Valley. Interviews were conducted with 11 participants and were about twenty minutes to an hour long in duration. The purpose of the data collection instruments was to understand the views and experiences related to medical students' training and to explore if pipeline programs and mentorship programs influenced their decision-making. NVIVO, a qualitative data analysis software, was used to analyze key themes in the interviews. Respondents revealed a lack of mentorship models in their field. They shared that prior exposure to the medical field was an important factor encouraging them to pursue a career in medicine.

Analyzing Minimum Wage Tasks and Occupations from 1940 to 2000

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A temporal mapping of minimum wage tasks leads to a better understanding of labor market history and allows us to possibly forecast future labor market changes. To create this, the study identifies what types of tasks and occupations were compensated minimum wage from 1940 to 2000. The expectation is that routine tasks become less valued over time with the advent of automation. This study augments Census data containing wage and occupation information from 1940 to 2000 to include task data provided by the Dictionary of Occupational Titles. This study also utilizes federal and state minimum wages to identify minimum wage workers and their occupations. Through analysis, this study finds that occupations consisting of routine tasks lost their value with the advancement of technology. This information is important for people entering or switching into new careers. Automation technology is continuously advancing, so occupations containing mainly routine or repetitive tasks should be avoided.

Efficient, Simultaneous Production & Purification of Multiple Proteins in *E. Coli*

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Recombinant bacterial protein expression is the method of choice to produce high protein expression rapidly and economically. However, protein production and purification remains a significant bottleneck within biological, biochemical, and biophysical laboratories. In our lab, each project involves tens of different proteins, each of which requires high yield expression. To help increase the effectivity of protein production and purification, we took a two-pronged approach that aims to increase protein expression levels as well as developed a method for multiplexing protein purification. To increase protein production yields, we increased cell content in our culture by optimizing the introduction of fresh nutrients before induction. This technique proliferated cell growth and as a result protein production increased by a factor of two. To multiplex protein purification, we attached elastin-like polypeptide (ELP) tags to a protein of interest. ELPs are known to phase-separate into liquid droplets at different temperatures, depending on ELP sequence. With multiple ELP tags, we can express many proteins in a single batch, and use centrifugation cycles at different temperatures to pellet out multiple proteins. Once optimized, these techniques pave the way to obtain high yields of up to 4 different proteins in a single expression batch.

Identifying Natural Killer Cell Ly49 Subset Development in Vitro

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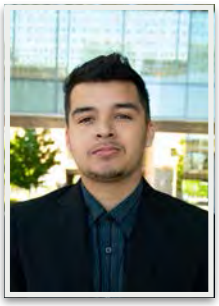
Natural Killer (NK) cells recognize and terminate virally infected and cancerous cells. Evidence shows Ly49 receptors play an important role in target cell recognition, but how NK cells acquire Ly49 receptors is incompletely understood. Ly49 activating and inhibitory receptors are membrane-bound glycoproteins encoded by genes in murine NK cell subset over time. We developed an assay in which we stimulated immature Nk Cells (CD27+CD11b-) in vitro to identify 16 possible combinations (clusters) of activating Ly49D and Ly49H, and inhibitory Ly49I and Ly49G2 receptors over time using flow cytometry. Our data identifies four novel clusters that significantly differ in frequencies over a period of six days in culture. We predict from frequencies a sequential cluster pathway that may originate from “Cluster 11” (Ly49H+Ly49D-Ly49G2-Ly49I+) which develops into “Cluster 14” by down regulating Ly49H, and then develops into “Cluster8” (Ly49H-Ly49D-Ly49G2-Ly49I-) by down regulating all four receptors. We then predict “Cluster 8” to up regulate Ly49D and Ly49G2 to develop into “Cluster 6” (Ly49H-Ly49D+Ly49G2+Ly49I-). To test this, we will sort and culture these clusters to determine the trajectory of development for each cluster over time. These data provide evidence of controlled regulation of Ly49 receptor expression on NK cells, which may indicate expression is not stochastic.



Solving Partial Differential Equations Using the Least Square Regression Method

Luis Monje Maldonado, Maxime Theillard, PhD, and Arnold D. Kim, PhD
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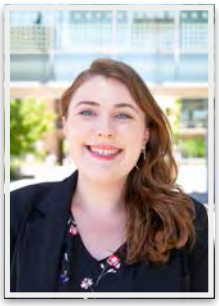
Least-squares regression (LSQR) has been used extensively for modeling data. For that problem, we seek to approximate a polynomial that best fits a data set by minimizing the misfit of the model to the data. We review this method and apply it to model several examples of stock prices. We then present our new LSQR based numerical method for solving boundary values problems for differential equations. Compared to traditional discretization techniques this new method offers the following advantages: (a) the implementation is straightforward (b) adaptive grids are easily handled (c) high order discretizations can be easily constructed. This new approach opens up the possibility of developing simple, efficient, and novel computational methods to simulate real-world phenomena with high accuracy at a minimal implementation cost.



Evaluating the Effectiveness of Emotional Stimuli in the Conners Continuous Performance Task III

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Attention influences an individual's ability to respond to their environment. Conners Continuous Performance Task III (CCPT-III) focuses on measuring an individual's attention and inhibition to serially presented visual stimuli (i.e. letters) (Conners, Pitkanen, Rzepa, 2014). The following study was developed by our lab to validate a new measure: the Emotional Continuous Performance Task (EMO_CPT). This task maintained the parameters established by the CCPT-III, excepting that this measure uses a standardized battery of emoticons instead of letters. Participants experience one of two counterbalanced conditions where they respond to a specific valanced emoticon via a keystroke and are asked to refrain from a response when a differently valanced emoticon is present. The EMO_CPT was standardized by establishing the unidimensionality, discriminative validity, and test-retest validity of our four measures. The results of repeated measures ANOVA's revealed no significant differences between either EMO_CPTs. Two-tailed independent t-tests, between the EMO_CPT and the CCPT-III, revealed several significant differences suggesting that there are relevant differences between these two measures. Pearson correlation comparisons exhibited an increased relationship in missed target stimuli between time one and time two for participants in the EMO_CPT versus that of the CCPT-III. The results from this study suggest that the EMO_CPT may be capable of evaluating metrics which are inaccessible with the standard CCPT-III.

The Relationship Between Socioeconomic Status and False-Belief Understanding

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False-belief understanding, which is the cognitive ability to recognize that other individuals can be mistaken, can be impacted during development by socioeconomic status (SES). Previous studies have confirmed that there is a positive correlation between a family's SES and their child's performance on elicited-response false-belief tasks. However, failure in those tasks can be explained by a number of reasons, such as difficulty in inferring false-beliefs, predicting behavior, or answering direct questions about the mistaken behavior. Our project will utilize a multi-method approach that will disentangle those sources of failure, thus, clarifying the nature of socioeconomic disparity in false-belief understanding. Child participants, between 3.5 and 5.5 years old, will complete elicited and non-elicited-response false-belief tasks and several other cognitive assessments. Their parents will complete questionnaires about family demographics, their stress levels, and knowledge of child development. Parent-child pairs will complete interactive tasks that will evaluate the parent's use of language. Preliminary results imply that including non-elicited-response tasks will help yield new insights into the nature of SES-related disparities in false-belief understanding. Preliminary studies also suggest that a child's verbal ability and their parent's use of mental-state language are positively associated with the child's performance on non-elicited-response false-belief tasks. These findings will advance knowledge about the nature and causes of SES-related disparities in the development of sociocognitive abilities.

In-Depth Analysis of Minimum Wage Workers from 1940 to 2000

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This study sought to explore what types of people work minimum wage occupations through analyzing minimum wage worker demographics. These demographics were found in U.S. Census data from 1940 to 2000 and included variables such as age, gender, race, and family size. The issue this study seeks to investigate was whether or not minimum wage workers changed during this time period. This study finds that minimum wage workers became more diversified in race and age, shifted from being predominantly men to predominantly women, and had a relatively consistent family size from 1940 to 2000. Knowing what types of people work minimum wage occupations will give insight into how the labor market is split demographically and who is affected the most by changes to the minimum wage and minimum wage laws.

Does trump's Anti-immigrant Rhetoric Lead to Greater Bias in Police Actions?

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Over the past century, the Latin community has been the target of various negative political rhetoric and anti-immigrant sentiment. From being intertwined with marijuana to push anti-immigrant propaganda back in the 20th century to now being targeted by Donald Trump's anti-immigrant rhetoric. The negative views on the Latin community can lead to the Latin population facing a cycle of issues such as fear to leave their house, and police distrust. This research uncovers how Donald Trump's anti-immigrant rhetoric has impacted policing actions against the Latin community among locations with high vs low support for Trump. The data in this research was gathered through GIS maps displaying support for Trump during the 2016 election and data from Stanford's Open Policing project. To help solve the ongoing issue of policing within the United States, there are many actions to be taken. This includes having a representative bureaucracy within city politics, ensure that there is police accountability by means of the supreme court, and police transparency to continue to conduct this type of research.

Evaluating Soil Moisture and Vegetation Patterns Over Time Through COSMOS

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Measuring soil moisture is an important factor in understanding how our natural environment functions and responds to change. We want to understand the behavioral patterns of vegetation and soil moisture within multiple areas and detect their similarities and differences throughout the years June 2011 to June 2019. We gathered approximately 160 sample points by hand in 8 different directions from the flux tower that has a COsmic-ray Soil Moisture Observing System (COSMOS) probe attached to it. This system allows us to view the area-average of soil moisture through the hectometer horizontal scale. This system carries a probe that measures the neutrons that are created by the cosmic rays that lie within the soil, air, and other materials. COSMOS is utilized in order to evaluate the contributing factors besides snowmelt that affect soil moisture. The data from our COSMOS indicates there is a drought and mortality event occurring near the tower located in Providence (P301) where a massive part of the forest has died off. We aim to see the accuracy of this instrument and view how close our results are to the data points collected from the tower through a series of graphs. This will guide us to discovering how soil moisture and vegetation patterns change over time.

Differences in Emotional Reactivity and Perceptions of Stress Intensity After Exposure to Stressful Life Events Among Adults

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Exposure to stressful life events may lead to different emotional reactions among adults, such as feeling anxious, sad, or angry. People may also report different perceptions of stress intensity that can influence different emotional reactions. It is unclear, however, if different age groups experience stress the same. This project seeks to understand the relationship between exposure to stressful events, perception of stress intensity, and emotional reactivity based on age. The sample consisted of 315 working adults, including 71 men, 208 women, and 36 other/unanswered responses, between the ages of 18 - 66 at the University of California, Merced. Perceived stress intensity, emotional reactivity, and exposure to a stressful event in daily life were assessed using Ecological Momentary Assessment (EMA) up to five times a day for four consecutive days. Based on prior research demonstrating that ageing is associated with a decrease in emotional intensity and negative emotional reactivity (Gross et al., 1997), we anticipate that younger adults will report higher levels of perceived stress intensity when exposed to stressful events compared to older adults. By examining the relationship between exposure to stressful events, perceived stress intensity, and emotional reactivity reported, we will have a better understanding of how age plays a role in the perception of everyday life stressors.

Individual-Difference and Well-Being Correlates of Perceiving Multicultural Threat: Evidence from a Hispanic Serving Institution

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Multiculturalism is the coexistence of multiple cultures and ethnicities in a society. Those living in multicultural environments experience a host of positive outcomes, including better academic performance, improved psychological well-being, and increased empathy toward others. Nevertheless, some people perceive multiculturalism as a threat to their own group's opportunities for success; that is, they perceive *multicultural threat*. The present study examines perceptions of multicultural threat in a highly multicultural environment (at a Hispanic Serving Institution) to address two primary questions: (1) Who perceives multicultural threat? and (2) How does perceiving multicultural threat relate to health and well-being?
A sample of 405 undergraduate volunteers at the University of California, Merced completed an online survey in which they reported perceptions of multicultural threat, demographic characteristics, personality traits, and health/well-being. Results suggested that women, those with higher subjective SES, those lower in agreeableness, and those lower in emotional stability were most likely to perceive multiculturalism as threatening. By contrast, Latino/a/x and first-generation students were the least likely to perceive multiculturalism as threatening. To the extent that people perceived multicultural threat, they also reported more stress, anxiety/depression, and sleep disruption, as well as a lower sense of belonging at the university. These findings offer initial insight into who perceives multicultural threat and suggests that such perceptions relate to poorer health and well-being in a diverse, multicultural environment.

Methane Adsorption Capacity of Activated Carbon and Biochar

Jesus Salas Hernandez, Sai Phani Kiran Hota, and Gerardo Diaz, PhD
School of Engineering, University of California, Merced

Dairies are the single largest contributor of California's anthropogenic methane production. Approximately, 11.67 MMT CO2e, constituting 34% of total agricultural emissions, are generated from manure management. Biochar is a porous material, that may be included during composting in order to reduce natural gas discharges, up to 32% in methane emissions, and aerate the mixture. This study focuses on biochar which, due to its surface area, has been demonstrated to be an effective material for the adsorption of natural gas. Compared with other adsorbents, biochar still exhibits non-optimal performances for industrial usage. Activation of biochar has become standard practice for enhancing the surface area and micro-porosity, yet there exists insufficient research on the effects of chemically activated biochar on methane adsorption. The objective of this research is to analyze how chemical activation of biochar enhances methane adsorption capacity. The physical properties of the biochar samples were obtained utilizing a Gemini VII 2390 Surface Area Analyzer; data analysis was completed via the Brunauer- Emmett-Teller method. A dynamic fixed-bed adsorption column was designed for obtaining breakthrough curves and adsorption capacities for each adsorbent. The activated carbon from biochar is predicted to exhibit a greater surface area and micropore distribution compared to that of the control sample. Breakthrough time for the activated biochar is anticipated to be longer than for the untreated samples, indicating a greater adsorption capacity.

Enhanced Luminescence Imaging with Ultrasonic Waves

Steven Soe, Michael Lun, Yile Fang, Changing Li, PhD
School of Engineering, University of California, Merced

Optical imaging methods such as fluorescence imaging or bioluminescence imaging have been used to obtain the bio-distribution of luminescent agents inside tissues by measuring the emitted optical photons from the tissue surface with high sensitivity. However, the spatial resolution of optical imaging is compromised in deep tissues due to the strong optical scattering. In this study, we proposed a new method to enhance the spatial resolution of luminescence imaging by stimulating the emission of optical photons in the luminescent agents (Europium and Dysprosium doped Strontium Aluminum Oxide (SrAl2O3: Eu, Dy) and Europium-doped Gadolinium Oxysulfide (Gd2O2S: Eu3+) with ultraviolet (UV) excitation and then using ultrasonic waves to release the excited state back to ground. If we used a focused ultrasound beam to control the energy-releasing region, we expect to obtain the luminescence imaging with a spatial resolution close to the ultrasound focal spot size. In this study, using the above mentioned luminescent agents, we have measured the UV-excited luminescence emission spectrum from each sample. We have also compared the performance of two ultrasound machines, Ultrason 101 and DPR300 Pulser/Receiver, to study other factors that contribute to this phenomenon. We have also computer-aided designed a prototype imaging system with ultrasound. Through our preliminary experimentation, the data confirms ultrasound can accelerate the release of luminescence energy.

Reducing Endogenous Biotin in Embryonic Mice

Oscar Torres Gutierrez, Xuecai Ge, PhD, and Xiaoiang Liu, PhD
School of Natural Sciences, University of California, Merced

This project serves as part of an ongoing proteomic study that aims to reveal *bona fide* cilium proteins in the developing brain. Our preliminary study showed that the endogenous biotinylation level is high in the brain, which prevents the isolation of cilium specific proteins from cilium-TurboID transgenic mouse. The goal of this project is to identify a time window in which biotin levels are reduced in the brain without significant impairment of brain development. To achieve this goal, we ordered 16 pregnant mice (Strain C57BL/6). 8 mice were fed biotin depletion food and the other 8 were fed normal food. The mice were then sacrificed at different stages (E8-E18) and the embryonic brains were dissected. The brains were either snapped freeze in liquid nitrogen or preserved in 4% PFA. The protein biotinylation levels were evaluated with Western Blot procedure. To evaluate the effect of biotin deficiency on brain development, we used immunostaining to observe the neocortex structure. Our result will provide important information for the overall experimental scheme of *in vivo* cilium proteomics. It may also contribute to better understanding of biotin deficiency-related deficits such as cleft palate.

Urban/Rural Divide In Politics

Osvaldo A. Valencia, Adi Dasgupta, PhD
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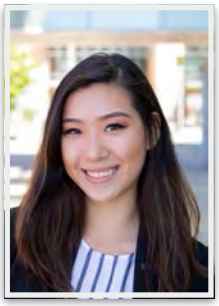
Today, rural counties in the United States consistently vote for conservative politicians. Common explanations for this phenomenon point to the cultural conservatism of rural voters. However, it is worth asking, was this always the case? A look at history suggests that the conservative turn in rural America occurred relatively recently, during the middle of the twentieth century. This research will examine quantitatively when a correlation between rural areas and support for conservative politicians emerged in the United States by assembling a new dataset connecting census data and election for all American counties between 1920 and 2000. Using digitized maps of major events such as the Dust Bowl, it will also conduct an exploratory analysis of historical events which may have influenced this shift. Preliminary results show that in Texas, between the 1970s and 1980s, counties that became more rural tended to vote more conservative. The goal of this research is to serve as a steppingstone for future researchers to explore the importance of these events by providing a dataset on ruralness and support for conservative politicians for all American counties for the period 1920-2000.

Epigenetic Sequencing of Bacterial Microbes in Mammals

Phalen N. Vang, Meng Mao, PhD, and Gordon M. Bennett, PhD
School of Natural Sciences, University of California, Merced

Most animals establish symbioses with bacteria that provide essential health benefits. In particular, bacteria offer nutritional metabolisms that hosts require, and in return hosts provide genetic and cellular support of the bacteria. However, the mechanisms that hosts use to regulate bacterial symbiont activities remains uncertain. One possible host regulatory mechanism is to control support genes so that they are expressed exclusively in symbiont organs (bacteriomes) where bacteria reside. This regulation may occur through epigenetic modification of genes via methylation. Methylation is essential for cell differentiation via repression of gene expressions, blocking promoters where transcription factors should bind. How, or if, animals use methylation to regulate interactions with bacterial partners remains unclear. We hypothesize that hosts methylate symbiont support genes in non-symbiotic tissues, allowing them to uniquely express them in the bacteriomes. To test this, we focused on the leafhopper, Macrosteles quadrilineatus (MAQ), that harbors two bacterial symbionts, Sulcia and Nasuia. Recent work showed that MAQ specifically expresses thousands of genes to support these bacteria, which are likely to be under epigenetic control. To date, MAQ specimens were collected from laboratory-reared lines. Head, leg, and bacteriome samples were dissected from 50 pooled females in three replicates. DNA extraction was performed and methyl-bisulfate sequencing is underway. We predict that epigenetic control, is a common mechanism to regulate the bacterial symbionts of animals.



Differences in Motor Movements During Implicit and Explicit Learning of Motor Sequences in a Serial Reaction Time Task

Emily Wang, Alexandria Pabst, and Ramesh Balasubramaniam, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

Implicit and explicit procedural learning differences have widely been studied in motor sequence learning paradigms utilizing button-presses. In this exploratory study, we aim to resolve if changes in the perceptual nature of stimuli in a serial response time task adapted for manual movements of the arm change aspects of movement during implicit and explicit learning of a motor sequence. Using the KINARM™ exoskeleton and an eye tracker, participants were asked to make back and forth movements using their right arm towards 8 targets surrounding a starting position while their gaze was recorded. Participants were separated into implicit learning and explicit learning groups and small perturbations could be applied to the hands after reaching toward a target, pushing them in the direction of the next upcoming target during sequence blocks, enhancing predictive mechanisms. Initial data indicate that reaction times, peak velocity, and acceleration of movements during sequence learning across all conditions are slower compared to randomized trials, similarly found in Moisello et al. (2009), showing that motor learning requires additional cognitive processing and resources. We hope to confirm that the KINARM™ accurately replicates results found in traditional sequence learning tasks, in addition to further understanding how manipulating the perceptual nature of stimuli influence learning styles.

Assessing Drivers of Migration from Guatemala: Experiences of Violence and Economic Hardship

Teagan Zuniga, Elaine K. Denny, PhD
School of Social Sciences, University of California, Merced

From 1960 to 1996, Guatemala faced an intense civil war that has left the population in a tense post-war world. With rising crime and poverty, what affects people's choice to stay in Guatemala or to emigrate? 19,003 individuals were surveyed in person in a representative sampling of the Guatemalan population. This survey asked questions about Guatemalans' economic situation, their relationships with various types of organizations, and their likelihood of migration. Here, I analyze whether an individual's economic situation or self-perceived likelihood of future violence drives the decision to migrate. A multivariate logistic regression shows that a person's economic situation, their past experience of violence, and expectation of future violence all correlate with planning to migrate.

UC Leadership Excellence Through Advanced Degrees

The following student scholars are part of the University of California Leadership Excellence through Advanced Degrees (UC LEADS) Program. The goal of the UC LEADS research and graduate preparation program is to educate California's future leaders by preparing promising students for advanced education in science, technology, engineering and math (STEM) fields. The program is designed to identify upper-division undergraduate students with the potential to succeed in these disciplines, but who have experienced situations or conditions that have adversely affected advancement in their fields of study.

For more information, please visit http://uroc.merced.edu/uc-leads

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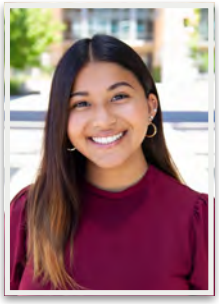


3-D Vessel Formation by Stem Cell Co-Differentiation

Diana Cruz Garcia, Jose Zamora, and Kara E. McCloskey, PhD
School of Engineering, University of California, Merced

As the fields of tissue engineering and drug discovery transition towards using larger organoids, they are limited by integration with perfusable blood vessels. Thus, the need for developing perfusable vascular is mounting. Using a polydimethylsiloxane (PDMS) microfluidic devices, perfusable blood vessels have been generated by seeding human aortic endothelial cells (HUVECS) and normal human lung fibroblasts (NHLFs) within fibrin or collagen gels, however, these vessels do not integrate with other cells/tissues. This study examined the ability to co-differentiate both endothelial cells (ECs) and smooth muscle cells (SMCs) from a population of mouse embryonic stem cells (ESC)-derived vascular progenitor cells (VPCs) within our 3D microfluidic device. Using our two-step serum free induction protocol for EC derivation, we have explored different matrix combinations (fibrin, fibronectin, collagen I& IV) that co-direct VPCs into neo-vessel structures. This research explores the co-differentiation of multiple tissues that can later be incorporate in the development of larger organoids.

Molecular and Cellular Mechanisms Underlying the Transition in the Brain from Acute Ethanol Exposure to Chronic Ethanol Exposure

Alexander E. Del Toro, Pratik Adhikari, and Fred W. Wolf, PhD
School of Natural Sciences, University of California, Merced

Alcohol is one of the most widely abused drugs, yet the molecular mechanisms involved in simple behavioral adaptations like tolerance, preference, and reward are still not well known. Our goal is to uncover molecular mechanisms for behavioral plasticity in *Drosophila Melanogaster* that are initiated by the first exposure to ethanol. Individuals nearly always require repeated exposures to ethanol to elicit an alcohol use disorder (AUD). The present understanding is that drug induced changes in gene expression alter the molecular landscape for the next drug exposure: each repeat exposure will act on neurons with changed properties and changed gene expression responses. We identify genes that are regulated by the first ethanol exposure and determine their role in ethanol-induced behavioral plasticity. Ethanol activates the Mef2 transcriptional activator to induce Hr38, and the Sirt1 histone/protein deacetylase terminates Hr38 to promote tolerance. Furthermore, the three genes function in the same neurons, the mushroom body a/b neurons, to promote ethanol tolerance, preference, and reward. Our findings suggest that ethanol uses a rapid and transient regulation of the expression of specific genes to allow a coherent molecular program to drive behavioral plasticity.

BrØnsted Acid-Catalyzed Stereospecific Dearomative Spirocyclization of Cis-β-Meth(hetero)arylstyrenes

Victoria Lerda, Anargul Tohti and Benjamin J. Stokes, PhD
School of Natural Sciences, University of California, Merced

Spiroheterocycles and quaternary geminal dialkyl groups are both important molecular motifs in important synthetic and naturally occurring compounds. There are few direct methods available to install a spirocyclic quaternary center adjacent to a second quaternary center. We hypothesized that a geminal dialkyl carbon atom linking the 3-position of a benzo-fused five-membered heteroarene to the β-position of a styrene would lead to a dearomative Friedel–Crafts-type cyclization in the presence of acid, with the heteroarene serving as the electrophile. Herein, we describe a Brønsted acid-catalyzed stereospecific dearomative spirocyclization of benzothiophenes by pendant cis-configured styrenes linked by a geminal dialkyl carbon atom. The reaction optimization is described in detail and is accompanied by a preliminary reaction scope (specifically yield and regioselectivity outcomes due to substituent variation) and mechanistic discussion.

The Efficiency of a 10-Year-Old External Compound Parabolic Concentrator

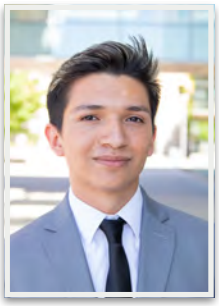
Sara Perez Vite, Jonathan Ferry, Sarah Kurtz, PhD
School of Engineering, University of California, Merced

The non-tracking external compound parabolic concentrator (XCPC) is a solar thermal system built at the University of California, Merced in 2009. It was designed to provide thermal energy to a double effect absorption chiller at low capital cost and low energy cost. The XCPC has been running for over 10 years to power different operating systems such as an evaporator and absorption chiller. The expected life span of the system is twenty-five years. Ten years is a good time to do a benchmark of the operating efficiency to see if it changed through the years due to equipment use, weathering, and natural degradation. Data were collected during the summer from the North-South XCPC to calculate the solar power, collector power, and efficiency. The efficiency was calculated under different load conditions with both dirty and clean collectors. The collected data and graphs showed that at low temperature 74 the dirty collectors had 49% operating efficiency, while the clean collectors had 54% efficiency. At higher temperature 151, the dirty collectors had an efficiency of 24%, and the clean collectors had 28% operating efficiency. After 10 years, the XCPC providing thermal energy has degraded by 9% in area due to vacuum tubes losses. Even though the collectors were very dirty, the efficiency was not drastically affected by the soiling since the collectors collect direct and diffuse light.

The Impact of Maternal Infection on Fetal Cytokine Repertoire

Jasmine Posada, April C. Apostol, Anna E. Beaudin, PhD
School of Natural Sciences, University of California, Merced

In adulthood, hematopoietic stem cells (HSCs) reside in the bone marrow and generate all the blood and immune cell lineages in the body. During infection, inflammatory signals directly influence HSC function, but little is known about how maternal inflammation shapes fetal hematopoiesis. Recent evidence from our lab indicates that a maternal infection evokes expansion of fetal HSCs and impinges on HSC function. We hypothesize that these changes occur as a direct response to alterations in the fetal inflammatory cytokine repertoire. In order to investigate fetal cytokines following maternal infection, we injected pregnant C57BL/6J mice with a low-dose of Polyinosinic:polycytidylic acid (Poly I:C), a viral mimetic. One day following infection, levels of inflammatory cytokines were assessed in fetal liver supernatant and amniotic fluid using a multiplex immunoassay. We observed an up-regulation of key cytokines such as IFN-B, IL-27, and IL-1B in the fetus that may have been in response to an induced maternal inflammation. We now aim to build on these results, gain insight into how changes to the fetal environment are influenced by maternal infection, and define the critical mediators that have a lasting impact on immune development and function across the lifespan.



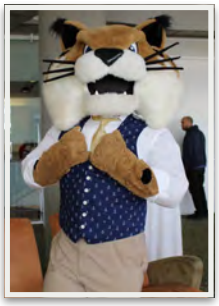
Does Analyzing Bulk Bone for Organic Carbon and Nitrogen Isotopes Similar Results to Analyses of Isolated Collagen?

Pedro Valencia Landa, Robin B. Trayler, PhD, and Sora L. Kim, PhD
School of Natural Sciences, University of California, Merced

Stable Isotopes of carbon and nitrogen from bone collagen are commonly used as indicators of diet and ecology for a variety of modern and fossil mammals. While nitrogen is present only in bone collagen, carbon is present both in the organic (collagen) and inorganic (mineral) phases of bone. Currently, demineralization of bone is both time consuming and may lead to undesirable damage of the extracted collagen, potentially altering isotope compositions. We compared isotope compositions from demineralized and unaltered bone to quantify the effect and necessity of demineralization. We selected samples of bone and dentine from modern gray wolves (*Canis lupus*) and a modern domestic goat (*Capra hircus*). An aliquot of each sample was demineralized using 0.1 M HCl. We analyzed the nitrogen and carbon isotope composition of the extracted collagen and the bulk material (bone, dentine) using a Costech Elemental Analyzer. Preliminary results show that demineralization shifted $\delta^{13}C$ values significantly lower and did not significantly shift $\delta^{15}N$ values. Therefore, we recommend demineralizing bone collagen before analysis of nitrogen and carbon isotopes is made.

UC Merced USDA Hispanic Education Training Program: UC FARMERs

The mission of the USDA program is to increase the numbers and diversity of students successfully continuing their research careers by pursing graduate education. A part of this program will allow students to attend a national conference, such as the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) to present their research findings. SACNAS is a large, multi-disciplinary conference targeting primarily UG that is annually sponsored by the USDA. Attending a national conference is especially important to the scholar's experiential learning process as it provides opportunities to participate in numerous professional/career skills development workshops and to network with peers and potential colleagues to advance educational and professional opportunities.



Multimodal Analysis of Multispectral Remote Sensing to Estimate Land Fallowing Following Extreme Drought: An Application of Google Earth Engine to Kern County, California, USA

Diego Gonzalez, Vicky Espinoza, MS, and Joshua Viers, PhD
School of Engineering, University of California, Merced

With California facing severe surface water scarcity during the 2012-2016 drought and relying heavily on groundwater to meet agricultural irrigation demands, a projected 10% of irrigated land may go out of production to meet groundwater targets by 2040. Therefore, it is necessary to identify areas where there is potential for less water-intensive land use. The objective of this research is to conduct a multimodal analysis of multispectral satellite remote sensing data within Google Earth Engine to identify regions of consistent fallowing from 2014-2018. This study consists of two approaches –1) a time-series analysis on NDVI and MSAVI2, measures of vegetation greenness, and 2) training a CART model on these variables– to highlight regions of consistent fallowing in Kern County. The time-series analysis shows a slight reduction of fallowing in recent years, coinciding with the drought ending in 2017. However, choosing the proper threshold for when to consider land fallowed is difficult, especially with respect to different crops. This is also reflected in the CART model, yet the classification is still 71% accurate compared to satellite imagery. Future work aims to improve these methods to increase classification accuracy and identification of fallowing trends to determine regions where alternative land uses may be optimal for promoting sustainable use of water resources.

Glycoproteins Associated with Blood Pressure Changes Following a Diet Based on the Dietary Guidelines for Americans

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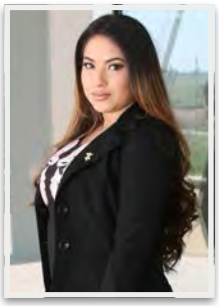
School of Natural Sciences, University of California, Merced; WHNRC, University of California, Davis

One in three Americans suffer from prehypertension; women tend to suffer more following a hemorrhagic stroke than men. Dietary factors have been associated with hypertension, however, their relationship still remains controversial. To understand the link between diet and hypertension, an 8-wk randomized controlled-feeding clinical trial was conducted. A weight-maintaining "Dietary Guidelines for Americans (DGA)" diet vs a Typical American Diet (TAD) were compared in 44 (n = 22 DGA, TAD each) over-weight or obese women, who were normotensive or prehypertensive. Women were tested at baseline (BL), 2 wks, and 8 wks after the intervention. The DGA group had a 9mmHg drop in systolic blood pressure, and no change in the TAD group. The glycoproteome, a subset of the proteome, has recently shown promise, where established biomarkers fail to offer mechanistic insight. Leveraging this, fasting blood samples at BL, 2wk and 8wk were used to measure glycoproteomic (GP) markers associated with blood pressure. GP analyses was done using HPLC Q-TOF-MS. Clinical (blood pressure, glucose, lipids), anthropometric (height, weight, body composition) and GP data are being used to analyze the effect of the diet on changes in glycopeptides that are associated with change in blood pressure. Data analyses is being done using R, Python and JMP Pro, to determine normality, apply appropriate transformations, and evaluate using linear mixed models. Preliminary results indicate there was a differential effect of diet on Fetuin, Apo C3 and Hemopexin glycopeptides. Further network and pathway analyses will be used to determine their use as prehypertensive diagnostic biomarkers.



Effects of Acute Caloric Restriction on Muscle Insulin Receptor Phosphorylation in Obese Insulin Resistant Otsuka Long Evans Tokushima Fatty (OLETF) rats

Dora Mendez, Manuel Alejandro Cornejo, Rudy Martin Ortiz, PhD
School of Natural Sciences, University of California, Merced

Chronic insulin resistance can lead to type II diabetes, which ultimately can lead to further longterm health complications. Gradual and sustained increases of fat deposition in the liver and pancreas leads to dysfunction of beta cells, which can progress to hyperglycemia and other metabolic disorders. Insulin resistance in skeletal muscle is characterized by impaired insulin signaling and other post-receptor, downstream defects. Studies have shown removal of excess fat in the liver and pancreas can normalize blood glucose content, proposing caloric restriction may reverse the effects of type II diabetes. We hypothesized that mild caloric restriction (30%) will increase the phosphorylation of the insulin receptor in obese insulin resistant Otsuka Long Evans Tokushima Fatty (OLETF) rats. To test our hypothesis, we had fourteen lean Long Evans Tokushima Otsuka (LETO) and fourteen OLETF which were then divided into ad libidum control or caloric restriction (CR) groups. At twelve weeks of age, rats in the CR group were given 70% food intake compared to ad lib controls for two weeks. Insulin receptor phosphorylation was measured by analyzing the IR/phosphorylated insulin receptor (p-IR) expression ratio in gastrocnemius muscle by Western Blot using Ponceau stain as loading control. We expect to demonstrate that the ratio of p-IR in the CR group is greater than the OLETF group suggesting that acute, severe CR can positively modulate the phosphorylation of the IR, which in turn should improve insulin sensitivity in skeletal muscle.

Relevance of Story-Telling and Emotion-based Messages to Improve Parent Modeling Behaviors and Feeding Practices

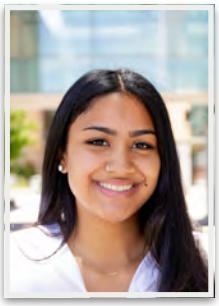
Samantha P. Navarro, L. Karina Diaz Rios, PhD, RD, Marilyn S. Townsend, PhD, RD
School Social Science, Humanities, and Arts, University of California, Merced;
Division of Agriculture and Natural Resources, University of California;
Nutrition, University of California, Davis

The prevalence of obesity is disproportionally high among Latino children (Penilla et al 2017). Few studies have investigated the importance of feedback from participants about nutrition education programs tailored for Latinos (Díaz Rios et al 2016). The relevance of motivational stories and emotion-based messages, incorporated into a nutrition education intervention in a medical setting, was assessed. Fifty-five parents who completed the intervention participated in 21 focus groups. Interviews were audio recorded and transcribed verbatim for analysis. Preliminary results indicate parents found stories to be relevant, appealing, and useful for understanding concepts from the lessons; emotion-based messages were less appealing and memorable. With the high prevalence of obesity among Latino children it is important to consider nutrition education strategies to increase motivation to improve parent modeling behaviors and feeding practices.

Undergraduate Research in the Humanities

The following students scholars are part of UC Merced's Undergraduate Research in the Humanities (UROC-H) Program. The goal of the UROC-H program is to engage a cohort of 10-15 promising undergraduate students each year in faculty-mentored research and prepare them for advanced education in the humanities and humanistic social sciences.

For more information, please visit http://uroc.ucmerced.edu/uroc-h



The Collateral Consequences of Incarceration on Family Members

Akhirah Bey, Yajaira Celiliano Navarro, MA, and Tanya Golash-Boza, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

Research has shown an abundance of negative effects of incarceration on the individual incarcerated. However, little research has been done about the effects of incarceration on the family members of the incarcerated individual. This study will focus on gender and age and how they shape the experience of having a family member incarcerated. A total of 5 in person interviews were conducted and analyzed with individuals who have an immediate family member who is either currently is, or has previously been incarcerated. After finding persistent themes, the data shows that gender and age play a significant role on how individuals perceive the experience of incarceration in their lives .

The Consequences of Deportation Through the Eyes of Latinx Women

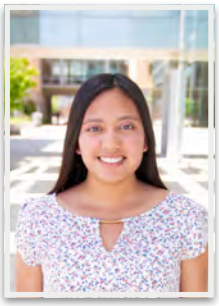
Nidia Burgos, Yajaira Ceciliano Navarro, MA, and Tanya Golash-Boza, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

Deportation is a recurring phenomenon that has detrimental consequences for families. The impacts of deportation impact families emotionally, financially and physically. This study examines the effects deportation has on families when a family member is deported. Using qualitative methods, we conducted five in-depth interviews with families in California in order to understand the obstacles they have faced due to a family member being deported. We specifically focused on Latinx women and their experiences. The following themes emerged from interviews with Latinx women: (1) financial stress and hardship on the family, (2) emotional stress on the family, and (3) increased responsibility in the household, including taking on additional roles. Findings suggest, whether it is a female or male family member, women take on more responsibilities. The implications of deportation make it harder for women to receive help and take care of themselves, and their family. Thus, families experience more difficulty succeeding. Future research should include findings from qualitative interviews and use narrative to inform culturally appropriate interventions and resources for Latinx women who have had a family member deported.

Beyond the Deportation: Experiences and Life After Deportation for the Family Members of Deportees

Mayra Cordova, Yajaira Ceciliano Navarro, MA, and Tanya Golash-Boza, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

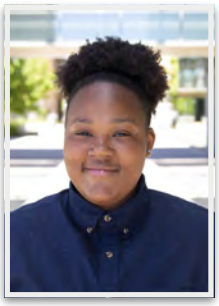
The topic of deportation and its affects has become more widespread in recent years with the political climate the United States is currently facing. Individuals are becoming more aware of what happens in the case of family separations leading to a rise in mobilizations to keep families together. While previous research has focused on the experiences of deportees, this study builds on the research regarding how deportation affects the families left behind immediately after the deportation and the challenges they continue to face. Through a series of five interviews with adolescent womxn, this study was able to create a narrative providing insight on the experiences of deportation on family members of deportees. Through an analysis of each interview, three common themes occurred: 1) emotional trauma and difficulties, 2) pressure on the family dynamic and 3) forced responsibility. Deportations will continue to harm families but it's important to give individuals with these experiences a platform to share their stories and educate others on the lasting affects it creates.



Financial and Emotional Burdens Women Experience When a Family Member is Incarcerated

Aurora Fabian Valentin, Yajaira Ceciliano Navarro, MA,
and Tanya Golash-Boza, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

This study examines the collateral consequences of incarceration by analyzing the challenges families experience when they have a family member that is incarcerated. Five interviews were conducted with women in the Central Valley on struggles they encountered as individuals and as a whole family. Specifically, challenges women with an incarcerated family member encounter, such as home instability, stigma, financial and emotional burdens. Findings reveal that women have to endure the incarceration of their family members by themselves and take on the role of moving the family forward. Oftentimes women do not receive any additional support because of the stigma that comes with incarceration and lack of resources to help families integrate their formerly incarcerated family member. Incarceration not only impacts the incarcerated individual, but also the women when they have to take on unexpected roles. These results allow us to understand how to provide better resources for women with an incarcerated family and thus help prevent these challenges from recurring.



Gateway to Merced: Sympathy In and Out of Minority Communities

Brijeanae Foster, Jayson B. Jones, PhD
School of Social Sciences, Humanities, and Arts, University of California, Merced

Music Memory Hours (MMH), are an ongoing research study on music-evoked remembering and mental health. The Beaster-Jones Lab at UC Merced, along with the Janita Lab at the Center for Mind and Brain at UC Davis, have been holding MMH in group and individual settings. They are conducted to observe the uniqueness of the human brain and how it reintroduces past events and memories by the significance of a particular melody or song. Idiosyncratic memories buried deep within the brain can resurface with MMH. By invoking these memories, the opportunity to analyze correlations between music and an individual's capacity to sympathize both in and out of minority communities is achievable. Taking a closer look at the growing city of Merced and the communities within it, MMH can essentially divulge differentiations among said communities. Music Memory Hours held with local Merced natives of over 10 years, have assisted in understanding the dynamics within these communities. Specific music and unique memories associated with that particular music, affect how one actively learns to sympathize outside of their identified community. This study focused on middle aged participants of Merced and in the future include adolescents. Understanding the way Merced community members have interacted with music throughout their lifespan with MMH, aided in discovering what minority communities they sympathize with.

The Effects of a Parental Deportation on Young Adults with Different Immigration Statuses

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The United States deportation system has been a threat to immigrant communities for decades. Hundreds of Latino families are separated by deportation yearly. Despite the large number of separated families there is still a gap in research on the effects of deportation on family members. This study focuses on how the immigration status of family members shapes how they experience the deportation of their parent. A total of five semi-structured interviews were conducted with young adults from California who were either undocumented, DACA recipients or U.S. citizens. Findings show similarities between family structure, financial difficulties and mental health. However, based on immigration status there are differences between experiences with family separation, conversations and fear about deportation, and chances of seeing their deported parent. Results show deportation is not a single narrative issue, rather, it is complex. Learning from the narratives of those who have experienced deportation in their family may help us engage more effectively with policymakers on relevant issues.

A Comparison of the Nutrition Environment across Three Church Neighborhoods in South Los Angeles

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Food environments refer to aspects of a person's surroundings, which ultimately influence one's diet. Aspects that may influence a person's diet include the way media portrays food or a certain lifestyle and physical locations such as schools, workplaces, and restaurants. Generally, low-income neighborhoods suffer from limited access to affordable, healthy foods and the tools that contribute to an active lifestyle. A general comparison on the nutrition environment, within a half-mile radius, around three churches in South Los Angeles were analyzed using data collected from 2015-2016. The data was collected through the Geographical Information System (GIS) tool, a mapping system that examines neighborhoods and their retail food availability, as well as the Communities of Excellence in Nutrition, Physical Activity and Obesity Prevention (CX^3) tool, which collects and measures the quality, availability, and affordability of food on a neighborhood-level. This study revealed these three neighborhoods faced many challenges when it came to their nutrition environment. The nutrition environments in these neighborhoods are faced with unhealthy food options, very few supermarkets, and an abundance of fast-food restaurants and convenience stores. With limited access to healthy foods, there are numerous solutions on how to improve the quality of food within each environment. A healthy food environment not only contains healthy food choices, but it also promotes healthy lifestyles, includes adequate transportation, educates the community on health-food choices, includes healthy advertising, and limits the tempting media coverage of unhealthy foods/lifestyles.

Gateway to Merced: Growing Up in a Town with "Nothing to Do"

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The Gateway to Merced project aims to create access for community participation in the retelling of Merced's history not as a quick stop off the highway but as a place to call home. My project places emphasis on the processes of community engagement to facilitate multiple narratives, specifically based on individuals' experiences as adolescents growing up in a town with "nothing to do". Using ethnographic data, oral histories, and Music Memory Hours in which participants are played music from their past and asked to share their memories that the music elicits, this project is designed to build and strengthen the ties between the university and the various communities of Merced through engagement with lifelong residents and their histories. Through this project, I anticipate we will have a greater understanding of how adolescents growing up in Merced created spaces for themselves when there were none.

Chinatown Declared a Nuisance: Merced, 1878-1892

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In 1884, Merced established a Board of Health that sought to address the town's health concerns. This measure comes at a time when much of the white population viewed Merced's Chinatown to be a drain on their city, that would otherwise be thriving. The creation of a public health crisis was a well-documented anti-Chinese tactic in San Francisco, a hub of Chinese population and culture. In 1880, San Francisco Mayor Isaac Kalloch declared the city's Chinatown to be a nuisance, deeming it a threat to public health. Earlier in the century, San Francisco's Board of Health passed an anti-Chinese piece of legislation known as the Cubic-Air Ordinance, designed to break up Chinese tenement houses that were often, out of necessity, wildly overcrowded. However, the prevalence of anti-Chinese ordinances such as these are not so clearly defined in places where Chinese history in general has not yet been fully illuminated, Merced being one of them. Using newspapers published in Merced from the 1870s to the early 20th century, as well as minutes from Merced's Board of Supervisors and Board of Health, this project seeks to understand the role that local government and news media played in the notion that Chinatown was a danger to Merced. The establishment of a Board of Health, similar to that of San Francisco's, indicate the strong possibility of local anti-Chinese legislation having been established.

Protecting bounded Spaces: Differentiated Policing in 19th Century Merced, California

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Towards the latter part of the 19th Century, the community of Merced, California became a site of transnational tensions over space. Anglo American imagined conceptions of place, saturated in Gilded Age morality, nascent capitalism, and republican ideals, clashed with a polyglot community vying for access to public space through independent businesses and autonomous ethnic enclaves. In order to facilitate a land boom, white residents attempted to inscribe their abstract expectations of the white, male West onto the cartesian space of Merced's Main Street by constructing a crisis of criminality that justified constant police raids. The police, as mobile arbiters of public space, instituted a regime of territorialization, or concrete boundaries regulating specific behaviors in certain spaces. They both enforced social control over Chinese and Mexicans, and ensured that all Mercedians conformed to strict behaviors of white, middle-class people. By exploring the rhetoric in several late 19th Century Merced county newspapers concerning differentiated policing, this research locates Merced in the larger project of integrating the American West into the nation by reshaping Western cities into a facsimile of Eastern urban expression, adapted to meet the pressures of a polyglot community. The result is a socially produced space, facilitated by differentiated policing, shaped by a dialogue between imagined place and implemented territory, that established anew the cultural and political supremacy of whiteness over Otherness.

The Impact of Incarceration on Women of Color in the Central Valley in the Household

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Research shows that incarceration creates financial, emotional, and social burdens on children and partners of incarcerated individuals. This research project focuses on how the incarceration of a family member impacts women's role in the household. Five interviews were conducted with women of color in the Central Valley who have an immediate family member currently or formerly incarcerated on their experiences throughout the incarceration. The interviews reveal that incarceration of a family member often impact women's geographic movement, emotional, financial and caretaking responsibilities. These findings suggest that incarceration shift household roles, often resulting in women having to take on multiple responsibilities in order to provide for their family.

Gendering the Workforce

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The history of women's job titles and their gender roles within the workforce is significant to understand because this research explains how women got to be in the positions they are today. White women joined the workforce in large numbers during WW2 and retained their positions postwar. It is critical to acknowledge the occupational path of African American women during and after WW2 because their occupations changed from the service to the clerical industry. The literature of the history of women in the workforce was analyzed and illustrated that the critical positions of all women were in the blue collar and clerical industry. The textual analysis of the articles was compared to the data analysis from the census for 1940, 50, 60, 70. The job titles were then defined by the primary source of the Dictionary of Job Titles. It was concluded that women's job titles and descriptions were different to men. Men were not negatively impacted by the increase of women in the workforce during and after the war. Women's gender role in the workforce was in lower skilled positions and men were in higher skilled positions. The workplace for women was desegregated by race but was segregated by gender and the gender pay gap was wide. The gender roles placed post war set the stage for a long battle of gender segregation in the workforce.

Health Disparities Amongst the Latinx Population: The Struggle for Proper Health Care

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Within the field of medicine and health, it is crucial to acknowledge the existence of health disparities within the United States' healthcare system. Many underprivileged communities, such as the latinx population, have experienced severe cases of inadequate treatment within many healthcare facilities. In attempt to access proper health care, research indicates that many latinx individuals experience certain financial, linguistic, and cultural barriers. While conducting this mixed methods literature review, there are very few articles which discuss the qualitative content needed for this project. As a result, an oral history was performed where latinx families were asked to share their personal experiences about their battles for proper healthcare. This project will interview a total number of six individuals divided into three different families. Our research hopes to voice the stories of those who can not share their personal experiences with the community. We desire to engage with our interviewees and share their personal hardships in accessing high quality health maintenance. These interviews further help individuals like myself to propose solutions to this ongoing healthcare problem. In order to decrease the amount of health disparities within the healthcare system, the national government must establish cultural competence programs which inform doctors about racial discrimination in the health industry, provide affordable healthcare for everyone including documented and undocumented individuals, and increase the diversity of doctors within these institutions.

Social Justice Bard: Grassroots Shakespeare As Activism

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Community-based grassroots Shakespeare is a new term and uncharted territory amongst Shakespeare and theatre scholars. Yet, these grassroots Shakespearean productions happen all over the world—so they are by no means a recent phenomenon. In this country, local productions of William Shakespeare's work wove themselves into the hearts of the American people. Today, national efforts to spread awareness about the political and biological landscape are pervasive and there are community driven uses of theater to counteract hatred, divisiveness, and alt-right politics happening nationwide. This essay argues that modern day grassroots Shakespearean productions function as anti-fascist activism. The methods used to come to this conclusion come from practice as research (my own work as a performer in a grassroots Shakespeare production), social scientific analysis of audience surveys, and theories from the growing academic field of applied theatre/community practice. Whether the nature of the social commentary is eco-critical or political, localizing these issues and demonstrating the need for progressive movements not only informs the community but also strengthens the bonds amongst them, thus fighting fascism. By investigating the effectiveness of grassroots Shakespeare with progressive directing, I demonstrate that community-based, socially aware artistic choices in contemporary Shakespeare productions help to localize political movements.

Music Memory Hours: Latinx Immigrants and their sense of Home

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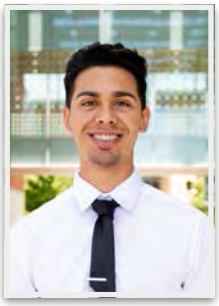
Music-evoked remembering has been proven to be an intriguing and helpful mental health procedure. Such procedure can be used to explore the relationship between music, cultures, and identity. Through the conducting of music memory hours, a connection between music and the integration of two cultures was revealed in children of immigrants. Participants expressed feelings of being torn between two cultures, being told they are not "American" enough or "Latino" enough. Music helped in binding both of their cultures, mostly through language. Speaking Spanish is an important marker of identity and is vital to music representing and creating a hybrid culture. I interviewed children of Latinx immigrants and performed Music Memory Hours. Music Memory Hours consist of semi-structured interviews with questions gathering information on culture and identity followed by playing music and discussing associated memories. My data revealed a connection between music, the participants cultures, and identity. Participants stated having two cultures; inheriting their parents' cultures and being born in America. They described music as holding memories and bringing them back to their culture while connecting them to their parents' stories and homelands. Participants also suggested that any music connects any two cultures. The interviews revealed that music brings two cultures together and expresses individuals' identities.



The Impact of Deportation on Family Dynamics and their Mental Health

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U.S. immigration policies that concluded with deportation results in negative consequences for undocumented and mixed-status families. These consequences vary from impoverishment, depression, stress, and constant fear of the possibility of being deported. The deportation of a family member can drastically impact children as well as the entire family dynamic. Five interviews were conducted on people from different families who have had a family member deported or are in the process of being deported. The change in family dynamic before and after the deportation of a family member is analyzed including how it affect them, and the social resources they have utilized through this process. The results have shown that indeed, the deportation of a family member negatively impacts the family emotionally and financially. Mental health includes stress and depression which can often lead to mental health clinic visits and gang involvement. With this being said, the results obtained will be used to show that changes to immigration policies are necessary because not only are they resulting in family separation, but jeopardizing the well being of family members.

Family Experiences: Incarceration and the Hidden Impacts

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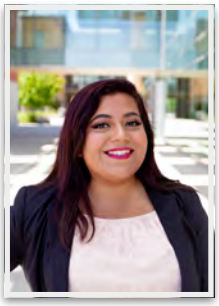
The consequences that incarceration has on an individual goes beyond their sentencing. They not only leave behind their family, but they also extend the hidden impacts that become a barrier on their family's lives. To further understand the hidden impacts of these individuals, I conducted five in-depth interviews of personal experiences in dealing with an incarcerated loved one and analyzed the coded data to find common themes that were shared among the interviewees. As a result, some the common themes varied from stigmatization to emotional stress that were faced among family members. Furthermore, these experiences highlight the complexity behind how incarcerated family members are able to succeed in integrating back into society and how much support they receive.



The Shaping of a Stigma, Collateral Consequences of Incarceration on Young Adults

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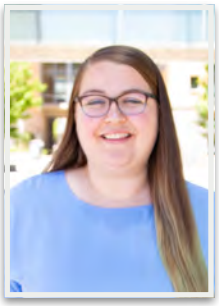
Impoverished families in the Central Valley have been succumbed to torment and agony due to the alarming number of incarcerations California has endured. This study will examine the impact incarceration has on young adults when a family member has been arrested. Most studies on incarceration have sought out to focus mainly on the negative effects incarceration has on young adults. This study will be focusing on how incarceration molds young adult's thoughts and actions, which leave a lasting impact on their life. A total of five, 30-50 minute interviews were conducted with individuals who currently live in the Central Valley. It was revealed that incarceration was perceived as normal amongst those affected. Resilience was developed through their relationships with their friends and family and through these, dreams of pursuing a higher education were made to defy what was expected of them. These findings will be used to emphasize the positive effects incarceration has had on young adults.



Gender Expression and Violence in Merced, CA

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Gender expression is a spectrum between two binaries: feminine and masculine. This expression can be through clothing, hairstyle, speech, mannerisms, etc. and is a way to express one's true self. For many, the choice to be their true self can lead to violence based on their perceived gender identity. The U.S. has recently seen a significant increase in murders and harassment of transgender women of color, based on their perceived gender expression. In more conservative cities such as Merced, this identity-based violence is a threat one learns to navigate throughout life, and one may develop means to try to avoid this harm. In conducting a one-hour interview with adult participants who identify their gender expression outside the binary and live in Merced for over three months since 2009, this study observes the avoidance tactics used to survive a potentially hostile environment. The goals of this study is to understand the relationship between those who express their gender outside binary expressions, and the violence they risk facing in public. The hypothesis of this study is that those who identify their expressions outside of the binary will either take steps to alter themselves to avoid violence, or avoid certain areas that violence may occur. Findings suggest people in Merced are not free to be their true selves without fear of violence.

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