THE SIXTH ANNUAL

UCMERCED

UNDERGRADUATE SUMMER RESEARCH SYMPOSIUM

USDA UNDERGRADUATE RESEARCH & MENTORING in the AGRICULTURAL SCIENCES

UNIVERSITY OF CALIFORNIA, MERCED
Center of Excellence on
Health Disparities

UC LEADS
LEADERSHIP EXCELLENCE THROUGH ADVANCED DEGREES

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LOUIS STOKES
CAMP
CALIFORNIA ALLIANCE for MINORITY PARTICIPATION

AUGUST 10, 2012

Welcome to the

Sixth Annual

UCMERCED

Undergraduate Summer Research Symposium

August 10, 2012

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The California Alliance for Minority Participation (CAMP) in Science, Technology, Engineering, and Math and Leadership Excellence Through Advanced Degrees (LEADS) research and graduate preparation programs.

The California Alliance for Minority Participation (CAMP) in Science, Technology, Engineering, and Math, is a statewide initiative funded by the National Science Foundation (NSF). The objective of CAMP is to strengthen the quality and quantity of underrepresented students receiving baccalaureate degrees in Science, Technology, Engineering, and Mathematics (STEM) 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 and its celebrating its first year at UC Merced.

The UC LEADS Scholars Program, funded by UC's Office of the President, is designed to educate California's future leaders by preparing promising undergraduate students coming from underrepresented or disadvantaged backgrounds for advanced education in the STEM fields.

2012 CAMP and LEADS student researchers.

Blockade of Aldosterone receptors does not lead to increased Na excretion in Ang II infused Male Sprague Dawley Rats

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Activation of the renin-angiotensin aldosterone system (RAAS) leads to the upregulation of the epithelial sodium channel (ENaC), which regulates sodium reabsorption and blood pressure. It has been recently demonstrated that blockade of the angiotensin receptor AT1 suppresses intracardiac and intrarenal angiotensin II (Ang II) in Ang II infused rats. However, the changes in kidney function mediated by aldosterone and Ang II are not well described. To assess the contribution of AT1 and MR activation on sodium reabsorption andkidney function, five groups of rats (n=11-17) were studied over 28 days: (1) control; (2) Ang II; (3) Ang II + ARB; (4) Ang II + Epl; (5) Ang II + ARB +EPL. Ang II infusion lead to an increase in systolic blood pressure compared to the control (165 vs. 117 mmHg). The effect was attenuated with ARB treatment and SBP returned to control levels. (117 vs. 117 mmHg). EPL slightly decreased blood pressure from Ang II levels (152 vs. 165 mmHg). Plasma Ang II levelswere almost tripled with infusion (26.3 vs. 77.7 pg/ml) and increased further with ARB treatment (26.3 vs. 144.7 pg/ml). Plasma aldosterone levels were greatly increased with Ang II infusion (45 vs. 2212 pg/mL) and the effect was diminished by ARB treatment (45 vs. 85.4pg/mL). ARB treatment boosted urinary Na excretion by more than double from Ang II levels (162.6 vs. 69). Blockade of MR with EPL caused a sharp decrease excreted Na (22.16 vs. 69). We attributed the increase of aldosterone excretion to the increased plasma aldosterone in EPL treated rats. Our results suggest that the rats may have some sort of mechanism which compensates for decreased MR activity.

Real-time Tuning of PID control gains in HVAC Systems

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The tuning of proportional-integral-derivative (PID) coefficients affects the overall efficiency of a heating, ventilating, and air conditioning (HVAC) system's energy consumption and thermal comfort1. If calibrated properly, the system can achieve optimum efficiency in both comfort and energy consumption by up to 35% in energy saving and by up to 52% in meeting effective temperature set points2. The current PID coefficient settings in the science and engineering (S&E) building create temperature fluctuations. To decrease the temperature fluctuation, the PID coefficients need to be recalibrated. The objective of this research project is to develop a precise calibration method to fine tune PID control gains. A bisection method for real-time tuning is developed to determine optimal PID coefficients from estimated PID control gain intervals2. The method was applied to a specific room in the S&E building during the summer. We hypothesize by utilizing the bisection method to recalibrate the PID coefficients, the temperature fluctuations will decrease substantially improving energy efficiency and personal comfort.

1. Qu, G., and M. Zaheeruddin. "Real-Time Tuning of PI Controllers in HVAC Systems." International Journal of Energy Research 28.15 (2004): 1313-27. Web.
2. Wemhoff, A. P. "Calibration of HVAC Equipment PID Coefficients for Energy Conservation." Energy and Buildings 45 (2012): 60-6. Web.

Inductively Coupled Plasma Torch for Plasma Gasification Analysis

Guadarrama Jose; Gerardo Diaz, Edbertho Leal-Quiros

Plasma is known as the fourth sate of matter, consisting of charged ions and electrons. Plasma is formed by generating an electric or magnetic field, used to ionize gas. Plasma temperatures of interest can range between 3,000oC to 10,000oC. These high temperatures are used for plasma gasification, which converts waste to energy. There are several methods of creating a plasma discharge; however, the purpose of this project is to analyze the aspects of an inductively coupled plasma torch. ICP torches are constructed of quartz and operate at low temperatures with argon. This study is concerned with atmospheric pressure discharges and analyzing nitrogen flow through a borosilicate chamber. A radio frequency generator is connected to a copper coil via an L matching network. The L-network uses two capacitors, one in series and another in parallel tuned to reduce the reflected power and increase efficiency. The inductive coil hence creates an oscillating magnetic field which excites the nitrogen particles creating a high temperature discharge. The discharge is used for biomass gasification forming synthesis gas. Synthesis gas is composed mainly of hydrogen and carbon monoxide which can be used as a clean source of energy.

Setal areal density of Musca domestica (Linnaeus) using scanning electron microscopy

Hall, Ashley; Christopher Viney

Geckos, and many insect and spider species, can scale vertical surfaces and also hang upside down from horizontal surfaces. How is this possible? All of these species have adopted a variety of hair-like nanoscale fibrillar structures (called setae) on their feet.

There is ongoing research regarding how the areal density (number per unit area) of the setae increases in relation to the body mass of varies types of organisms. It is believed that the areal density is an increasing function of body mass, ending with the gecko that contains the highest density of setae among all of the animal species studied. The tip of each seta is covered in hundreds to thousands of small protuberances called spatulae which play an integral part in the adhesive mechanism. While different spatula shapes have been observed in different organisms (flies, spiders, geckos, beetles), further research needs to be done with how the spatula shape and areal density varies among the different species of the same biological family.

While the interspecific relationship of mass and the areal density has been studied, the intraspecific has not. In our research we are focusing on the intraspecific relationship between the mass and areal density of Musca domestica (housefly). Specimens will be captured and weighed before taking a sample leg for examination by scanning electron microscopy.

The data drawn from this study can give some insight on the convergent evolution of hairy attachment systems in biology, and provide inspiration for the development of optimized biomimetic adhesives.

Annotation and Analysis of Seven Viviparity-Related Genes in the Marine Fish- Embiotoca jacksoni (Embiotocidae)

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Investigation into the reproductive genes of non-mammalian species is under-represented in current scientific communities. Such families as the viviparous Embiotocidae can provide valuable insight into the genetic understanding of reproductive processes because of its lesser-developed reproductive system comprised of a placenta-like structure or ovarian cavity. Genomic research into the reproductive systems of species, such as the black perch (Embiotoca jacksoni), can further our understanding of the evolution of viviparity. Because marginal consideration has been given to the study of viviparous fish species, this study aims to predict elements within the genome that specifically yield gene predictions and attach information to these predicated elements, such as biological functions and gene expressions. This process, known as gene annotation, will lead to greater comprehension into the evolution of the lesser-developed ovarian cavity in other fish species. Furthermore, this will improve knowledge about the mammalian placenta because many of the genes produced by this study are conserved in mammals. Using bioinformatic tools, such as MAKER, RepeatMasker, and tblastx we annotated the reproductive genes of E. jacksoni which yielded seven candidate genes for further study. We tested for evidence of positive selection with PAML, DataMonkey, and Selecton in these seven candidate genes. The annotation and subsequent analysis of the selection of the Embiotocoid reproductive genes provides insight into the evolutionary development of viviparity and increases our knowledge of developmental biology and the evolution of diverse life history strategies.

Well Defined Surface Chemistry on Supported Gold Microplates

Lopez, Adriana[1], Eric Josephs,[2] and Tao Ye, PhD[1] (NO superscript key)

Gold microplates are atomically flat, anisotropic particles that can be up to 100 microns wide and 40 nanometers in height. By depositing them on the surface of ITO (Indium Tin Oxide) or glass, they can function as substrates for novel sensors or scanning probe microscopy studies. High-molecular weight polymer surfactants that preferentially bind to crystal facets are often needed in controlling the shapes of these plates during chemical synthesis. These polymers can be difficult to remove, and this poorly controlled surface chemistry limits the application. In order to address this problem, we have developed an alternative growth procedure that does not use polymer surfactants. Instead, iodide, which may be more easily removed, was used to control the shapes. We have demonstrated the growth of large microplates supported on a number of different substrates (ITO, glass, silicon nitride), and have additionally shown that the iodide can be removed by dipping the surface in strong oxidizers or through electrochemical desorption. The surfaces were then able to support high quality self-assembled monolayers (SAMs), which can be used to control the surface chemical properties of the plates (charge, hydrophilicty, etc). We are currently applying the microplate substrate in DNA biosensors. We are also exploring the possibility of integrating the microplates with digital microfluidic systems, which will significantly improve the sensitivity, speed and throughput of DNA biosensors.

Varying Electrolyte Composition in Contact Glow Discharge Electrolysis

Martin, Adam, Gerardo Diaz

Due to the abundance of wastewater in the world, it is highly desirable to develop a cost-effective and efficient process of converting this waste into clean reusable energy. Processes involving electrolysis, the splitting of chemical compounds into simpler components, have been conducted and have demonstrated such conversions are indeed possible. One such process under investigation is Contact Glow Discharge Electrolysis (CGDE). CGDE is the phenomenon where an electrode immersed in an electrolyte solution raises the temperature of the electrolyte to a produce gas, through the process of joule heating. The resulting gas creates a film around the electrode, which is then excited to high levels of energy as a result of the high voltage, thus emitting a glow. CGDE also produces a large amount of steam at high voltage and low current; all while the electrolyte is at or near its boiling temperature. The process of CGDE is interesting because the level of gas produced can no longer be modeled using Faraday's Law. Many parameters dictate the level of steam produced by CGDE, including temperature of operation, the composition of the electrolytes, voltage, and current applied. Current studies aim to understand the effect of varying the mass fraction of electrolyte in the solution and the corresponding rate of steam production during CGDE. The study is conducted utilizing sodium bicarbonate solutions. Results will aid in the effective modeling of the vapor and gas compositions produced through the use of CGDE with varying electrolytes.

Temperature Measurements of an Electrolytic Tank Under Normal Electrolysis and Glow Discharge

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Electrodes are conductors used to apply a voltage in applications such as an electrolytic cell. A negative electrode is known as a cathode, and it attracts cations (positive ions) in a reaction also know as reduction. The positive electrode is called anode and it can have a significantly different material and contact surface with the electrolyte solution. The process known as electrolysis can be established by applying a voltage difference between electrodes in an electrolyte-water solution inside an electrolytic cell. Normal electrolysis occurs at relatively low voltage and high current flow. However the Joule heating effect increases the temperature of the solution inside the electrolytic cell until it reaches a point near boiling. At this point, the normal electrolysis mode changes to a process known as contact glow discharge electrolysis for which the voltage increases significantly but the current flow is low. For this particular experiment, electrodes are placed in an electrolytic tank with a specific concentration of sodium bicarbonate in distilled water. The purpose of this project is to understand the temperature gradient that is caused by Joule heating. The temperature will be measured using thermometers placed at different locations at the surface and inside the electrolyte solution. A thermocouple will also be placed at the surface of the cathode. It is expected that the energy balance in the electrolyte can be calculated once the temperature conditions occurring within the tank are measured.

Experimental Investigation on Role of Root Mucilage on Soil-Water Retention Dynamics

Sweet, Jamie. Teamrat A. Ghazzehei

Using a considerable amount of energy, soil microbes and plant roots release organic molecules in order to adapt to their surroundings. Our hypothesis is that the organic molecules deposited on the soil particles surface are able to alter the soil water retention characteristic of the rhizosphere, relative to the bulk soil. Specifically, we expect that the organic deposits enhance the soil's ability to retain moisture. For experimentation, glass beads of size 40 microns are used to imitate soil. These glass beads are saturated with various concentrations of polygalacutronic acid (PGA) to represent the organic exudates from plant roots. PGA at varying concentrations is used to replicate the amount of organic matter released depending on the condition of the soil. To determine the soil water retention curves, measurements of water potential using WP4C Dewpoint PotentiaMeter were recorded. We measured the water potential for PGA alone, glass beads with distilled water (DI) and glass beads with PGA at different concentrations. We will present the effects of different concentration levels of PGA on changing retention curves compared to DI water by determining the water retention curve for each sample. These results will provide direct quantitative evidence of how rhizosphere organic matter helps plant-soil relations.

Nanopatterning wrinkles into biodegradable materials for aligning heart cells

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Myocardial infarctions (MI) are the most common cause of death in industrialized countries1. The ability to replace damaged cardiac tissue is one strategy for MI repair, but the delivery of cardiomyocytes (CM) alone does not provide structural support or physical cues to facilitate cell-cell communication. Wrinkled polydimethylsiloxane (PDMS) nano- and micro-topographies have been shown to align cardiac cells in vitro3. However, PDMS is not biocompatible, requiring a laborious separation of the aligned cell-sheet for implantation. Alternatively, poly(glycerol-sebacate) (PGS), an inexpensive biocompatible, degradable synthetic polymer could be directly implantated.1,2 The goal of this study was to capture the 'wrinkled' alignment topography directly into implantable PGS microchips. Molded chips were produced by placing PGS directly onto smooth-surfaced glass plates or wrinkled PDMS surfaces. The PGS was cured by baking at140-160˚C under -20Hg over 5-17 hours. We also found that in order to prevent air-bubbles, one must pretreat the uncured PGS by raising the temperature and lowering pressure in the vacuum-oven. A glycolated surface-coating was also tested for efficiency in removing the PGS from the mold after heating, but was not found to signficantly aid the removal of the PGS chip. The next step will be to plate CM on the PGS microchips for evaluation of biological shape signaling. This study plays an important role in developing biomimetic materials for transfer which may eventually lead to prevention of cardiac degradation after MI or the need for heart transplantation

The Evolution of Antibiotic Resistance in BlaTEM genes.

Vera, Viviana; Miriam Barlow, Christiane Pailo, and Anna Nandipati

Bacterial resistance has been increasing over the past 70 years in the human population (Hall and Barlow 2004). The Centers for Disease Control and Prevention state that about 13,000 patients in US hospitals have died due to bacterial diseases that conferred resistance to the antibiotic therapies and the costs of antibiotic long–term care range from $38 million to $137 million annually (CDC). Bacteria have acquired different mechanisms that enable them to become resistant to antibiotics such as common clinically prescribed β-Lactam antibiotics. BlaTEM gene variations which code for TEM-β-Lactamases are the most prevalent mechanisms of resistance. Extended studies of different mutations on BlaTEM genes have provided us with valuable information of resistance. The evolving mutations from blaTEM-1 gene to blaTEM-85 gene, a gene containing four mutations that leads to four different amino acid substitutions, provides us a model to study the evolutionary mechanisms of these naturally occurring mutations. We measured the fitness of the different alleles on the pathway from blaTEM-1 gene to blaTEM-85 gene to evaluate blaTEM-1 evolutionary mechanisms. We have identified and evaluated a large amount of sign epistasis of these alleles under single drugs, which help us to understand one more aspect of natural selection process guiding antibiotic resistance evolution.

The Center of Excellence for the Study of Health Disparities in Rural and Ethnic Underserved Populations' Undergraduate Research Training Program

In September 2009, UC Merced was awarded a program grant by the National Institutes of Health's National Center on Minority Health and Health Disparities to develop a Center of Excellence for the study of Health Disparities (COEHD) in Calfornia's San Joaquin Valley.

The COEHD's Undergraduate Research Training Program begins with an eight-week intensive summer program and continues throughout the following academic year with the goals of:

- Increasing the number of students who are knowledgeable about health disparities;
- Increasing the numbers of undergraduate students from under-represented and disadvantaged groups performing basic, clinical and/or bio-behavioral research; and
- Expanding the capacity and competence of UC Merced in conducting health sciences research that address health disparities in the region.

Ultimately, the COEHD will develop a sustainable infrastructure and culture on our nascent campus that recognizes and supports health sciences education and research with an emphasis on training and research that impacts health disparities, especially in the geographic region in which UC Merced is located, but that also has national and global implications.

Along these lines, the ultimate goal of the Undergraduate Research Training Program is to produce highly qualified and well-trained students that are well-positioned to seek advanced degrees in basic, clinical and bio-behavioral biomedical sciences to support the main goals of the National Institute for Minority Health & Health Disparities of reducing health disparities.

2012-13 COEHD Undergraduate Research Trainees.

Examining the Validity of Public Data to Describe Unincorporated Areas: A Case Study with a Rural Latino Community in California

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Unincorporated areas nationwide house populations with socio-economic challenges correlated with many disparities in quality of life. In California, an estimated 438 unincorporated areas house over 7 million people, or approximately 1 in 5 Californians. Publicly available data sources are important first steps in the analysis of the health of unincorporated areas. However, limited research exists to understand the validity of public secondary data for unincorporated communities. A case study using a small rural town in the San Joaquin Valley of California (Lost Hills) was conducted to examine the validity of public data in describing the population. Existing critiques of the U.S. Census and the American Community Survey (ACS) were used to identify threats to their internal validity. Subsequently, these threats were examined using the data available for Lost Hills to understand their relevance for this unincorporated area. The findings indicated that both the Census and the ACS may undercount the overall population of Lost Hills, in particular the Latino population. Limited English proficiency and lack of citizenship also threaten the valid count of the largely immigrant and migrant population of Lost Hills. The data and methods of the ACS may offer a more valid representation of this unincorporated community. These findings may be generalizable to other small communities with a proportionally larger percentage of Latino residents.

Contribution of adipose RAS proteins to metabolic syndrome in OLETF model rats

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Activation of the renin-angiotensin system (RAS) has been shown to contribute to metabolic syndrome. Hyptertension is a key component of metabolic syndrome and is regulated by RAS. A preferable model used to evaluate the effects of such conditions is the Otsuka Long-Evans Tokushima Fatty (OLETF) rat because their pathogenesis closely resembles that of the progression of human insulin resistance, metabolic syndrome, and type 2 diabetes. However, the contribution of adipose RAS to metabolic syndrome is not yet well defined. To address the hypothesis that adipose RAS activation is increased with insulin resistance, rats were divided into two groups (n=10-12/group): 1) lean strain-control LETO 2) Obese insulin resistant OLETF. Systolic blood pressure (SBP) was measured weekly for 24 weeks and insulin resistance index (IRI) was determined at 9 and 24 weeks. Tissue samples were collected from each group (n=5-6/group) at 15 and 24 weeks. Mean SBP from OLETF was 28% and 27% greater compared to that of the LETO after 15 and 24 wk respectively. Mean IRI was greater at both time periods as well, and we exacerbated in 24 wk OLETF compared to 15 wk. By 24 wk, adipose angiotensinogen (angiotensin precursor) expression had increased in 24 wk OLETF suggesting that activation of adipose RAS was increased. The data suggest that increased activation of RAS may contribute to the increased metabolic disorders (SBP and IRI) commonly associated with metabolic syndrome.

Chlamydia pneumoniae in Gingival Epithelial Cells Respond by Secreting Proinflammatory Cytokines

Yotzelin Cervantes, Ye Zhu, David Ojcius

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Chlamydia is one of the world's most common sexually transmitted disease as well as the leading cause of blindness. Recently there has been more of an interest in Chlamydia pneumoniae, an intracellular bacteria that infects humans and has been known to cause lung complications, bronchitis, and pharyngitis. However, little is known about whether if C. pneumoniae can cause oral disease. Chlamydia infections are usually characterized by inflammation, which is an innate immune response. NLRP3 inflammasome is one of the most well studied type of inflammasome due to its keen immune response to microbial molecules. NLRP3 inflammasome triggers the secretion of proinflammatory cytokines acting as a defense against infection. Knowing this, there is a belief to be a connection between NLRP3 inflammasomes and gingival epithelial cells. Gingival epithelial cells (GEC) are beneficial when studying the oral mucosa and in order to understand if C. pneumoniae is causing oral diseases we will study infected GEC. Through this study we hope to see that the C. pneumoniae will adhere to the GEC which then can help determine if C. pneumoniae will activate NLRP3 inflammasome during infection. Respectively, there is an expectation to see growth inhibition of C. pneumoniae in the gingival epithelial cells through an increase of proinflammatory cytokines.

Developing C2C12 Cell Model for IBMPFD to Study TDP-43 and Ubiquitin Pathology

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Inclusion body myopathy associated with Paget's disease of bone and frontotemporal dementia (IBMPFD) is a degenerative genetic disorder caused by mutations in the valosin-containing protein (VCP) gene. Approximately, 80% of patients carrying VCP mutations develops inclusion body myopathy. Although the molecular mechanisms underlying IBMPFD pathology remain unknown, mislocalization of TAR DNA binding protein 43 (TDP-43) in cytoplasm and the accumulation of ubiquitinated proteins have been implicated as important culprits in the mutant VCP-mediated myodegeneration. We sought to investigate mechanisms by which disease-associated mutations in VCP triggered TDP-43 redistribution to cytoplasm and the accumulation of ubiquitin inclusions in the cell. Currently, there is no in vitro model that recapitulates the disease phenotypes. In this study, we developed a cell culture model overexpressing human wildtype or disease-relevant mutant VCP. Murine myoblast C2C12 cells were used as a model for skeletal muscle cells and transfected with disease-causing mutant forms of human VCP, R155H, A232E, and a dominant-negative mutation, K524A. We established optimal conditions for the transfection in C2C12 cells and examined pathological hallmarks using immunocytochemical and biochemical approaches, both of which were optimized in the laboratory. Our preliminary results suggest that mutant VCP expressions slightly altered TDP-43 localization in the cytoplasm and aggregation of ubiquitinated proteins, but accurate comparisons to wildtype forms have yet to be quantified. Nuclear and cytoplasmic fractionations were achieved, and will be used to analyze distribution of TDP-43 and ubiquitin aggregates. Taken together, we have developed optimal techniques that will be used to study IBMPFD pathology in C2C12 cells.

Optimizing Existing HIV Entry Inhibitors

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HIV entry inhibitors have been a groundbreaking discovery in the search for successful HIV drugs, and in particular to stop initial infection. Currently, Fuzeon (T20) is a drug approved by the FDA for treating and decreasing viral load in HIV-infected persons, which has the mechanism of binding to HIV and preventing HIV entry into cells. Cell entry is mostly due to two major glycoproteins on HIV-1's surface: gp41 and gp120. Since the introduction of T20, a "first-generation inhibitor", many laboratory and wild-type strains of HIV have become resistant to this specific inhibitor. This has led to further studies implementing different proteins or molecules to identify a stronger inhibitor to block HIV entry. One method of stopping HIV is by blocking gp120. Griffithsin, a protein derived from algae, has been discovered as a very potent entry inhibitor. It acts by targeting the glycoprotein gp120, and, works effectively on its own, or coupled with another inhibitor. In our previous study, we discussed the success of the chemokine variant inhibitor 5P12-linker-C37. By blocking HIV entry into the host cell by binding gp41 and host cell proteins, these powerful yet inexpensive inhibitors potentially provide a remedy for the ever-increasing number of HIV infections. With the recent success of a new third generation gp41-binding fusion inhibitor, T1144 (Pan, C., Cai, L. (2011) Journal of Biological Chemistry), newer inhibitors seem to carry potential for an improved anti-HIV drug. By linking Griffithsin with T-1144, and 5P12 RANTES with T-1144, it is hypothesized that HIV inhibition could be improved.

Comparing Indicators of Quality Early Care and Education from State and National Sources

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Research shows that children who experience higher quality early care and education programs (ECE) perform significantly better in school than do children from lower quality programs. In order to objectively assess and improve ECE, a quality rating and improvement system (QRIS) with research-supported quality indicators is crucial. California is in the process of developing QRIS, following 23 states nationwide, which have already adopted statewide QRIS. A comparative analysis of national and state indicators was conducted to understand the potential importance of existing indicators for California's QRIS. Indicators from a 2010 national compendium of 23 states' QRIS and California's CAEL QIS 2010 report were organized into a matrix and reviewed to identify similarities and differences between California and other states. Five of California's proposed indicators ("ratios and group size," "teaching and learning," "family involvement," "staff education and training," and "program leadership") matched 12 of 13 indicators identified nationally. A nationally-compiled indicator on "accreditation by a national accrediting body" was not included in the California set. One potential strength in the California QRIS that was largely absent nationwide was the definition of quality criteria for different types of ECE (preschool and family child care). This comparison of nationwide and California indicators of quality ECE demonstrated that the majority of ECE quality indicators were consistent between the two reports. Results from this study may inform conversations on the development of California's QRIS and application of the quality indicators to county- and city-level efforts to ensure high quality early care and education.

Undergraduate Research in Computational Biology (URM) Program

In January 2011, UC Merced was awarded a program grant by the National Science Foundation to establish the Undergraduate Research in Computational Biology (URM) program.

The UCM-URM program will provide a two-year research mentoring program in which each cohort will receive combined classroom and hands-on training in a broad array of computational and mathematical biology methods and tool during the summer portions of the program and then join research projects with faculty mentors in the UC Merced Applied Mathematics, Biological Sciences, Computer Science, and Physics Program.

Ultimately, the goal of this program is to increase the numbers and diversity of students successfully continuing in quantitative and computational biology research careers by pursuing their graduate and professional education opportunities.

2012 Computational Biology Undergraduate Researchers

Semi-flexible Polymer Network Structures Varies Across Filament Length

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Semi-flexible polymers form a variety of structures in different environments. F-actin, a semi-flexible polymer found in nearly all eukaryotic cells, forms bundled networks when bound with certain cross-linkers for cell structure and motility. The effects of filament length and morphology of the cross-linker on bundling structure are observed through molecular dynamics (MD) simulations. Filaments are modeled as semi-flexible bead-spring chains. Systems are set up with filaments of varied length and either implicitly or explicitly modeled cross-linker. Implicit cross-linkers are modeled by running simulations by modifying a Lennard-Jones-like potential. By adjusting the strength of the interaction and the distance of the attractive regime, novel network morphologies and packing orders are observed. The simulations are analyzed using a radial distribution function (RDF) and power law scaling to identify bundling extent, mesh size, and packing order. Both filament length and cross-linker morphology affect the structures formed when bundling. While the computational model employed is based on actin, the model is applicable to semi-flexible polymers in general.

Conformational Sampling Of FG-Nucleoporins Using Extended Molecular Dynamics Simulations

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FG nucleoporins (FG-nups) are intrinsically disordered proteins that fill the central core of the Nuclear Pore Complex (NPC) and are believed to mediate the selective gating of cargo molecules though the NPC. Previous molecular dynamics (MD) simulations of FG-nup fragments approximately 100 amino acids (AAs) in length have shown that different FG-nups adopt different average shapes, ranging from compact premolten globules to extended coils, which are the basis for a new model for NPC gating. For MD studies of disordered proteins there are still open questions about the appropriate simulation times and protocols needed to sufficiently search conformation space, and how different force fields and ionic conditions affect the resulting structural ensembles. For this reason we have performed MD simulations on smaller, 50AA fragments of key FG-Nups for microsecond timescales, using both implicit and explicit solvent. Our goal is to see if their dynamical properties exhibit previously documented behavior for the larger fragments and to evaluate the thoroughness of conformational sampling for the FG-nups. The MD simulations completed include two sets of implicitly solvated simulations with “charged” open ends and “neutral” capped ends and one set of explicitly solvated simulations with “charged” open ends. The overall results suggest that expected size variation persists between the different FG-nups over the longer time scales. Additionally, results suggest that “charged” open ends have a stronger impact on the motion of the FG nup fragments in simulations with implicit solvent than in explicit solvent.

The Ronald E. McNair
Post-Baccalaureate Achievement Program

The Ronald E. McNair Post-Baccalaureate Achievement Program is a comprehensive program structured to prepare undergraduates for successful careers as graduate students, professors, and professional researchers.

The program is one of various educational opportunity programs funded under the Higher Education Act of 1965 collectively known as TRIO Programs.

At UC Merced and CSU Stanislaus, a partnership was created to provide an enriching educational experience for low-income/first-generation and underrepresented college students to: excel as undergraduates, succeed in graduate school, and ultimately enter faculty and research positions in our nations' colleges and universities.

The McNair Scholars Program supports a cohort of 25 student scholars each year. All students participate in academic year and summer activities until they graduate.

McNair Scholars are motivated students who have both the desire and the potential to earn a doctoral degree. By participating in the program, scholars increase and refine their academic skills and learn the tools necessary to be successful in graduate school.

2012 McNair Scholars.

Decision-Making and Motivations of Becoming a Naturalized US Citizen in the San Joaquin Valley

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This study inquires into the motivation of becoming naturalized citizens within various ethno-racial immigrant populations of the San Joaquin Valley in California. With immigration contributing to national, state, and local demographic shifts, this qualitative study explores the process that members of this population seek out to become naturalized citizens, and how the individuals, as legal permanent residents, are currently actively engaged in their communities. The qualitative instruments that were employed in this study consist of semi-structured interviews and interpretive analysis of secondary data. The incorporation of these methodologies will provide us with a glimpse of the levels of civic participation of the above-mentioned population. Some of the questions posed in the research are related to the timeframe of when such individuals became eligible for naturalization and the decision-making that led such individuals to apply for U.S. citizenship. Moreover, this study examines the key factors that individuals considered when deciding to become naturalized US citizens. Secondary data was collected from the United States Department of Commerce, United States Department of Labor, and the Pew Hispanic Center. The hope of this project is to shed light on a region that has not been fully researched as it relates to immigration and civic engagement including identifying barriers to naturalization.

The Relationship Between Mood and Cognition in Older Adults

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Uncovering the factors that influence the way we age becomes an important part of understanding the development of the devastating diseases associated with aging. One such disease is Alzheimer's disease, a neurodegenerative disease which affects various brain functions including memory loss and decline of other cognitive functions. With so many people reaching older adulthood, Alzheimer's disease is on the rise and is going to become more prevalent. Additionally, people are living longer which has lead to a greater proportion of people reaching the older age range (80 and above) in which the probability of developing Alzheimer's disease is much higher. Therefore, detecting variables that put a person at greater risk for developing Alzheimer's disease is important. The present study used data from a larger longitudinal study tracking cognitive changes over time among a non-demented (i.e., no diagnosis of Alzheimer's) elderly sample. Participants in this study were administered a battery of neuropsychological tests including a measure of verbal and visual memory (Wechsler Memory Scale IV; WMS- IV), a health questionnaire, and the Geriatric Depression Scale (GDS). We expect greater depression to be associated with more pronounced cognitive decline. Implications, limitations, and considerations for future research are also discussed.

How a Biological Clock Tells Time

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Organisms display daily rhythms in behavior, physiology, and metabolism in anticipation of sunrise and sunset. These involuntary oscillations are controlled by an internal clock, called the circadian clock. These bodily rhythms generated by the circadian clock are critical to health and disease. However, how clocks works remain mysterious. Our goal is to understand the mechanism of a model clock system. The simplest system is that of cyanobacteria. Its clock is only composed of three proteins, called KaiA, KaiB, and KaiC. Mixing these three proteins with ATP, a 24-hour oscillation can be generated that functions as the basis of a biological clock. In the KaiABC clock system, the circadian oscillation is generated in KaiC, which exhibits phosphorylation and dephosphorylation profiles over a 24-hour period. Initially, KaiC interacts with KaiA to produce the phosphorylation signal over the first 12-hour period. In the next 12-hour period, KaiC interacts with KaiB forming a dephosphorylation complex to complete the 24-hour period. We hypothesize that a particular structure of KaiC, termed the 'a-loops', regulates KaiA binding. From our preliminary data, we observed that the a-loops were exposed in phosphorylation states and buried in the dephosphorylation states. In essence, some of the phosphorylation states of KaiC determine when KaiA binds. By studying this simple clock system, we can apply some of the same concepts to higher organisms such as ourselves.

Las Cuevas Archaeological Reconnaissance Mission

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The ancient Maya site of Las Cuevas in western Belize was an important ritual venue in the 9th century AD, just prior to the ancient Maya "collapse." Las Cuevas is also one of the closest centers to the site of Caracol, one of the largest polities in the Maya lowlands, located about 14km to the east. But, despite the close proximity to its larger neighbor, relatively little is known about Las Cuevas. The LCAR seeks to better understand the relationship of the two sites and how this dynamic may have changed over time. Data collected during the 2012 field season continued to address these issues through chronology building, excavation and mapping. Mapping the site and the cave is one of the most important components of the research. At Las Cuevas, our maps provide information regarding the site's architectural layout so that it may be compared to other sites in the region. In 2011, the project discovered the Monkey Tail site, located about one hour's walk west. Monkey Tail appears on the surface to be architecturally similar to Cuevas, which may suggest a close connection between the two. This may suggest that influences from the west of Las Cuevas may be more important than those from its larger neighbor Caracol. Based on field survey training, I was able to map this site and compare the architectural layout to that of Las Cuevas.

Heat Transfer and Rayleigh Benard Convection

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By applying temperature difference on a fluid, we can measure and calculate conductive and convective properties of a fluid. Conductive properties include heat flux, thermal conductivity, thermal diffusivity, and heat capacity. We can measure convection patterns as in Rayleigh-Benard convection by cooling a fluid from the top and heating it from the bottom. Studying Rayleigh-Benard convection is particularly important because it can be used in many applications as it appears in atmospheric patterns and in the earth's outer core, which would otherwise be very difficult to measure. We constructed an apparatus that generates this convection and control certain boundaries of the experiment such as the dimensions of the flow chamber. Liquid Gallium is a fluid of interest because it serves as a good model for the sun and earth's inner molten iron alloys. We can measure Gallium's thermal properties using another apparatus that we designed to create a temperature gradient across the fluid. Ultimately, these experiments will render a dimensionless number that can be applied to any fluid. This is known as the Nusselt number; and its values have significance over defining turbulent and laminar flows. We found that the thermistors respond quickly and were able to find an exponential equation that related the thermistor's readings to temperature. This data gives us confidence in the apparatus design and allows us to transfer our measurements into solvable equations.

Interval-Vector Polytopes

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An interval vector is a (0,1)-vector where all the ones appear consecutively. Polytopes whose vertices are among these vectors have some astonishing properties that are highlighted in this research. We present a number of interval-vector polytopes, including one class whose volumes are the Catalan numbers and another class whose face numbers mirror Pascal's triangle.

Effects of Inhibitors on the Secondary Structure of baPurE

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PurE is an important enzyme in the purine biosynthetic pathway. Humans do not use the same type of PurE enzyme as microbes. Therefore, purine biosynthesis differences among microbes and humans demonstrate a potential target for the development of an antibiotic against microbes such as Bacillus anthractis. Previous studies show that when PurE is removed in B. anthratis, the bacterium would not survive in serum. Thus, we investigated recombinant PurE in B. anthratis to understand the effects of inhibitors in PurE's secondary structure. We used circular dichroism (CD) spectroscopy to study the secondary structure of PurE in the absence and presence of specific inhibitors. The inhibitors used were NAIR and compound 0074. We found that these two inhibitors did not change the CD spectrum and thus the secondary structural elements in PurE, suggesting that the inhibitors are binding to the active site of PurE as competitive inhibitors, and they do not bind elsewhere to induce structural changes to reduce the enzymatic activities, as in allosteric inhibition.

Deviant Mamas: Understanding How and Why Women Make Empowered, Informed Choices for Healthier, Safer Outcomes in Maternal/Infant Care

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Increased use of interventions, especially cesarean sections, in U.S. maternity care has resulted in high morbidity and mortality rates. In a birth culture filled with misinformation and misconceptions about the safety of obstetric care, women must be empowered to search for healthier alternatives for themselves and their babies. Despite the safety of midwifery-based care and its improved results throughout the world, women remain ignorant to their options for non-obstetric care, impeding their ability to make informed and safe birth choices. Qualitative interviews with mothers who have chosen midwifery as their primary form of maternity care for at least one birth reveal trends in the influences that allow these women to create a space for themselves to make decisions contrary to mainstream culture. Additionally, trends appear in how a woman's birth experiences (specifically in having a vaginal birth) contribute to her overall sense of female empowerment.

The Utilization of Transcription within the Complexities of Conversation

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The basis of this eight-week summer research project involved the transcription and examination of conversations between interacting individuals. The study of conversations provides valuable insight regarding the way dialogue is used across various populations including its influence on behavior. The utilization of transcription allows researchers to separate dialogue into several dimensions and analyze the processes that conversation creates. All transcriptions contained conversations consisting of two pairs each which were recorded on video. The dialogue between both individuals was transcribed by utilizing a media player and writing down the conversation verbatim. The audio of each pair was separated to aid in differentiating the speech of each participant. The transcription process is known to often involve several hours of analysis which can be extremely time-consuming. Additionally, researchers are often faced with challenges of consistent accuracy when attempting to measure several simultaneous structures of conversations such as overlapping speech, and temporal information. To minimize the time complexity, the implementation of the computer program Anvil was used. Anvil, offered a cost effective method of video annotation which provided the flexibility to customize various coding schemes, as well as aiding in the achievement of accuracy and reliability. The current transcriptions show repeated use of accommodating words. As the transcription is currently in its beginning phase, future examination will begin to focus towards relationships and bodily synchrony.

The Ability of Undergraduates to Create an Effective Latino Civic Engagement Campaign

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California is reaching a pinnacle moment in its electoral history due to a rapidly increasing Latino population. Still, this population finds itself unequally represented in politics due to low civic engagement. Civic engagement encompasses an array of actions or behaviors that can range from voting to reading a proposition. Obstacles such as naturalization and diversity in language can hinder most voter mobilization efforts that seek to increase such engagement. Latinos aged 18-25, however, are less encumbered by these types of barriers. Mobilization of this demographic could increase civic engagement among Latinos. The challenge is to determine the most effective civic mobilization of 18-25 year old Latinos. My hypothesis is that undergraduate students are capable of creating this effective mobilization. To assess this hypothesis I conducted an ethnographic study on eight UC Santa Cruz undergraduates named V.I.C.E (volunteers increasing civic engagement) performing summer research in the Merced, Stanislaus, and San Joaquin Counties. Their objective was to increase civic engagement among young Latinos. To determine their effectiveness I attended V.I.C.E. meetings as well as conducted a focus group with V.I.C.E. members. As a result, I determined some assets that undergraduate students provide to mobilization efforts as well as some challenges that they face. With this data, the team was able to establish some improvements that could be applied to future civic engagement campaigns to mobilize Latinos aged 18-25.

Impacts on Suspension of Cornstarch and Water

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Non-Newtonian fluids can exhibit a variety counterintuitive phenomena. One example is a suspension of cornstarch in water, which has the ability to absorb incredible amounts of momentum on impact. The mechanism for this phenomenon has not been understood using traditional shear rheology. To study impact-activated solidification and momentum absorption within the cornstarch suspensions, we use high-speed videography in conjunction with an ElectroPuls E1000 materials tester which impacts the surface of the suspension while measuring the force and position. We observe that a transient solid-like front grows out from the point of impact. We report measurements of the load carried by the suspension and how it changes depending on whether the front reaches the boundaries of the system.

Calculus of Variations: The Brachistochrone

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Two famous optimization problems in mathematics are The Minimal Surface problem and The Brachistochrone Problem. In Calculus of variations, each can be related to a functional which is a family of functions. Solutions to such problems are the functions that minimize the functional. The theoretical solution to each of these problems can be found with methods of Calculus of Variations. In other words, we will derive the Euler-Lagrange equation from the Gateaux Variation of the functional set equal to zero, and the resulting partial differential equation will describe the true solution. The objective of this research is to numerically calculate the solution by selecting data points near the true solution and running them through the steepest descent algorithm until the points are aligned with the true solution. The curve that is mathematically described is the theoretical solution. This method of numerically calculating the minimum of a functional can be applied to anisotropic smoothing models in image processing such as restoring regions of interest in medical images.

In a Cage with Tigers: Identifying Support for Child Language Brokers

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Parents with Limited English Proficiency often rely on their children to help them communicate across language barriers. Child "language brokers" informally intermediate to bridge linguistic and cultural differences between parties. This study explores language brokers' perceptions of their experiences. We formed a focus group of Latina, Hmong, and Burmese college students who language brokered as children. The discussion centered on experiences that participants consider "positive" and "negative," as well as things parents might do during the process to "support" their children. An audio recording of the discussion was transcribed and analyzed qualitatively. Results show there are variables that shape children's perception of each transaction. Participants were more likely to report positive experiences when they facilitated understanding between parties, helped someone, learned something, or felt their parents trusted them. Negative experiences were characterized by lack of understanding, missed opportunities for parents to learn English, or negative feelings. One participant described her fear while language brokering as: "I felt like I was put into, like, a cage with tigers." Participants indicated that parents might support their children during language brokering transactions by offering words of encouragement, providing simple rather than complex explanations of content to be translated, creating a learning opportunity, and expressing gratitude. Further inquiry into the topic of child language brokering is warranted as the cognitive, social, and psychological effects of the practice are inconclusive.

USDA Summer Scholar Program

The USDA Summer Scholar program is funded by a grant from the United Stated Department of Agriculture Hispanic Serving Institution Education Grants program. This program aims to develop the next generation of highly trained, graduate students in agricultural-related sciences. This will be accomplished by:

- Recruiting students from two HSIs (UCM and CSUS) to participate in long-term, intensive research projects with participating UCM faculty and participating USDA researchers
- Providing students the opportunity to attend and present research results at national conferences such SACNAS, which provide opportunities to undergraduate researchers in STEM fields
- Incorporating practical agricultural science-related themes into the curriculum of UCM STEM courses

This program will target the highly diverse undergraduate population of the San Joaquin Valley, with the goal of increasing the representation of students from the two institutions, and notably students from underrepresented groups into graduate programs related to the research area needs of the USDA.

2012 USDA Summer Scholars

Targeted Inhibition of the NF-kB Pathway: Effects on IL-6 Secretion and Cell Viability in C2C12 Myotubes

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Insulin resistance is defined as the reduced ability of insulin to trigger tissue uptake of blood glucose. Previous work has shown that free fatty acids are elevated in the plasma of Type 2 Diabetics (T2DM) along with pro-inflammatory markers (IL-6, TNFα, etc) that activate potent pro-inflammatory pathways through specific recognition receptors. Simultaneously, dysregulation of fat metabolism results in the accumulation of a number of bioactive metabolites that accumulate in key metabolic tissues such as liver, adipose and pancreas that also negatively regulate insulin sensitivity. Notably, acylcarnitines (fatty acids of varying chain length that are bound to the modified amino acid carnitine), are also elevated in the plasma from T2DM and have been shown, when exogenously added to cultured cells, to activate the NF-κB pathway, possibly through similar pathways. Our group has been examining the pro-inflammatory effects of acylcarnitines. Toward this end, we focus here on using an NF-κB inhibitor (Bay 11-7082) in order to understand the role of this pathway on cytokine secretion (IL-6) in LPS- or acylcarnitine- treated C2C12 myotubes. The goal of these studies is to define the optimal inhibitor concentrations that effectively block LPS- and acylcarnitine- mediated IL-6 secretion but maintain cell viability. These studies will provide the groundwork for applying this inhibitor to our models of insulin resistance.

The effects of topography on soil properties in high elevation meadows

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Topography is one of the factors of soil formation and it controls certain physical properties of the soil. Understanding how topography affects soil properties will allow us to understand how it affects soil formation, and the soil's influence over biodiversity and water quality. Because topography influences certain soil properties, soils in the same general area will showcase different properties. Our field site consists of high elevation meadows in Yosemite national park, high elevation meadows sustain biodiversity and they store, filter and release water from the Sierra Nevada snowpack to watersheds. We collected the soil samples at different depths, different moistures and different topographic areas in one general region. We measured gravimetric moisture, pH, soil color, particle size, cation exchange capacity, carbon to nitrogen composition and bulk density on each sample. By conducting these tests on each sample we were able to obtain data that would allow us to compare how soils differ in characteristics based on their location. When it came to soil color, color was more similar across depth and moisture relevant area. Moisture was scattered throughout areas, similarities or differences were not limited to one area. Topography plays a vital role in soil formation. Topographically different soils will showcase different physical properties in comparison to other soils in the same general area. Understanding that soils differ physically across a region will allow for a better understanding on how topography will affect biodiversity and water quality in these areas.

Invasive Plants Alter Nitrogen Cycling Dynamics in a California Annual Grassland

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Invasive species are non-native organisms that have the capability to cause economic, ecological, or human harm. Invasive plants and animals accrue an average management cost of $120 billion per year in the US. California grasslands, having been strongly affected by invasive plants since the early 1800's, are critical ecosystems to consider when determining the overall impact of invasive plants in California. Effects of exotic annual grasses on Nitrogen (N) cycling are important to consider because N is often the common limiting nutrient for plant productivity. Our research attempted to identify the effects of invasive plants on N cycling by looking at fluxes of inorganic N throughout the 2011-2012 growing season. Using ion-exchange resin bags, we analyzed seasonal N fluxes within communities of native species (Bromus carinatus, Elymus glaucus, Leymus solstitalis, Lotus purshianus, Lupinus bicolor, Nassella pulchra, Poa secunda, Culpia microstachys), naturalized invasives (Avena Fauta, Bromus hordeaceus, Lolium multiflorum, Trifolium subteranneum), and new invasives (Aegilops triuncialis, Centaurea solstitialis, Taeniatherum caput-medusae); n=15). We found that throughout the span of a year, soil associated with natives, naturalized, and invasive species had significantly different flux rates of nitrate and total inorganic N; however, cycling of ammonium did not differ by treatment. Specifically, we found that native plants tended to have the highest fluxes of total inorganic N and that certain seasons had more marked differences than others. These results should help land managers to make better estimations on how to successfully manage for, and mitigate ecological damage of, invasive plants in these invaluable ecosystems.

Sorption Mechanism of Hazardous Heavy Metals on Reactive Surfaces of Clay Minerals

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Chemical reactions occurring at the surface of natural solids control many processes in Earth's aqueous systems. Natural solids regulate the concentration and distribution of contaminants, nutrients, and salts. Discrepancies between conventional surface area measurements and the actual reactive surface sites for interfacial reactions readily enlarge to order-of-magnitude errors in sorption capacities or dissolution rates when molecular-scale processes are extrapolated to larger scales. Thus, we seek to develop a more meaningful measurement of surface reactivity by examining molecular binding sites and their dynamic nature by utilizing site-specific probe molecule(s) using solid state nuclear magnetic resonance (NMR), spectroscopic/microscopic characterizations, and computational chemistry. In support of these microscopic characterizations, batch sorption experiments of Pb onto kaolinite were conducted in 0.01 M CaCl2 as the background electrolyte with a total dry mass of kaolinite of 1 gram and a total Pb concentration of 5.0E-5 moles of Pb suspended in 10 ml of solution in a 16 ml centrifuge tube. Each sample was adjusted to a different pH between ~ 4 to 6.5 in order to achieve different amount of sorption from solution. Samples were equilibrated for 24 hours and pH was measured at the end of the experiment. The concentration of Pb remaining in solution was measured by Graphite Furnace Atomic Absorption Spectrometry (GFAAS) and adsorbed Pb was calculated by difference. Based on these results, we will probe surface reactive sites and examine hydroxyl site blocking. With the information acquired from our experiments, we will be able to understand the sorption mechanism of interfacial surface reactions which will allow us to accurately predict critical environmental processes.

Sugar sweetened beverage consumption is higher in normal weight than overweight and obese adolescents: Implications for future increased prevalence of obesity

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The National Youth Physical Activity and Nutrition Study indicates that approximately 57% of adolescents in high school consume a sugar-sweetened beverage (SSB) at least once per day even though weekly consumption of 100% fruit juice, milk, and water are greater. Because high consumption of SSBs is associated with the development of metabolic disorders (ie, insulin resistance and obesity) and can displace the intake of water or milk, robust measures of consumption among adolescents is important for assessing the potential impact on public health. The associations among beverage consumption (water, milk, juice and soft drinks) with regards to body mass in Hispanics in rural areas are not well examined. Surveys collected self-reported data on daily beverage consumption and related to direct measures of BMI from non-Hispanic white (312 males, 301 females) and Hispanic (671 males, 610 females) adolescents (13-17 years old.) On average, 49% of overweight and obese adolescents, regardless of race and gender, drank more water than their normal weight counterparts. 61% of normal weight White females reported consuming more soft drinks per day than their obese and overweight counterparts regardless of race. Furthermore, 46% of normal weight and overweight Latino males drank more juice per day than white males. The lack of higher SSB consumption in overweight and obese adolescents suggests that either SSB consumption is not a principal cause of their increased weight or that most of these adolescents are beginning to reduce their intake to address their weight issues. The higher SSB consumption in normal weight females is alarming because we have reported reduced physical activity levels in this group, and thus, suggests that this group is susceptible to weight gain and increasing the prevalence of overweight and obesity in this population of adolescents, further burdening the epidemic that plagues the United States.

Conservation Genetics of Yosemite Toads in Sequoia- Kings Canyon National Park

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Rapid changes in global climate coupled with human encroachment on ecosystems have resulted in the decline and extinction of numerous species. The Yosemite toad is particularly at risk because of its reliance on alpine meadows. Yosemite toads are vulnerable to three hazards: climate change, pollution and a fungus called chytrid. Whether or not the Yosemite toad is affected by chytrid is still unclear, but its small range (Alpine County to Kings Canyon National Park) combined with climate change further increases its possibility of low genetic variation and connectivity among populations. Additionally, rapid changes in global climate will dramatically modify the environment of these toads. In order to better understand and document genetic variation and population connectivity, over 350 Yosemite toads were sampled from twelve meadows in Sequoia-Kings Canyon National Park. These samples were genotyped at eight microsatellite loci, but two were insufficient for analysis. From these six microsatellite loci, we quantified population structure/connectivity and evidence for low genetic variation in one population. The cause of low variation in this single population is not fully understood, but limited gene flow can cause inbreeding, genetic drift and an overall loss in fitness. By excluding this single population we observed a correlation in geographic distance and gene flow between populations. This is suggestive of isolation by distance. STRUCTURE analysis indicates that peripheral populations were genetically distinct. The population structure/connectivity results of this study will aid the predictions and spatial analysis of future work across the range of the species.

Movements and Habitat Use of Yosemite Toad

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The Yosemite toad is a species of concern; they are found in areas where the forest service constructs roads, thins trees, and prescribes fires. It became an issue for the forest service to do forms of mechanical harvesting with such a sensitive organism around certain area. Therefore, the results of this study can ultimately provide the forest service important information that can lead to informed decisions about what to do in the areas where Yosemite toads are found. I followed up on a study conducted by Dr. Liang on the movements and habitat use of adult Yosemite toads in the Sierra National Forest. Twelve toads were captured from the breeding meadows, equipped with radio transmitters and radio tracked as they left those areas in the summer of 2012. Data was collected on their location, habitat, and environmental conditions and the results correlate significantly to those previously noted. The most commonly used microsite were the burrows but they also utilized rocks, tree stumps, and sometimes they were found in open meadows. Both male and female avoid dense forest areas and prefer an open terrestrial environment. Female Yosemite toads traveled longer distances, up to 1.04 m from breeding sites, averaging about 700 m, whereas the males averaged a distance of about 430 m. Overall, the data obtained on the Yosemite toad can be implemented to the plans done by the forest service for mechanical harvesting, which can ultimately help maintain this species safe.

Dairy vs. Supplements: Effects on Bone Health

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Postmenopausal women are at risk for osteoporosis due to lower bone mass and decreased estrogen which is essential for bone health. Calcium and Vitamin D are both important nutrients in the prevention of osteoporosis with a role in the structure and function of bones. This study compares calcium and vitamin D supplements to 4 servings of dairy foods to determine if dairy foods are more effective than supplements in improving bone metabolism. Postmenopausal women, ages 50-65 yrs., were given an oral dose of 41Ca isotope followed by a 180 day equilibration period. After isotope equilibration, women were assigned, in random order, to 1300 mg Ca + 400IU vitamin D daily supplements or 4 servings of dairy foods for 6 weeks. Treatments were separated by a 6 week washout period to reduce any carry-over effect. Urine samples were collected during stabilization and weekly during intervention. Three-day food records were collected weekly during intervention and washout. Using the Nutrient Data System for Research (NDSR) average daily nutrient intakes and food group servings were computed from food records to determine the relationship between nutrient intake and urinary excretion. Urinary mineral analyses were conducted to determine the excretion of Ca, K, P, Na, and Mg. Urinary creatinine was used as a correction factor for urinary mineral excretions. Although there are no finalized results for this study, data from the analyses can serve as additional information to compare the different effects of nutrient-rich dairy foods vs. supplements on overall bone health.