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College of Engineering and Computer Science

Civil and Environmental Engineering

1. Pratanu Ghosh

Research Interests: My research focusses on sustainability and durability of concrete structures using advanced experimental and numerical technologies. My research directs several innovative cutting edge non-destructive testing technology on concrete samples to evaluate different strength and durability problems in concrete structures. Currently, my students are involved to investigate the beneficial effect of Zeolite based high performance concrete (HPC) mixtures for future implementation in reinforced concrete bridges and pavements. They always enjoy hands-on experience in laboratory environment and they are also involved with different statistical analysis to determine service life of bridge decks and pavements. Earlier, my research students obtained TRB Eisenhower Fellowship, 2nd Prize in CSUF research competition. Every year, my undergraduate research students took part in CSUF student research competition, ECS Student Research showcase and presented their research in Southern California Undergraduate Student Conference (SCCUR).

Projects Available for URE20:

1. Investigate service life modeling of bridge slabs and pavements using life 365 software. Corrosion is one of major problems that deteriorate reinforced concrete over time. Students can compute corrosion initiation time and corrosion propagation time using diffusion coefficients of various sustainable cementitious materials and finally compute service life of bridges and pavements.

2. Investigate Surface Electrical Resistivity and Shrinkage of concrete samples using non-destructive testing techniques. More testing is needed for different high performance concrete mixtures for future implementation in reinforced concrete bridges and pavements.

Desired preparation for this lab: Students need to know basic statistical analysis and Excel and some basic lab training to conduct experiments. Our lab technician can help to provide adequate training to use the equipment.

2. Garrett Struckhoff

Research Interests: My current research interests are bioremediation of contaminated soil and groundwater, biofuels, and greenroofs.

Projects Available for URE20: The research will focus on using brewery waste to sustain algal growth for biofuel production.

Desired preparation for this lab: Chemistry or biology knowledge will be helpful.

Computer Engineering

3. Yu Bai

Research Interests: Dr. Bai's research interests include neuromorphic computing, FPGA design, nano-scale computing system with novel silicon and post-silicon devices, and low power digital and mixed-signal CMOS circuit design.

Project Available for URE20: Titan Providence: Self-navigation drone goes where no GPS can!
Data and analysis of information have become a crucial aspect in society's current development, allowing accurate awareness of our environments, benefitting maintenance, safety, and overall innovation. However, being informed in some situations require extensive and intensive manpower and are generally costly and dangerous, with situations ranging from inspecting power lines to plotting potholes within an urban area's road system. Titan Providence is a drone project that utilizes machine learning and 3D printing with improved accessibility and maneuverability to enable applications in various fields that would otherwise be prohibitive given previous limitations. Differing from common Unmanned Aerial Vehicle (UAV) systems, Titan Providence implements edge-based bottom-to-top design method to implement efficient machine learning algorithm and customized 3D- designing and printing bypass the limitations of required human control and environmental systems, such as GPS, allowing for fully autonomous completion of extensive analysis of environments that are otherwise inaccessible, vast, hazardous, monotonous, or a combination thereof, in addition to having the benefits of an overall lowered cost in finance and labor.

With the increasing desire for efficiency and effectiveness, in having the ability to give a UAV a task that would be otherwise too resource-demanding or risky for human involvement, Titan Providence provides a significant alternative for surveying and environmental awareness through multiple scheduled assignments and real-time automated problem solving that may be attuned for countless situations and applications.

Desired preparation for this lab: No additional preparation is required. I will take the responsibility to ensure that the students have sufficient background during the summer research activities to fully benefit from their participation in the projects.

4. Kiran George

Research Interests: Bio-signal based assistive technology devices, Brain-computer interfaces, Digital wideband receivers, High-performance computing, and Pattern recognition techniques.

Projects Available for URE20:
1. Design and Development of Brain-Computer Interface (BCI) based Systems to Improve Quality of Life
A person moving mouse cursor on a computer screen is an insignificant accomplishment. But if the person is a quadriplegic controlling the cursor with nothing but brainwaves, now that would be interesting! As part of the research, students will design and build a Brain-Computer Interface (BCI) system. A BCI based on electroencephalogram (EEG) signals can be used to provide a direct communication channel for healthy or disabled users from the brain to a technical device. Through movement intentions brain activity can be voluntarily modulated in a predictable way. A BCI system can detect these alterations in the ongoing EEG using advanced signal processing techniques and control an application (text-entry system; prosthesis; computer game) accordingly. Since no peripheral nerves or muscles need to be involved in this process, BCI technology may be used in assistive technology for paralyzed patients. BCI systems can help surgeons, mechanics, soldiers and pilots who experience "induced disability" when hand or voice communication is infeasible. BCIs might help them request tools, navigate maps or schematics, access data, or perform otherwise difficult, distracting, dangerous, or impossible tasks.

2. *Titan Grove* - Self-sustaining Carbon Sequestering Smart and Connected Artificial Trees

Titan Grove is a collection of aesthetically appealing smart and connected artificial trees in wheeled planter boxes with flexible solar cells as its leaves and with the capability to absorb and store carbon dioxide from outdoor atmospheres parks, yards and other locations leaving the air fresher. Each smart tree, with internet connectivity, displays relevant system information including current level of CO2, remaining charge in the battery, etc. on an associated website, mobile app, and the one-inch OLED display on the trunk of the tree. The parts of the tree (leaves, branches, truck, planter box, etc.) are 3D printed using colored fire retardant material.

3. Autonomous Underwater Vehicle (UAV): AUV autonomously navigates, detect objects, and perform predetermined tasks without any user input. Students will be provided kits with the hardware need to build a mini underwater vehicle; they will then add more functionalities including data communication, automatic object recognition, and so on.
Desired preparation for this lab: Programming experience will be beneficial.

5. Rakesh Mahto

Research Interests: My research interests include ASCI design, low power design, reconfigurable FPGA design, photovoltaics, renewable energy and mixed signal design and testing.

Project Available for URE20: Currently, I am working on creating reconfigurable solar cells. This kind of solar cells can be used for powering micro-autonomous drones and CubeSat. You will get chance to understand the working of solar cells and learn programing of Arduino or Raspberry Pi boards.

Desired preparation for this lab: Some courses related to C and C++ programming should be sufficient.

25. Ankita Mohapatra

Research Interests: Her research interests are embedded systems, printable electronics, signal analysis and optimization.

Projects available for URE20:
Forest fires leave an unwanted consequence of massive economical, fiscal and sociological imprint on the community. Given the recent increase in the frequency and scale of fires, there is an urgent need for finding better, smarter technologies to assist California's existing fire control capabilities. This project intends to explore a smart, low-power, unmanned early-detection system that can be deployed in remote locations, and alert the authorities about probable forest fires. The student will get an opportunity to work with sensors in low power circuits and sensor data interpretation.

Desired preparation for this lab: Students should have a basic knowledge of working with microcontrollers and programming with C/C++, if possible. The student must also have an interest and motivation to work with embedded systems.

Computer Science

6. Christopher Ryu

Research Interests: Artificial intelligence and machine learning.

Project Available for URE20:
1. Serverless application development using AWS cloud
Required background: Java/Python programming, familiar with Linux operating system

2. Navigation and collaboration with multiple robots
Required background: Python/C++ programming, familiar with Linux operating system, mathematics (trigonometry, linear algebra), motion physics

3. Creating music using artificial intelligence
Required background: Python programming, being able to play a musical instrument such as piano, guitar, etc., and basic knowledge of music theory

Desired preparation for this lab: Desired preparation varies by project. See "required background" under each project to understand requirements. Overall desired preparation: Java, Python, C++, Linux operating systems, motion physics, trigonometry, linear algebra, music theory, ability to play musical instrument.

Mechanical Engineering

7. Sagil James

Research Interests: Research areas include advanced manufacturing, smart and intelligent manufacturing, and clean-energy manufacturing. Several projects are currently being undertaken. The focus of the projects is to study and develop smart technologies needed to reduce the time and cost required to translate design innovations into commercial processes and products.

Project Available for URE20:
1. Smart manufacturing and PLC-based industry automation
2. Internet-of-Things (IoT) enabled Remanufacturing
3. Bionic design principles for intelligent manufacturing
4. Advanced composite fabrication and assembly
5. The transition from 3D printing to 4D printing technology

Desired preparation for this lab: No additional preparation required.

College of Natural Sciences and Mathematics

Biological Science

8. Alison Miyamoto

Research Interests: We are interested in how proteins on the surface of mammalian cells communicate with each other and with their environment. Specifically, we are studying: 1) the mechanism of Notch signaling (Notch is conserved in all animals, required for proper development of the embryo, and defects in Notch signaling are associated with birth defects and cancer), and 2) how MAGP2, a protein of the extracellular matrix (ex. cartilage, bone), affects the activity of at least two different signaling pathways. We are also involved in a collaborative project tracking the localization of a RNA splicing factor, PTBP1, that is important to neural cell maturation.

Projects Available for URE20:

1. For the Notch project, we want to generate a human cell line that expresses a Notch1 receptor fused to Green Fluorescent Protein (GFP) that fluoresces green in live cells. These cells could be used in live cell imaging assays for Notch receptor cell signaling.

2. For the MAGP2 and PTBP1 projects, we have ongoing antibody-based assays (keywords: immunofluorescence, microscopy) to track their signaling/localization in mammalian cells.

Desired preparation for this lab: We will train students in all required techniques.

9. Nilay Patel

Research Interests: Niclosamide is an FDA-approved drug that is being considered as an adjuvant chemotherapeutic agent for cancer treatment. Our collaborators have synthesized compounds similar to niclosamide and our goal is to characterize how these compounds reduce cell proliferation. We have used microarray technology to identify which genes are differentially regulated by these compounds and we plan to evaluate role of these genes using cellular and molecular biology techniques such as quantitative PCR, immunocytochemistry, overexpression, knock-down along with drug treatments, and CyQuant cell proliferation assay.

Desired preparation for this lab: No additional preparation required.

10. Maria Soledad Ramirez

Research Interests: My research focuses on mechanisms of antibiotic resistance, their dissemination and evolution, and their impact on the morbidity and mortality of bacterial infections. The increase in infections caused by antibiotic-resistant bacteria are a serious threat to human health, and the problem has attracted the attention of diverse government and agencies that are trying to establish strategies to increase research and design of new therapies. In the past few years, we have explored various aspects of a major nosocomial pathogen -*Acinetobacter baumannii*- that has a particular ability to acquire antimicrobial resistance traits and survive in the hospital environment. In addition, recognizing the importance of interactions among multiple pathogens and pathogens with the host, our lab expanded the scope to study pathogen-pathogen interaction such as *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Burkholderia cepacia* complex, as well as, pathogen-host interactions exposing *A. baumannii* to different human fluids.

Projects Available for URE20:

1. Pathogen-pathogen interactions
2. Discerning the role of HSA on *A. baumannii* behavior
3. Genomic and phenotypic analysis of Multidrug-resistance strains
4. Synergy of Beta-lactamase inhibitors combinations to inhibits the growth of *Acinetobacter* spp.
5. Searching for novel strategies to combat Multidrug-resistance strains

Desired preparation for this lab: No preparation/skills required. We will provide the corresponding training and knowledge required for a dedicated and enthusiastic student.

11. Melanie Sacco

Research Interests: We are interested in how viruses successfully infect some plants, while other plants are able to defend themselves with immune responses. We use different plus- and minus-sense RNA viruses for our research questions, and study interactions primarily in plants of the tobacco genus *Nicotiana*. Various projects in the lab investigate the activities of virus proteins in promoting infection or immune receptors that recognize those proteins through molecular biological and biochemical approaches, including mutation of clones for expression in tobacco to observe what kinds of effects the mutations have on protein function.

Projects Available for URE20: We are currently researching two immune receptors in the model plant *Nicotiana benthamiana*: the Rx protein from potato that recognizes the virus potato virus X and the Tm2-2 protein from tomato that recognizes tobacco mosaic virus and tomato mosaic virus. Previous work in our lab showed that there are potential phosphorylation sites at the amino-terminus of these proteins, and that members of the 14-3-3 protein family of phosphoprotein-binding proteins are important for Tm2-2 function. Two available projects for summer 2019 will test ten members of the tomato 14-3-3 protein family (called TFT1 to TFT10) and dominant mutants of selected TFTs with the two immune receptors Tm2-2 and Rx for an effect on immune signaling. Wild-type and mutant immune receptor proteins will also be used to investigate if any of the TFTs function by binding to their amino-termini when phosphorylated.

Desired preparation for this lab: Students should have an interest in molecular biology or biochemistry and we will conduct the required specialized training for the specific research projects.

12. Parvin Shahrestani

Research interests: We study the evolution and genetics of health-relevant traits, such as longevity and immune defense. Our lab uses a fruit fly model system.

Projects Available for URE20:

1. Understanding sex differences in immune defense against fungal infection. When flies are infected with fungal pathogens, female flies die faster than male flies. We want to understand what genetic, anatomical, and behavioral factors cause this sex difference in immune defense.

2. Understanding the role of the gut microbes in immune defense. The bacteria that live in our guts have a large role on immune defense, but we don't exactly understand this role yet. We will study the impact of the microbiome on immune defense using the fruit fly model system.

3. Understanding the relationship between longevity and the microbiome. Gut bacteria affect not only immune defense, but also longevity. But which microbes increase lifespan? Which ones decrease lifespan? How do populations that differ in longevity compare in their gut microbes? These are some of the questions we are exploring.

4. Understanding the genetic basis of longevity. In this study, we are evolving populations of fruit flies to become long lived. We then compare the long lived populations to short lived populations genetically, in order to identify genes that influence longevity.

Desired preparation for this lab: We will train students in all aspects of the experiments.

13. Danielle Zacherl

Research Interests: The Zacherl lab's research interests center around topics in marine ecology including larval behavior, settlement and recruitment dynamics, population connectivity, restoration ecology, and native-non-native species interactions.

Keywords: Marine Ecology, Marine Population Connectivity, Restoration Ecology, Marine Invertebrates.

Projects Available for URE20:

1. Population connectivity – We use statoliths, otoliths, and genetic markers to measure dispersal and connectivity over ecological and evolutionary timescales.

2. Restoration – We have been engaged in science-based restoration projects focused on restoring the Olympia oyster, *Ostrea lurida*, in southern California since 2010.

3. Monitoring – We have been monitoring populations of Kellet's whelk since 1996, settlement dynamics and populations of oysters since 2005, and pinto and black abalone since 2013.

Desired preparation for this lab: An interest in marine ecology or restoration ecology.

Chemistry & Biochemistry

14. Daniel Curtis

Research Interests: Suspensions of small particles in air, known as aerosols, are present in the atmosphere due to natural and anthropogenic activities. Aerosols influence Earth's climate by scattering and absorbing incoming sunlight. However, the climate effects of atmospheric aerosols are relatively poorly understood due to their complex and changing chemical and physical properties.

The Curtis group studies the spectroscopic properties of atmospheric aerosol particles in order to better understand their effects on Earth's climate. These measurements are made using sensitive techniques such as cavity enhanced spectroscopy and polar nephelometry. The goal of these studies is to better understand how aerosol particles influence global climate and urban visibility.

Currently, the Curtis group is studying sea spray aerosol, which is produced from the oceans, and brown carbon aerosol, which is produced in wildfires (biomass burning) and is found in some urban smog particles. Additionally, we are working on measuring heavy metals such as copper, in the aerosol produced from automobiles in an attempt to better understand their effects on human health.

A newer direction for the Curtis laboratory is the study of the chemical composition and physical properties of the aerosol particles generated from the use of electronic cigarettes. E-cigarettes are potentially less harmful than traditional tobacco cigarettes, but they have been shown to produce harmful heavy metals and organic components, which the user inhales during use. The Curtis group is currently working to measure heavy metals and organic compounds in E-cigarette aerosol in order to better understand the mechanism by which these potential toxins are produced during E-cigarette use and their potential impact on human health.

Projects available for URE20:

1. Measurements of air pollution during fireworks. Fireworks cause localized air pollution that may impact the communities surrounding areas where displays take place. This project will attempt to measure suspended particulate matter in the atmosphere during firework events. Particles will be measured using newly developed low-cost sensors located indoors and outdoors to better understand how outdoor fireworks affect indoor air quality. Particles generated from fireworks are known to contain heavy metals, such as barium, magnesium, and copper. Particles will be collected and analyzed in the laboratory to determine heavy metal concentrations.

2. The use of electronic cigarettes is increasing rapidly, but the potential health impacts of e-cigarettes are poorly understood. E-cigarette particles are known to contain potentially harmful compounds, such as heavy metals and aldehydes (formaldehyde and acetaldehyde). This project will attempt to measure how different parameters, such as the power applied to the e-cigarette, affect the concentrations of metals and aldehydes in the aerosol plume breathed in by users.

Desired preparation for this lab: At least completion of the second semester of general chemistry by the beginning of summer 2020.

15. Allyson Fry-Petit

Research Interests: Research interests are in solid state inorganic chemistry, focused on the rational design of new materials through the use of data mining, synthesis, structural characterization and optical and vibrational probes.

Projects Available for URE20: Solid materials make up all of the technologically important items we use every day, such as cell phone batteries, computers, and medical equipment. However, finding a new solid that will be useful has for hundreds of years been driven by serendipity. The Fry-Petit lab is working at the interface of machine learning and solid state synthesis to rationally design new materials that will improve the quality of life for humans. Students working with us will focus on database creation and management so that they can perform machine learning algorithms towards the identification of materials. Students will be integrated into the synthetic portion of the lab if they are interested in learning how new solids are made.

Desired preparation for this lab: Interest in biochemistry and/or chemistry.

16. Michael Groves

Research interests: We work to understand how chemical reactions take place on surfaces and develop the tools necessary to quickly and accurately predict them. Our current projects include understanding the role of molecular handedness over metal alloy surfaces as well as hydrogen peroxide synthesis over modified graphene structures. We are also using machine learning algorithms to develop automated, and intelligent global optimization search protocols for organic systems which are designed to increase the performance of the search for thermodynamically favorable structures. We intend to use them to search for novel modified graphene surfaces.

Project Available for URE20: Transitioning away from fossil fuels will be one of the major challenges facing humanity in the 21st century. For fuel cell operation, discovering a portfolio of fuels is important so that these devices can operate in a diverse set of applications. Recent work in my lab has shown that molecular handedness, or chirality, plays a role in the power density of a molecule. This URE20 project would focus on computationally modeling the properties of chiral fuels over metal alloys to discover the relationships necessary to predict what properties are important for efficient operation of fuel cells. This project also involves working in tandem with experimentalist who will verify predicted properties.

Desired preparation for this lab: I will teach the students all the computer programming they need to work effectively in the lab.

17. Maria Linder

Research interests: Mammalian copper and iron metabolism, focusing on the structure, function and regulation of proteins associated with these elements. Current emphasis is on copper transport within the blood plasma (particularly a new small copper carrier we have discovered), mechanism of uptake by cells, and excretion of copper via the bile and urine, in conditions of copper overload (which naturally occurs in dogs) as well as in pregnancy and with estrogen intake/exposure. With iron we are studying the mechanism by which iron stored in a large protein, ferritin, is made available to cells and organs when needed. Studies use a broad variety of approaches from cell culture models, mutated mice and rats and tracer radioisotopes, to isolation, sequencing and characterization of proteins, as well as manipulation of mRNA/protein expression.

Project Available for URE20: Determining the identity and structure of small copper carriers in the blood plasma of humans and animals.

Desired preparation for this lab: Interest in biochemistry and/or chemistry.

18. Marcos Ortega

Research interests: The Ortega lab is a biochemistry lab that focuses on viral assembly and replication. We week to study how proteins interact with each, and with viral DNA, to assemble a mature virus. The Ortega lab uses structural, kinetic, and biophysical studies.

Projects Available for URE20:

1. Large terminase expression, purification, and characterization.
In this project, students will express and purify a viral enzyme involved in viral replication. The protein will be screened for crystal formation and sent to a collaborator for further structural studies.

2. Small terminase expression, purification, and characterization.
In this project, students will express and purify a viral protein involved in binding viral DNA to initiate assembly. The protein will be used in structural studies and in DNA binding studies.

Desired preparation for this lab: Students should have completed general chemistry before entering the lab.

19. Stevan Pecic

Research interests: One of our research interests and assignments are focused on design, synthesis and evaluation of novel classes of acetylcholinesterase (AChE) inhibitors and their evaluation as potential therapeutics for Alzheimer's disease (AD). AD is a debilitating neurodegenerative disorder in the elderly and according to the data from European Prevention of Alzheimer's Dementia, AD affects more than 40 million people worldwide and its prevalence is expected to double over the next 20 years. Moreover, AD is currently the fourth leading cause of death in people over 65 years old in the world, which makes it one of the major health, social, and economic concern of the society worldwide. One approach for AD treatment involves drugs that inhibit the activity of enzyme AChE- the main enzyme that metabolizes the neurotransmitter acetylcholine Through traditional medicinal chemistry techniques, including *in silico* drug design, organic synthesis, structure-activity relationship (SAR) studies and *in vitro* biological evaluations, our goal is directed toward elucidation of the pharmacology and biochemistry of neurotransmitters and pathophysiology of AD. Read more at www.PecicLab.com

Projects Available for URE20: Our main research interests are focused on the identification of novel inhibitors of enzymes involved in lipid metabolism and their evaluation as potential therapeutics. In our second project, we are aiming to develop DNA aptamer-based fluorescent biosensors for the detection of various antibiotics using a biochemistry method called SELEX.

Desired preparation for this lab: Interest in biochemistry and/or chemistry.

20. Andrew Petit

Research interests: The Petit lab uses computational chemistry to answer fundamental questions about the mechanisms through which chemical reactions take place as well as photochemistry (i.e. what happens after molecules absorb light and become excited).

Projects Available for URE20:

1. Using Computational Chemistry to Discover Greener Routes to New Medicines. Many drugs contain complicated rings containing atoms other than carbon and hydrogen. In collaboration with Dr. de Lijser's research lab at CSUF, we are using computational chemistry to discover an approach to making these structures using light instead of other, less environmentally friendly, methods. This project will involve using computational chemistry to determine how changing the structure of the reactant affects its ability to undergo the reaction.

2. Photobases: Using Light to Transform a Weak Base Into a Strong Base A series of recent studies performed in the Dawlaty lab at USC have explored the properties of a small family of photobases – molecules that are normally weak bases but become strong bases after absorbing light and becoming electronically excited. We are using computational chemistry to greatly expand the family of known photobases and make predictions about how adding different functional groups affect their properties. Such compunds have potential applications as light-activated catalysts.

Desired preparation for this lab: This project will be a good fit for students who are planning to major in chemistry, biochemistry, or physics. It would be good if the student has completed either general chemistry or introductory physics. Experience with organic chemistry would be useful but not necessary. Experience with calculus and/or coding are helpful but not required.

21. Nicholas Salzameda

Research interests: We are involved in two areas of research: the synthesis of novel peptide catalysts for asymmetric carbon-carbon bond forming reactions and the discovery of biologically active molecules for disruption of protein-protein interactions, focusing on targets related to human health. Both of these research objectives are centered on solid phase reaction methodology.

Desired preparation for this lab: Students must have completed General Chemistry I and General Chemistry II.

Geological Sciences

22. Nicole Bonuso

Research interests: Invertebrate paleontology with an emphasis on the paleoecology of marine communities; combining field based research with laboratory work, including multivariate statistics, to explore the paleoecological variation of biotas at different temporal and spatial scales.

Desired preparation for this lab: No additional preparation required.

23. Joe Carlin

Research interests: Dr. Carlin's research is focused on coastal and shallow marine sedimentology over the recent geologic past (last ~3,000 years to the past several decades). The research primarily utilizes sediment cores to better understand the processes that have shaped coastal and marine environments over these times, and to better understand the connectivity between terrestrial (land) and ocean processes that come together at the coast and in the shallow ocean. By understanding how sediment deposits and coastal landforms have changed in the recent past, we can have a better sense of what to expect in the future as climate change, sea level rise, and human populations increasingly impact our oceans and coasts.

Projects Available for URE20:

1: This project will analyze sediment cores collected from offshore Monterey Bay California to investigate how the supply of sediment form the land to the ocean has changed throughout time. The project offers the opportunity to assess environmental changes on land in the ocean over a variety of time scales including the recent past (last ~ 150 years) and recent geologic past (~ 3,000 years).

2: This project will determine how an urban estuary (Tijuana River Estuary, CA) has evolved over the past 100 years under the influence of humans.

3. This project will look at suspense sediment fluxes within a coastal wetland to assess the vulnerability of a wetland to sea level rise. For wetlands to keep pace with sea level rise, sediment delivery must be sufficient to offset the increased water lever from rising sea level

Desired preparation for this lab: No additional preparation required.

24. Matthew Kirby

Research interests: Late Quaternary paleoclimatology with a specific focus on the late-glacial/Holocene transition and the present Holocene Epoch. Lacustrine-based multi-proxy, multi-disciplinary research that incorporates historical records of climate change as a calibration tool for assessing past climate states.

Projects Available for URE20: Are you interested in the Environment? Climate Change? Ecological Change? Come work with Professor Kirby. He studies the geological history of California's past climate (floods, drought, fire) and ecosystems. To do this, he and his students examine long tubes of mud taken from lakes. Within this mud is a variety of materials such as charcoal, sand, and shells. Working with Kirby, help to reconstruct a history of floods, droughts, fire, and/or ecosystem changes for California. If you are interested in climate, the environment, and/or ecosystems, you will like this summer experience.

Desired preparation for this lab: No additional preparation required.