Entry Number: 1 GL
A NEW HONEY BEE THREAT- THE PARASITIZING PHORID FLY *APOCEPHALUS BOREALIS*
By: Andrew Core
Ecology and Systematics
Faculty Advisor: Dr. John Hafernik
Abstract: Colony Collapse Disorder (CCD), a syndrome characterized by loss of hives and the behavior of hive abandonment, threatens honey bees (*Apis mellifera*) in the United States and Europe. So far, the main causal suspects have been fungal parasites, viral diseases and interactions amongst them. While viral and microsporidian infections have been linked to increased mortality and declining health in CCD colonies, studies have not directly addressed behavioral changes involved in abandonment of hives. Here we report that *Apocephalus borealis*, a phorid fly native to North America, previously known to attack bumble bees and paper wasps, has begun to attack the non-native honey bee. Notably, this fly has a profound effect on parasitized bees, leading them to abandon their hives at night. Through DNA barcoding, we confirm that phorids that attack honey bees in the San Francisco Bay Area are the same as those attacking bumble bees. We sample honey bee hives throughout the Bay Area, and demonstrate that the majority of hives yield honey bees parasitized by phorids. We investigate diseases co-occurring with *A. borealis* using a comprehensive honey bee disease microarray chip. Bees parasitized by *A. borealis* carry other diseases, some linked to CCD. Adult flies and larvae also test positive for pathogens that have been implicated in colony collapse. Understanding causes of the hive abandonment behavior we document could explain symptoms associated with CCD. Further, knowledge of this parasite could help prevent its spread into regions of the world where naïve hosts may be easily susceptible to attack.

Entry Number: 3 GL
INVESTIGATING THE EXPERIENCES OF GRADUATE WOMEN OF COLOR IN BIOLOGY
By: Carol Umanzor
Cell and Molecular Biology
Faculty Advisor: Dr. Kimberly Tanner
Abstract: Women of color are significantly underrepresented within the science community (NSF 2006). This study aimed to examine whether the presence of other women of color in biology was influential in the experiences of female biology graduate students of color, currently enrolled in a Master's program. These women reported the following: 1) constantly having to prove their authenticity as a scientist and at times having to face possible rejection from their personal communities, 2) being motivated and inspired by the presence of people of color in biology, 3) thriving in an environment where they felt cared about and, 4) feeling motivated to utilize their skills in science to give back to the community. These findings suggest graduate women of color in biology reconcile tensions between personal and science identities through caring mentors, the presence of other people of color in biology and through giving back to the community.

Entry Number: 4 GL

IS A DEADLY DISEASE CAUSING THE DECLINE OF ANOTHER AMPHIBIAN IN THE SIERRA NEVADA?

By: Celeste Dodge
Ecology and Systematics
Faculty Advisor: Dr. Vance Vredenburg

Abstract: Presented here is a preliminary examination of the historical prevalence of the amphibian Chytrid fungus, Batrachochytrium dendrobatidis (Bd) in preserved museum specimens of the Yosemite toad (Anaxyrus canorus). This work is an ongoing part of a master's thesis project designed to quantify the effects the fungal pathogen, Bd on the threatened Yosemite toad. Expected beneficial impacts of this research include enabling the more effective conservation management of a declining amphibian. The use of previously unemployed qPCR techniques allows for the testing of many individuals without the destructive and time consuming rigors histological examination. Skin swabs were collected from 196 museum specimens (dated 1950-2005) and were tested for the presence of Bd with recently validated methods. As compared to histological examination, researchers have reported zero false positives and few false negatives with the use of Prepman DNA extraction and qPCR for Bd-detection in specimens of Batrachoseps attenuatus. When grouped by decade, the detected prevalence of Bd in Yosemite toads ranged from 0% (pre 1960) up to 82% in the 1990's, and again dropped off after the year 2000. The results appear consistent with an SIR disease epidemic model but further sampling is needed, particularly for animals collected in the 1980's (n=5). Further sampling may provide strong evidence that Bd has played a significant role in the decline of the Yosemite toad over recent decades, and that a Bd epidemic occurred during the time observed die off events in the 1970's.

Entry Number: 5 GL

COLLETOTRICHUM CAUSES GREEN ISLAND FORMATION IN WHITE *PHALAENOPSIS* PETALS

By: Issam Jadrane and Mikhail Kornievsky
Cell & Molecular Biology and Botany
Faculty Advisor: Dr. Zheng-Hui He

Abstract: The term green island is used to describe and area of living, green tissue surrounding a site of infection by an endophagous pathogen where senescence is retarded and photosynthetic activity is maintained. Green islands can form as responses to fungal pathogens and infestation by certain insects most likely through a bacterial vector (1). It is believed that the pathogen hijacks host cells to re-allocate nutrients for its own use. It has also been suggested that the phytohormone, cytokinin, is likely the causative agent in green island formation in plant tissue (2). The cytokinin can be produced by either the host or the pathogen indicating that green island formation may be pathogen-mediated or hostmediated. White Phalaenopsis flowers growing at the SFSU greenhouse exhibited infection sites on their non-photosynthetic petals, a phenomenon that had not been documented before. Areas of dead plant and fungal tissue are surrounded by a green halo. We show that the green areas are made of functional chloroplast-containing photosynthetic cells. Morphological and microscopic analysis of surface sterilized samples harvested from infection sites suggest that the infections were caused by a fungus of the genus Colletotrichum. Furthermore our analysis suggest that this type of

interaction is species or genus specific as fungus of the genus Botrytis failed to have a similar effect on the Phalaenopsis petals. We hypothesize that the green island formation is a host defense mechanism that aims at containing the spread of the fungal infection and promoting fast sporulation in order to minimize the effects of the infection. Our on-going research aims to determine the molecular and physiological mechanism of the green island formation.

References:
(1) Kaiser et al., (2010) Plant Green-island Phenotype Induced by Leaf-miners Is Mediated by Bacterial Endosymbionts. Proc Biol Sci. 277: 2311-2319.
(2) Walters et al., (2008) "Are Green Islands Red Herrings? Significance of Green Islands in Plant Interactions with Pathogens and Pests." Biol Rev Camb Philos Soc. 83:79-102.

Entry Number: 6 GL

INVESTIGATING ELEMENTARY SCHOOL STUDENTS' PERCEPTIONS ABOUT THE BENEFITS OF INTERACTING WITH SCIENTISTS IN THEIR CLASSROOMS

By: Lakisha Witzel
Conservation Biology
Faculty Advisor: Dr. Kimberly Tanner

Abstract: Elementary-aged students from a large urban school district participated in videotaped interviews investigating their perceived benefits of having scientists in their classrooms. Grounded theory methodology guided the design of this study, which took place in three phases. First, students were recruited from a population of 4th and 5th grade students whose teachers had partnered with scientists from a local university to co-plan and co-teach four science lessons. Next, qualitative data was collected in the form of semi-structured videotaped interviews with individual students. Finally, post-hoc quantitative analysis was performed on interview data to identify emergent themes. Emerging as four major findings, students reported: valuing the hands-on learning opportunities provided by scientists and the materials they bring, changing their ideas of what a scientist is like, a positive view of science and scientists that doesn't translate to career goals, and the scientist's expertise as a benefit of having scientists in the classroom.

Entry Number: 7 GL

RETROSPECTIVE SURVEY OF AN AMPHIBIAN PATHOGEN IN THE SIERRA NEVADA

By: Sam McNally
Conservation Biology
Faculty Advisor: Dr. Vance Vredenburg

Abstract: Amphibians are facing a global biodiversity crisis, with at least 32% of all species listed as globally threatened, and over 40% showing population declines. A single pathogen, the amphibian chytrid fungus (Batrachochytrium dendrobatidis; hereafter "Bd"), is widely suspected of causing many of these declines. In California's Sierra Nevada mountain range, two amphibian species (Rana muscosa and R. sierrae) have suffered immense population declines and extirpations over the past 100 years, despite living in remote and often protected habitats. Many populations have recently suffered catastrophic die-offs associated with Bd, while other populations persist with

low infection intensity. The factors determining persistence versus extirpation are as yet undetermined, yet one hypothesis proposes that persistence is a result of natural selection following previous, undetected die-offs. If true, this may suggest a time frame for the evolution of resistance in the wild. However, detailed information on the spatiotemporal spread of Bd to test this hypothesis is lacking. Using nondestructive tissue sampling of museum specimens and a quantitative PCR assay, I will reconstruct the historic occurrence and spread of Bd in the Sierra Nevada amphibian community in order to better evaluate hypotheses concerning the evolution of resistance, and the potential role of Bd in historic mass mortality events. This poster describes preliminary data, methods, and scope of project.

Entry Number: 8 GL

COINCIDENT MASS EXTIRPATION OF NEOTROPICAL AMPHIBIANS WITH THE EMERGENCE OF THE FUNGAL PATHOGEN, *BATRACHOCHYTRIUM DENDROBATIDIS*

By: Tina Cheng
Ecology and Systematics
Faculty Advisor: Dr. Vance Vredenburg

Abstract: Amphibians highlight the global biodiversity crisis because ~40% of all amphibian species are currently in decline. Species have disappeared even in protected habitats (e.g., the enigmatic extinction of the golden toad, Bufo periglenes, from Costa Rica). The emergence of a fungal pathogen, Batrachochytrium dendrobatidis (Bd), has been implicated in a number of declines that have occurred in the last decade, but few studies have been able to test retroactively whether Bd emergence was linked to earlier declines and extinctions. We describe a noninvasive PCR sampling technique that detects Bd in formalin-preserved museum specimens. We detected Bd by PCR in 83–90% (n = 38) of samples that were identified as positive by histology. We examined specimens collected before, during, and after major amphibian decline events at established study sites in southern Mexico, Guatemala, and Costa Rica. A pattern of Bd emergence coincident with decline at these localities is revealed—the absence of Bd over multiple years at all localities followed by the concurrent emergence of Bd in various species at each locality during a period of population decline. The geographical and chronological emergence of Bd at these localities also indicates a southbound spread from southern Mexico in the early 1970s to western Guatemala in the 1980s/1990s and to Monteverde, Costa Rica by 1987. We find evidence of a historical "Bd epidemic wave" that began in Mexico and subsequently spread to Central America. We describe a unique technique that can be used to screen museum specimens from other amphibian decline sites around the world.

Entry Number: 9 GL
SEASONAL FLUCTUATIONS IN PHYTOPLANKTON COMMUNITIES AND NUTRIENT LEVELS WITHIN A LOW INFLOW ESTUARY (DRAKES ESTERO MARINE CONSERVATION AREA, CA)
By: Christina Buck
Marine Biology
Faculty Advisor: Dr. Frances Wilkerson
Abstract: Drakes Estero Marine Conservation Area, Point Reyes National Seashore, CA is the only designated marine coastal wilderness on the west coast of the United States. The shallow low-inflow estuary is surrounded by wilderness and cattle farms, and is the site of an oyster aquaculture facility where Harmful Algal Bloom (HAB) species have been observed. How nutrient enrichment from coastal upwelling and anthropogenic nutrient loading impact the estuarine ecosystem is unknown. A study was initiated in May 2010 to measure seasonal and spatial variations in concentrations of nutrients and chlorophyll, enumerate phytoplankton species, and obtain rates of primary production and nutrient uptake. The interplay between physics and variation in the supply of different forms of nitrogen, both from natural and anthropogenic sources, are hypothesized to lead to seasonal shifts in primary production and dominant phytoplankton species, including HAB dinoflagellates. This study will be of use to water resource managers by providing a mechanistic look at the consequences of different nitrogen sources on the phytoplankton community and ecology of Drakes Estero.

Entry Number: 10 GL
EFFECTS OF OCEAN ACIDIFICATION ON THE PHYSIOLOGY OF PORCELAIN CRAB PETROLISTHES CINCTIPES EARLY LIFE STAGES
By: Hayley A. Carter
Marine Biology
Faculty Advisor: Dr. Jonathon Stillman
Abstract: An increase in anthropogenic emission of CO2 into the atmosphere since the Industrial Revolution is predicted to reduce surface ocean pH up to 0.4 units by 2100. Very little is known regarding the physiological effects of ocean acidification on crustaceans, including that of porcelain crab species Petrolisthes cinctipes. As adult intertidal organisms, they experience diurnal and seasonal fluctuations in pH. However, planktonic larval stages live in relatively stable open ocean waters and may be particularly vulnerable to CO2-induced decreases in pH. Here we propose to examine the effects of ocean acidification on metabolism, growth and energy storage in porcelain crab early life stages. Detriment to early stage P. cinctipes may decrease larval recruitment and greatly impact intertidal community structure.

Entry Number: 11 GL
PHYSIOLOGICAL RESPONSES TO OCEAN ACIDIFICATION IN MULTIPLE STRAINS OF EMILIANIA HUXLEYI
By: Kristine Okimura
Marine Biology
Faculty Advisor: Dr. Ed Carpenter
Abstract:

Entry Number: 12 GL
DEVELOPMENTAL EFFECTS OF OCEAN ACIDIFICATION PORCELAIN CRAB OF THE GENUS *PETROLISTHES*
By: Lina Ceballos-Osuna
Marine Biology
Faculty Advisor: Dr. Jonathon Stillman
Abstract: The energetic cost of responding to reduced pH during an already costly period such as development may be manifested in delayed growth. Very little is known about the impacts of ocean acidification in decapod crustaceans, therefore we are investigating the effects of increased pCO2 on early stages of porcelain crab growth. Preliminary results suggest that elevated pCO2 may suppress growth of porcelain crab larvae and therefore they may spend more time as planktonic organisms leaving them susceptible to predation and potentially reducing settlement. Juveniles, another vulnerable developmental stage, showed significant mortality when exposed to a constant high pCO2 condition. A better understanding of the effects of ocean acidification on different stages of *Petrolisthes*' life cycle would allow us to make predictions about consequences on the intertidal community.

Entry Number: 13 GL
THE ROLE OF GABA AS AN INHIBITORY NEUROTRANSMITTER DURING ECDYSIS IN *MANDUCA SEXTA*
By: Roth Ea, Laura Mendoza, Adrian Chase, Abhishek Seth and Dr. Megumi Fuse
Behavioral Biology and Physiology
Faculty Advisor: Dr. Megumi Fuse
Abstract: The neuromodulation of stereotyped behavior relies on the interactions of neuropeptides within a series of neural pathways. When these neural pathways in the tobacco hornworm, *Manduca sexta*, are activated by a variety of hormones, the animal undergoes a process of ecdysis, or the shedding of the outer cuticle. There appears, however, to be a latency between cell activation and onset of the behaviors, since removal of the subesophageal ganglion (SEG) by ligation *in vivo*, or by transection *in vitro*, results in an earlier onset of ecdysis behaviors. Thus, timing of onset appears to be regulated by inhibitory inputs, but the nature of the inhibitor is unknown. In this study, we used *in vivo* and *in vitro* methods to assess the role of GABA as such an inhibitor. We tested whether GABA could (i) rescue the loss of inhibitory inputs after removal of the SEG by ligation/transection, and (ii) delay normal timing of ecdysis in intact animals/preparations. *In vivo*, we timed onset of ecdysis visually after GABA injections +/- ligations. *In vitro*, we measured fictive ecdysis motor patterns by extracellular electrophysiology after GABA application +/- transections. We found that in comparison to control groups with intact CNS, removal of the SEG resulted in early onset of ecdysis, while injection/application of GABA restored normal timing of ecdysis to control levels. In contrast, while application of GABA to intact *in vitro* preparations significantly delayed the onset of the fictive ecdysis motor patterns, no significant delay was noted *in vivo*. These data support the role of GABA as a classic inhibitory neurotransmitter regulating timing of onset of ecdysis, but suggest that rapid turnover of the injected

product in the hemolymph makes *in vitro* models stronger for further studies. These results thus add to the complexity of the current model of ecdysis regulation.

Entry Number: 14 GL
EFFECT OF DIURON AND IMAZAPYR HERBICIDES ON PHYTOPLANKTON IN THE SAN FRANCISCO ESTUARY
By: Sarah Blaser
Marine Biology
Faculty Advisor: Dr. Frances Wilkerson
Abstract: The San Francisco Estuary (SFE) is classified as a low chlorophyll-a estuary despite relatively high inorganic nutrient concentrations and one contributing factor for the low chlorophyll-a may be herbicides that enter the estuary through runoff. Diuron is an herbicide of concern in the northern San Francisco Estuary because it is heavily used and is persistent in the environment. Another herbicide in use is imazapyr, which is currently being applied to lands immediately adjacent to the SFE to manage invasive plant species. Despite the known use of these herbicides in the SFE, little is known about the potential impact of diuron and imazapyr on phytoplankton communities. For this study, a series of experiments were conducted to empirically determine the impact of increasing concentrations of diuron and imazapyr on primary production and phytoplankton community composition of natural phytoplankton assemblages collected in the SFE. Results show that primary production was reduced with diuron concentrations as low as 1 µg L-1; this concentration falls within the range of diuron concentrations that have been previously reported for the northern SFE and Delta. Imazapyr took longer to take effect (48 hrs), and reduced productivity at an order of magnitude higher (~15 mg L-1). With higher diuron concentrations (5µg L-1) diatoms declined while flagellate numbers increased.

Entry Number: 15 GL
ESTABLISHING THE PRESENCE OF A CIRCADIAN RHYTHM REGULATING ECDYSIS BEHAVIORS IN *CARAUSIUS MOROSUS*, THE STICK INSECT
By: Tracy Wadsworth
Behavioral Biology and Physiology
Faculty Advisor: Dr. Megumi Fuse
Abstract: Circadian rhythms are involved in behavior modifications of an organism to allow for behavioral processes to occur during the least vulnerable and most beneficial times of the day (Harmer et al., 2001). The goal of this study was to determine whether there was a circadian rhythm regulating the onset of ecdysis in the stick insect, Carausius morosus. It was hypothesized that there was, and it would occur just prior to early dawn (lights on). A population of 15 stick insects, 2 weeks after hatching, were marked with white-out and placed in their own labeled jars within a controlled environment, influenced only by a 17h light:7h dark photoperiod and its reversed light regime. A hands-free video system was used to record the precise timing of ecdysis behaviors as characterized by the shedding of the white out marked cuticle since prior research had suggested that mechanical stimulation such as handling might impact onset of ecdysis. Current data showed the majority of insects ecdysed just before lights on for all photoperiods tested. An all-dark regimen should help verify that light is the influential

zeitgeber. Establishing the presence of a circadian rhythm regulating ecdysis in the stick insect will allow for identification of vulnerable times to be targeted for eco-friendly pesticides as well as to facilitate further understanding of behavioral processes that are conserved within insects with different life histories.

Entry Number: 16 GL
IS THERE A SYNERGISTIC EFFECT OF THERMAL AND OSMOTIC STRESS ON METABOLIC PERFORMANCE IN FRESHWATER ZOOPLANKTON?
By: Xi Chen
Marine Biology
Faculty Advisor: Dr. Jonathon Stillman
Abstract: Human diversion of freshwater runoff and changes in weather resulting from climate change can both result in elevated variations of temperature and salinity in upper estuarine ecosystems, where freshwater habitats meet brackish waters. We investigated the synergistic effect of temperature and salinity variation on metabolic performance in freshwater zooplankton, D. pulex. Daphnia were exposed to 9 different conditions of daily fluctuations in temperature (15, 15-25, 15-30°C) and salinity (0, 0-2, 0-5ppt). Metabolic rates and developmental timing of 5 replicate isofemale lines of Daphnia were measured and recorded at the 1st, 5th and 6th generations. After 5 generations at each of those 9 conditions, newborns of the 6th generation were cultivated in either each of the 9 experimental conditions, or at the control condition (15°C, 0ppt). No statistically significant differences in metabolic rates in Daphnia were found among all treatments at the 1st generations. However, Daphnia exposed to the treatments of higher temperatures and higher salinities showed significantly slower metabolic rates at both the 5th and the 6th generations. Metabolic suppression was maintained in Daphnia reared at the control condition after 6 generations. Exposure to lower temperature may slow growth due to Q10 effects, whereas exposure to higher temperatures may slow growth due to energetic tradeoffs with stress responses.

Entry Number: 17 GL
HISTONE ACETYLATION PROFILE CHANGES IN IFN-BETA PROMOTER REGION DUE TO A
By: Anithah Pillai
Cell and Molecular Biology
Faculty Advisor: Dr. Steve Weinstein
Abstract:

Entry Number: 18 GL
CHARACTERIZATION OF GENOME INSTABILITY IN *CDC24* MUTANTS IN *S. POMBE*
By: Anna Marie Tuazon
Cell and Molecular Biology
Faculty Advisor: Dr. Sally Pasion
Abstract: Genomic instability is the hallmark of many genetic disease and cancers, as it is can result in unfaithful replication and an accumulation of mutations. A gene responsible for faithful replication and maintaining a stable genome in the fission yeast

Schizosaccharomyces pombe is cdc24+. Though it is apparent that cdc24 mutants arrest in S phase and with broken chromosomes, the mechanism of the genetic instability is unknown. Using yeast genetics, we will examine whether the conserved endonuclease and known tumor suppressor, Mus81, is the protein responsible for chromosome breakage in these mutants. Viability and growth assays will be performed to characterize the mus81cdc24 phenotype. Pulsed field gels and DAPI staining will identify whether chromosome breakage occurs in these double mutants. If the lack of Mus81 in cdc24 mutants yields intact chromosomes, suggesting Mus81's role in genome instability, further analysis of double mutants with other replication-dependent genes will be conducted to further characterize the mechanism of chromosome breakage found in S. pombe. It is important to understand if Mus81 is the endonuclease involved in DNA breakage in cdc24 mutant cells because, by understanding the mechanism involved, we can better understand causes of DNA instability found in other more complex eukaryotes.

Entry Number: 19 GL
RNAI SCREEN FOR MITOTIC SPINDLE MATRIX COMPONENTS
By: Arthur Chase
Cell and Molecular Biology
Faculty Advisor: Dr. Blake Riggs
Abstract: During cell division, cellular components dramatically rearrange; the nuclear envelope breaks down and the microtubule network reorganizes into a bipolar spindle. In order to explain the rapid formation of the mitotic spindle, a scaffolding factor termed the mitotic spindle matrix has been proposed, however, the components involved have remained elusive. Recently, several nuclear membrane components have been implicated as putative spindle matrix factors. In order to identify additional spindle matrix components, I will use a targeted RNA interference (RNAi) screen of nuclear envelope proteins. I will knock down the expression of the 90 known nuclear envelope proteins in Drosophila melanogaster S2R+ cells. I will examine them for mitotic spindle defects by using immunofluorescence analysis of microtubules and measuring mitotic index. Positives from this screen will be examined in combination with treatment of colchicine, a microtubule-depolymerizing agent. After colchicine treatment, mitotic spindle matrix factors should retain function upstream of the microtubule network and should show no changes in mitotic index. I will repeat the RNAi treatment with colchicine on the positive hits in human HeLa cells to confirm homology in humans. Finding additional components of the mitotic spindle matrix will improve our understanding of the basic underpinnings of the mitotic spindle.

Entry Number: 20 GL
THE SYNERGISTIC EFFECT OF SPINDLE ASSEMBLY CHECKPOINT ACTIVITY AND INHIBITION OF MITOTIC EXIT IN REDUCING MITOTIC SLIPPAGE.
By: Beatriz Alvarado
Cell and Molecular Biology
Faculty Advisor: Dr. Blake Riggs
Abstract: During the treatment of cancer, chemotherapy is an important part of a patient's regimen. Anti-microtubule agents, such as vinca alkaloids and taxanes are anti-mitotic drugs function by activating the Spindle Assembly Checkpoint (SAC) arresting the cell in

mitosis. Unfortunately these types of chemotherapeutic agents are broad acting, less effective and they allow cancer cells to slip out of mitosis before apoptosis can occur. Due to this mitotic slippage, these treatments aren't as effective against more aggressive forms of cancer, including "triple negative" breast cancer. It is now believed that blocking mitotic exit downstream of the SAC is a better strategy for reduction of mitotic slippage. We hypothesize that tumor cells adapt to the inactivation of the SAC, making them more sensitive to reactivation, or prevention of mitotic exit. We aim to show that arresting cells downstream of the SAC by inhibition of the Anaphase Promoting Complex (APC), mitotic slippage will be decreased in Drosophila S2 cells. We will examine the change in rate of mitotic slippage in Drosophila S2 cells by RNAi-mediated inhibition of proteins that function in late mitotic events, focusing on components of the APC. We will also measure the cumulative effects of inactivation of the SAC and mitotic exit inhibition on mitotic progression and apoptosis. Drosophila eye clones, employing the FLP/FRT Recombinase system, will be used to examine mitotic slippage more physically. This will be used to create a functional model for examination of mitotic slippage with over-expression or suppression of certain late mitotic genes and drug addition.

Entry Number: 21 GL
IDENTIFICATION OF A SECRETED OSTEOCLASTOGENIC FACTOR IN IRRADIATED PRE-OSTEOCLAST CELLS
By: Deena Hassanein
Cell and Molecular Biology
Faculty Advisor: Dr. Steve Weinstein
Abstract: The mechanism of bone degradation in response to aging has been the focus of many osteoporosis studies. However, there are other factors that can contribute to bone degradation, including radiation. People exposed to abnormally high levels of radiation, including astronauts and cancer patients undergoing radiation therapy, have an increased risk of osteoporosis. However, the mechanism by which this occurs is unknown. It has been shown *in vitro* that the pre-osteoclast cell line RAW 264.7 secretes osteoclastogenic factors in response to radiation, but the factors have yet to be identified. My goal is two fold— first, determine if primary pre-osteoclasts mimic this event, and second, identify the osteoclast-producing factors. Preliminary results have shown that primary pre-osteoclast cells are able to produce an osteoclast-producing factor in response to radiation. In order to achieve the second goal, I plan to use a cytokine array to measure the concentration of potential factors, and observe if there is a difference in concentration between medium from irradiated cells and non-irradiated cells. The results of the array will then be confirmed by successfully mimicking the effect of radiation by controlling the concentration of the factor added to naïve pre-osteoclast cells. Once the factor is identified, it may allow scientists to elucidate the mechanism by which radiation induced osteoclastogenesis and subsequent bone degradation occurs. If the mechanism is known, more targets may become available for osteoporosis treatment, and this might allow for more specialized therapies that could slow or even stop the progression of this disease.

Entry Number: 22 GL

MYOTOME PIONEERS CELLS (MPS) NOT A FIRST MYOGENIC WAVE IN SOMITES OF CHICKEN EMBRYOS

By: Farzad Ghamsari
Cell and Molecular Biology
Faculty Advisor: Dr. Wilfred Denetclaw

Abstract: Early embryo development is under tight spatial and temporal control due to secreted morphogens and growth factors, which stimulate and/or antagonize cells to undergo proliferation/differentiation changes and that couples rapid embryo growth with tissue formation and morphogenesis. Myogenesis in somites is well studied for early genetic and cellular changes in primitive skeletal muscle formation (or myotome formation) and is understood for the timing of the first myotome expression. Myotome being first made in the 7-8 newly formed somites in embryos with 21-30 somites as revealed by various approaches including desmin and titin immunofluorescence labeling, myoD in situ hybridization probing myotome expression in somites, and by direct somite cell labeling in ovo with membrane fluorescent dyes for use as lineage tracers in myotome formation. In spite of these studies, myotome pioneer cells (MPs) in somites have been declared to be the first skeletal muscles and represent a first myogenic wave. MPs are proposed to distribute themselves across the entire medio-lateral dorsal somite and to function to facilitate the growth of a secondary myotome formation wave in somites. These cells are defined by their initial location in the medial region of the 3rd newly made somite in embryos with 21-30 somites and by their post-mitotic state with expression of myoD and desmin protein. However, support for the existence of MPs leading to myotome formation is controversial but recent papers continue to report its role in embryo myogenesis. We have undertaken an investigation of MPs in somites based on desmin antibody labeling with confocal microscopy and high-resolution imaging. Our findings show the first expression of desmin by immunofluorescence labeling in somites 7-9 in embryos with 25 to 32 somites. This disagrees with a presence of MPs in somites where desmin expression was reported in somite 3 in embryos of similar ages. We conclude that MPs are not a first wave of myogenic cells in somites and that their existence is unlikely based on this work and the work of an extensive early literature on early myotome formation in chicken embryos that spans over a century.
NSF-IOS-0821324.

Entry Number: 23 GL

ANALYSIS OF THE ROLE OF WNTLESS IN FORMATION OF THE WNT GRADIENT IN THE CHICK NEURAL TUBE

By: Linda Szabo and Lydia Li
Cell and Molecular Biology
Faculty Advisor: Dr. Laura Burrus

Abstract: Wnt1 and Wnt3a are secreted morphogens expressed in the dorsal midline of the developing neural tube. A dorsal-to-ventral b-catenin-dependent Wnt activity gradient is critical for proper growth and patterning in the developing central nervous system. This gradient is well-characterized in the chick, but mechanisms controlling its formation remain unclear. The expression of Wntless (Wls), a conserved transmembrane protein required for Wnt secretion, is varied temporally and spatially in the developing chick neural tube. Wls is thought to transport Wnt to the cell surface where the retromer

complex then recycles it to the trans-Golgi network. Wls is a transcriptional target of Wnt, so a positive feedback loop between Wnt and Wls has been proposed. Interestingly, Wls is found outside the cell in the Drosophila neuromuscular junction and is sequestered by mu-opioid receptors in the presence of opioid agonists, suggesting a complicated mechanism by which Wls controls Wnt secretion. Cumulatively, these data led us to hypothesize that Wls is an important regulator of Wnt gradient formation in the developing neural tube. We first show that chick Wls enhances the activity of Wnt1 and Wnt3a in a TopFlash assay. We then use in ovo electroporations to overexpress Wls in the neural tube. Surprisingly, changes in proliferation and dorsal interneuron patterning suggest that Wls overexpression inhibits Wnt1 and Wnt3a in this context. Further experiments *in vivo* and *in vitro* indicate that the effect of Wls on Wnt activity is concentration-dependent. Cumulatively, these data support the idea that the concentration of Wls can provide an additional level of regulation for Wnt signaling.

Entry Number: 24 GL
DEVELOPING A REAL-TIME TAQMAN PCR ASSAY TO DETECT VIOLACEIN FROM *JANTHINOBACTERIUM LIVIDUM*
By: Stephanie Hyland and Lilia Torres
Cell and Molecular Biology
Faculty Advisor: Dr. Vance Vredenburg
Abstract: Amphibians worldwide are facing major declines, over 1/3 of all known species are threatened with extinction. Various factors are involved such as pollution, loss of habitat and chemical contaminants. Recent studies have shown that a deadly fungus, Batrachochytrium dendrobatidis (Bd), which causes the disease chytridiomycosis, plays a key role in amphibian declines. This disease has affected over 200 species, driving many to extinction. However, not all species of amphibians are susceptible. For example in the Sierra Nevada mountains of California, the Pacific chorus frog (Pseudacris regilla) remains abundant despite the rapid collapse of overlapping mountain yellow-legged frog (Rana sierrae). To test susceptibility in the lab, 11 juvenile Pacific chorus frogs were infected and monitored over a 10 week period. The infection levels were tested weekly using a real-time PCR assay for Bd. Six frogs became lightly infected with Bd, but after 8 weeks (the length of time susceptible species succumb to Bd) all frogs survived. To increase transmission the frogs were housed together for three months. Infection levels significantly increased in 2 frogs causing 1 to die. These results suggest that the Pacific chorus frog is only susceptible to Bd when Bd transmission is high. Symbiotic bacteria, known to protect some species, may be allowing the Pacific chorus frog to survive. I propose to follow up this study by creating a real-time PCR assay for a known bacteria that protects some species of amphibians from Bd.

Entry Number: 25 GL
ULTRASTRUCTURE OF THERMOPHILIC ARCHAEON NITROSOCALDUS YELLOWSTONII
By: Emily Tung
Microbiology
Faculty Advisor: Dr. José de la Torre

Abstract: This study examines the ultrastructure of an AOA, Nitrosocaldus yellowstonii, isolated from a Yellowstone National Park hot spring. Based on our findings N. yellowstonii appears to be coccoid-shaped with a 20 nm thick S-layer. In addition to TEM micrographs, whole cell negative staining of our cultures revealed approximately 14 nm thick filaments, suggesting the possibility of flagella or filamentous archaeal viruses.-

Entry Number: 26 GL
EVOLUTION AT THE ORIGIN: COMPARATIVE GENOMICS OF THE ARCHAEA
By: Hope M. Gray and Robert M. Theis
Microbiology & Computer Science
Faculty Advisor: Dr. Jose R. de la Torre
Abstract: Archaea form the third domain of life, a unique group of microorganisms whose roots in the evolutionary tree reach back almost to the origins of life. Although famous for thriving in extreme conditions, archaea inhabit diverse ecosystems that include many 'ordinary' environments. In 2008, a new archaeal phylum was proposed, the Thaumarchaeota, which is composed largely of mesophilic organisms found in marine and soil systems. The exception is Nitrosocaldus yellowstonii HL72, a thermophile from a terrestrial hot spring which is cultivated and studied only in the de la Torre lab. We have sequenced the genome of N. yellowstonii and used a comparative genomics approach to explore the evolutionary relationships of all proposed phyla and the deepest branching archaea. Phylogenetic analyses of core information-processing genes demonstrate that Thaumarchaeota is monophyletic and that N. yellowstonii is a basal member of this lineage. Thaumarchaeota have gene sets for essential functions, such as DNA management and cell division, that distinguish them from other archaeal clades. The chromatin architecture proteins encoded in the Thaumarchaeota are distinct from that of the most closely related phylum, Crenarchaeota. All Thaumarchaeota contain multiple topoisomerase genes for DNA winding, including a gene for topo IB, which absent in other archaea but found in eukaryotes. All Thaumarchaeota share a unique set of cell division genes, while other proposed phyla, Korarchaeota and Nanoarchaeota, resemble the well-established clade Euryarchaeota. The Aigarchaeota, a phylum proposed just a few months ago, appear most related to Thaumarchaeota. Our analysis of Nitrosocaldus yellowstonii shows that Thaumarchaeota is a diverse, well-supported natural group that branches deeply within the domain Archaea, and hints that a cell with a complex genome emerged soon after the origin of life and became the ancestor of all Archaea.

Entry Number: 27 GL
MICRORNAS, MIR-302 AND MIR-372, PROMOTE HUMAN FIBROBLAST REPROGRAMMING INTO INDUCED PLURIPOTENT STEM CELLS THROUGH MULTIPLE PATHWAY.
By: Jason Liu
Cell and Molecular Biology
Faculty Advisor: Dr. Carmen Domingo
Abstract: Previously, a family of microRNAs highly expressed in mouse embryonic stem cells, have been shown to contribute to their shortened cell cycle. These microRNAs

were subsequently shown to enhance reprogramming efforts when differentiating mouse fibroblasts into induced pluripotent stem cells. Here, we demonstrate that human orthologs, miR-302b, and miR-372, can also enhance efforts to reprogram human fibroblasts. Our findings show that not only do they shorten the G1 phase of the cell cycle, but enhance the kinetics in which cells undergo a transition from a mesenchymal cell like state, to an epithelial cell like state reminiscent of embryonic stem cells. Realizing the significant differences in cell cycle structure and cell morphology between a differentiated fibroblast and a pluripotent stem cell, we suggest a mechanism to explain why these microRNAs can have such profound effects in reprogramming. We propose that microRNAs act on multiple targets synergistically to influence cell fate decisions.

Entry Number: 28 GL
CELL THERAPY AS A NOVEL MYOPIA TREATMENT: DETERMINING A DIRECTED DIFFERENTIATION MECHANISM OF ADULT LIMBAL STEM CELLS TO BECOME FUNCTIONAL SCLERAL FIBROBLASTS.
By: Lidia Tekie
Cell and Molecular Biology
Faculty Advisor: Dr. Carmen Domingo
Abstract: Myopia, commonly known as nearsightedness, is a leading cause of registered blindness throughout the world. Degenerative Myopia is a catalyst to other debilitating ocular diseases such as age related macular degeneration and glaucoma. Current myopia treatments include prescription eyeglasses and lasik surgery. Despite their popularity, these current treatments only fix blurred vision. The patient still has an abnormally extended eye that can lead to retinal detachment and blindness. The issue of elongation of the eye due to scleral connective tissue loss has not been addressed. In the field of regenerative medicine, stem cells have been used to repair damaged tissue. Multipotent stem cells produce cells of a particular lineage or closely related family. Limbal stem cells (LSC) are adult multipotent stem cells that are found in the eye and have been shown to differentiate to a variety of cell types in the eye. Here, I purpose that limbal stem cells can be isolated, cultured, and directed to differentiate into functional scleral fibroblasts *in vitro* to replace lost sclera tissue in degenerative myopia patients. I expect that multipotent limbal stem cells will be induced to differentiate into scleral fibroblast cells using the growth factors fibroblast growth factor 2 (FGF2) and transforming growth factor beta 1 (TGF-β1). These functional scleral fibroblasts derived from LSC will be transplanted into myopic guinea pigs and halt elongation of the eye. This study will be a significant contribution in facilitating the development of transplantation therapies for ocular diseases and advance cell-based therapy for myopia and other ocular diseases towards clinical use.

Entry Number: 29 GL
SUPPRESSION ASSAY DEVELOPMENT: TREG'S ROLE IN SUPPRESSING ANTI-DONOR T CELLS PROLIFERATION IN LIVER TRANSPLANT PATIENTS
By: Mariela Pauli
Cell and Molecular Biology
Faculty Advisor: Dr. Frank Bayliss

Abstract: Most liver transplant patients must take anti-rejection drugs for their rest of their lives so they don't reject their organ. However, continuous anti-rejection drugs expose patients to diseases and cancer. Currently, the only way to test for transplant tolerance is by exposing the patient to a rejection episode. Regulatory T cells (Tregs) are a type of T cells that play a role in maintaining self tolerance by preventing activation of the immune response. Tregs have been shown to induce transplant tolerance. We will use Tregs as a biomarker to predict transplant tolerance so patients can stop using anti-rejection drugs safely. We have developed a Suppression Assay that measures the suppression of anti-donor T cells due to Tregs in the presence of donor antigens. Once the assay is developed we will compare Treg function from tolerant and non-tolerant transplant patients. We will compare their Treg suppression slope to determine the biomarker.

Entry Number: 30 GL
MANUFACTURING DONOR-SPECIFIC REGULATORY T CELLS
By: Michelle Wray
Microbiology
Faculty Advisor: Dr. Qizhi Tang (UCSF Dept of Surgery) and Dr. Frank Bayliss
Abstract: Regulatory T cells (Tregs) are critical in maintaining peripheral tolerance and modulating immune responses. Thus, Tregs are a promising target for immunotherapy approaches in autoimmunity, organ transplantation, and graft-vs-host disease. Therapeutic application of antigen-specific Tregs in mouse models of organ transplantation leads to the establishment of transplant tolerance and freedom from chronic/global immunosuppression. Translating this preclinical success into a clinical setting requires the ability to generate clinical grade donor antigen-specific Tregs. Previous studies in the laboratory has established the feasibility of this approach and this current study focuses on adapting the research protocol to a GMP-compliant protocol by addressing the following three issues: 1) replace the rodent feeder cells currently used to stimulate donor B cells with GMP-compliant K562 cells; 2) establish standard operating procedures that ensure consistent recovery of 1x10^9 donor-specific Tregs; 3) establish quality assurance assays and clinical release criteria for the expanded Tregs. The immediate goal at the conclusion of this study is to apply for an Investigational New Drug approval from the FDA for the use of *ex vivo* expanded autologous donor-specific Tregs in liver transplant patients. Such protocols could have potential use in the fields of autoimmunity, graft-vs.-host disease, alloimmunity, in addition to solid organ transplantation.

Entry Number: 31 GL
MULTI-ORGAN SEGMENTATION WITH MISSING ORGANS; ATLAS-GUIDED APPROACH
By: Miyuki Suzuki
Computer Science
Faculty Advisor: Dr. Kazunori Okada
Abstract: Multi-organ segmentation is a technique to extract organs in CT/MRI images to highlight the region of interest to help doctors for easier and clearer diagnosis. Current technique of multi-organ segmentation is suffered from abnormal images due to

surgically removed organs(missing organs) or diseased organs. Such abnormality in images make high errorneous segmentation result. However, there is no wonder that many clinical images contain such missing organs and especially those images need further analysis. Therefore, segmentation application can not disregard the failure of missing organs. This project points out the failure, introduces the missing organ detection and induces the framework for improvements of the segmentation result.

Entry Number: 32 GL
IN SILICO PREDICTION OF ENZYMATIC ACTIVITY OF THREONINE PROTEASE VARIANTS.
By: Trevor Gokey
CCLS
Faculty Advisor: Dr. Anton Guliaev
Abstract: Serine proteases, including trypsin, play an important role in the regulation of most biological processes. Malfunctions in this class of enzyme lead to a variety of diseases and thus serine proteases are an important target in medicinal chemistry. Replacing the catalytic serine with threonine leads to a loss of catalytic activity which can be restored by removing the C42–C58 disulfide bridge turning trypsin into an active threonine protease (S195T). Biochemical experiments showed that selective mutations at the enzyme's active site altered the activity of the S195T variant. Here we provided structural rational for different enzymatic activities of the three S195T variants, and predicted the activity of a fourth variant. We determined that the key component to the activity of the protease was the conformation of the hydroxyl group of threonine. The conformational features of the S195 residue were monitored during 110 ns of explicit solvent Molecular Dynamics (MD) simulation. Using a post-processing technique based on implicit solvation energy calculations, it was found that the electrostatic energy was most indicative of conformational preference. This work provided excellent agreement between computational and biochemical data and demonstrates how MD simulations can be used to predict enzymatic activity.

Entry Number: 33 GL
DEVELOPING A CRYOGENIC MCD METHOD TO STUDY THE SHORT-LIVED INTERMEDIATES IN HEME MONOOXYGENASES
By: Diego Baptista
Biochemistry
Faculty Advisor: Dr. Raymond Esquerra
Abstract: Isolating the short-lived intermediates in enzymatic reactions can provide a significant amount of insight to the intramolecular electron transfer of these systems. This could be an invaluable resource in helping provide the structural details for fast-acting protein dynamics and eventually open up several avenues to study these systems in greater detail. Our research group is developing a method for cryogenic magnetic circular dichroism for heme-containing monooxygenases. By pairing this spectroscopic technique with the photo-release of oxygen from the compound (μ-peroxo)(μ-hydroxo)bis-[bis(bipyridyl)cobalt(III)] nitrate we will be able to control the initiation of these reactions and then remove enough thermal energy to watch the reactions proceed at an observable rate. Preliminary results have been obtained using a heme-protein analogue

for our system--myoglobin. Once the method has been developed our first goal is to prove or refute the existence of Compound I--also known as the Iron(IV)oxo intermediate--that is generally thought to be the reactive intermediate in the reaction catalyzed by Nitric Oxide Synthase.

Entry Number: 34 GL
COFACTOR RECYCLING IN CATABOLIC METABOLISM OF STYRENE IN *PSEUDOMONAS PUTIDA* S12
By: Eliot Morrison
Biochemistry
Faculty Advisor: Dr. George Gassner
Abstract: Styrene, a simple alkylbenzene classified as a "potential human carcinogen" by the EPA, is highly toxic to most organisms. However, a strain of Pseudomonas putida is able utilize styrene as its sole source of carbon through a three-step catabolic metabolic pathway. This metabolism involves three important enzymes; this research focuses on the first enzyme in the pathway, styrene monooxygenase (SMO), which oxidizes styrene to styrene oxide by epoxidation with molecular oxygen. This two-component monooxygenase is comprised of a NADH-specific reductase (SMOB) and a FAD-specific epoxidase (SMOA.) This poster reports on the nature of flavin and pyridine nucleotide binding to SMOB, as well as the mechanism of hydride transfer and formation of a charge-transfer complex with reduced SMOB and NADH. In addition, preliminary evidence of reduced-flavin transfer from SMOB to SMOA will be presented.

Entry Number: 35 GL
PARTIAL ACTIVITY RESTORATION OF AN ENGINEERED THREONINE TRYPSIN BY SUBSTITUTION OF A CONSERVED DISULFIDE BRIDGE
By: Mie A. Lansang
Biochemistry
Faculty Advisor: Dr. Teaster Baird
Abstract: The Cys42-Cys58 disulfide bridge of an engineered threonine trypsin was substituted with combinations of alanine, valine and serine residues to accommodate the side chain of Thr195 in the active site. While the single trypsin variant, S195T, had no observable hydrolytic activity, all the variants regained moderate activity; C42V/C58VS195T (VVT-Tn) variant was the most active. Surprisingly, VVT-Tn and wild type trypsin maintained >90% of activity after incubation at 50 °c for 50min. suggesting the both species are similarly stable and demonstrated the maintenance of functional integrity. While C42A/C58V/S195T (AVT-Tn) and C42V/C58A/S195T(VAT-Tn) variants had the same hydrophobicity index, AVT-Tn had 100-fold less activity than the VAT-Tn suggesting that geometric factors are more significant than hydrophobicity. Interestingly, C42S/C58A/S195T (SAT-Tn) and C42S/C58V/S195T(SVT-Tn) had similar activity even though they had different hydrophobicity and geometry.

Entry Number: 36 GL
THE EFFECT OF MAGNESIUM ON NITRIC OXIDE SYNTHASE ACTIVITY
By: Pooncharas Tipgunlakant, Daniel Asarnow, Diego Baptista, Gregory Alan Ho, Christopher Bernt, and Michael Samuel Minton

Biochemistry
Faculty Advisor: Dr. Raymond Esquerra
Abstract: Neuronal nitric oxide synthase (nNOS) is a calcium (Ca2+)/calmodulin (CaM) dependent enzyme that generates nitric oxide from the amino acid arginine. Nitric oxide (NO) is responsible for numerous physiologically significant processes, including vasodilatation, angiogenesis, neuronal signaling, and cytotoxic immune response. This thesis examines how the binding of the divalent cation magnesium (Mg2+) affects nNOS activity. Although Mg2+ also plays many significant roles physiologically, its relationship to nNOS function has not been previously examined. We show that Mg2+ can induce significant activity in nNOS in the present low concentration of Ca2+ but it is able to reduce the activity in nNOS at high concentration of Ca2+. This implies that Mg2+ and Ca2+ levels may play an important physiological role in regulating nNOS activity. The effect of Mg2+ on the activity of nNOS is observed using a microplate spectrophotometric assay starting with low concentration to high concentration of Ca2+ (25 μM to 10mM) nNOS and titrating increasing amounts of Mg2+. The inducing conformational changes of CaM and nNOS by Ca2+ and Mg2+ is determined using circular dichroism spectroscopy and nanosecond time – resolved absorption spectroscopy (nTRAS), repectively. This result may correlate the neuroprotective effect and vasospasm antagonistic effects, typically associated with nitric oxide production, observed for Mg2+ and help in the design of drugs that target NO production.

Entry Number: 37 GL
PREPARATION AND BIOCHEMICAL CHARACTERIZATION OF MUTANTS OF STYRENE MONOOXYGENASE FROM *PSEUDOMONAS PUTIDA* S12
By: Priyanka Chandrasekaran
Biochemistry
Faculty Advisor: Dr. George Gassner
Abstract: Styrene monooxygenase (SMO) is a two-component flavoenzyme composed of a 20 Kda NADH-dependent flavin reductase (SMOB), and a 46 Kda FAD-dependent epoxidase (SMOA). In turnover, SMOA binds reduced FAD and catalyzes the stereo-selective epoxidation of styrene to yield pure S-styrene oxide. The crystal structure of N-terminally histidine-tagged SMOA (NSMOA) was recently solved and we have identified the valine side chains at positions 211 and 303 as having key roles in defining the volume of the styrene-binding pocket. In the present work, we have prepared recombinant systems for the expression of NSMOA, in which alanine or isoleucine has been substituted for valine at positions 211 and 303. These mutants are expected to tune the active site to favor the binding of substrate analogs that differ from styrene in the functionalization of either aromatic ring or vinyl side chain. V303A mutant of NSMOA is expressed in E.coli BL21(DE3), purified by Ni-affinity chromatography to a concentration of 11 μM and characterized by SDS PAGE. Stopped flow fluorescence and absorbance spectroscopic studies of the reaction of styrene and oxygen with chemically reduced V303A NSMOA, demonstrated the formation of the highly fluorescent hydroxyflavin intermediate. This suggests that V303A NSMOA follows a reaction mechanism similar to that of the wild type.

Entry Number: 38 GL
BIOCHEMICAL CHARACTERIZATION OF AN N-TERMINALLY HISTIDINE TAGGED STYRENE OXIDE ISOMERASE FROM *PSEUDOMONAS PUTIDA* S12
By: Sindy Liao
Biochemistry
Faculty Advisor: Dr. George Gassner
Abstract: In the styrene catabolic and detoxification pathway, styrene is transformed to styrene oxide, a biochemical alkylating agent and carcinogen. In *Pseudomonas putida* (S12), Styrene Oxide Isomerase (SOI) performs the critical role of catalyzing the isomerization of styrene oxide to a less toxic intermediate, phenylacetaldehyde. The detailed kinetic mechanism of SOI is a subject of current investigation. Conditions have been identified that allow an N-terminally histidine-tagged version of Styrene Oxide Isomerase (NSOI) to be over-expressed and partially purified by Ni2+-affinity chromatography in a catalytically active form for biochemical characterization. An enzyme-coupled assay with phenylacetaldehyde dehydrogenase was developed to indirectly monitor the activity of NSOI and kinetically characterize the enzyme by using a microplate reader. In this way, the steady- state kinetic parameters were determined at pH 8 and 25°C to be Vmax (2.3±0.3) μM/min and KM=(2.6±1.1) μM in the reaction of NSOI with native substrate (S)-styrene oxide. In the reaction of NSOI with (R)-styrene oxide, Vmax=(3.2±0.2) μM/min and KM=(1.2±0.4) μM. Interactions of NSOI and styrene oxide with the other proteins in the styrene degradation pathway were investigated by kinetic assay and isothermal titration calorimetry.

Entry Number: 39 GL
INVESTIGATION OF RAT ANIONIC TRYPSIN'S CATALYSIS BY MUTATION OF PHENYLALANINE 41 TO ISOLEUCINE AND VALINE
By: Zahira Begum
Biochemistry
Faculty Advisor: Dr. Teaster Baird
Abstract: In order to evaluate how Phe41 of trypsin affects the enzyme activity, the residue has been substituted with isoleucine(F41I-Tn) and valine(F41V-Tn). Mature F41I-Tn has been successfully expressed and purified using hydrophobic interaction chromatography. Initial active-site titration and kinetics did not show any activity. Zymogen forms of both variants were also activated and tested for catalysis via active-site titration. Surprisingly, variants derived from the zymogens exhibited activity. The catalytic triad is not altered in these variants therefore the activity is not expected to be significantly different from wild-type. The variants will be tested for hydrolytic activity and sensitivity to inhibition using commercial substrates and inhibitors.

Entry Number: 40 GL
A STUDY OF THE REACTION MECHANISM OF ARSENIC (III) WITH ZEROVALENT IRON
By: Abdul Azeez
Chemistry
Faculty Advisor: Dr. Bruce Manning

Abstract: The removal of arsenic from groundwater and well water are repeatedly challenging due to high presence of contaminants like arsenite and arsenate and low natural iron concentrations. The remediation of zerovalent iron is promising; this study was carried out using zerovalent iron. This study investigated adsorption by zerovalent iron and subsequent oxidation of arsenite to arsenate and the formation of iron oxide. Arsenite As(III) was oxidized in parallel to reduction of corroded zerovalent iron to produce Fe(II)/Fe(III) in solution and solid iron oxide like magnetite. The flame atomic absorbance spectrometry (FAAS) technique revealed the amount of As(III) uptake in mg/g changes as the As(III) concentration increases, the amount of As(III) uptake reaches a maximum at 7.02 mg/g. The X-ray diffraction (XRD) pattern from corroded iron revealed iron oxide magnetite (Fe_3O_4) at 2θ values of 30, 35, 43, 53, 57, and 62.5 degrees. Zero amount of As(III) concentration in the batch experiment gave higher XRD intensities and which indicated evidence of more crystal structure of iron oxide (Fe_3O_4) than the sample that contained higher amount of As(III) concentration. The four strong peaks at 44, 64.5, 82, and 99 degrees 2θ on each of the three powdered XRD pattern revealed zerovalent iron Fe0 peaks. These results suggested that corroded iron produce more magnetite than arsenic reacted with zerovalent iron

Entry Number: 41 GL

HIGH-THROUGHPUT SCREENING AND QUANTITATION OF PESTICIDE RESIDUES ON FOOD COMMODITIES BY DART ORBITRAP MASS SPECTROMETRY

By: Adam Leung
Chemistry
Faculty Advisor: Dr. Pete Palmer

Abstract: Numerous studies have demonstrated reliable, selective, and sensitive determination of large numbers of different pesticides in a single GC/MS or LC/MS analysis. However, such analyses are laborious, time consuming, and rarely completed before the commodity reaches the market. FDA's Forensic Chemistry Center (FCC) developed a new DART-Orbitrap MS method for rapid screening of pesticides on the surface of fruits and vegetables. This method can be used to screen for hundreds of pesticides and other toxic compounds with minimal sample preparation, accurate mass measurement with relative errors on the order of 1 ppm or less, and turnaround times on the order of minutes. The focus of this study was to evaluate the quantitative capabilities of this method and assess figures of merit such as detection limits, accuracy, precision, and linearity. Data were acquired by spiking pesticides onto the surface of various commodities such as grapes and apples and swabbing with a piece of foam wetted with a mixture of solvents to remove pesticides from the surface. Use of an internal standard significantly improved the quantitative performance of this method, giving much better precision and linearity. Calibration curves were linear from sub-ng to 200 ng levels, with typical R^2 values greater than 0.99. Typical LODs were in the 0.3 to 3 ng range, depending on the type of pesticide, its volatility, ionization efficiency, and food commodities. Precision was estimated to be on the order of 5-10% from the analysis of replicate samples. Accuracy was assessed through spikes of known amounts of pesticides onto the surface of grapes and gave recoveries in the 80-120% range. However, similar spikes onto the surface of apples gave lower recoveries, most likely due to the sampling

process in which the swab "smeared" the pesticides over the much larger surface area of this commodity. Nevertheless, this approach may be useful in providing semi-quantitative results on well characterized commodities. This method will not only be useful for detecting the presence of banned pesticides such as DDT on a commodity, but based on these results can provide quantitative results that can be used to monitor for the presence of a pesticides at levels above EPA-specified tolerances.

Entry Number: 42 GL
SYNTHESIS AND EVALUATION OF UREARETICS: A NOVEL CLASS OF UREA-TRANSPORT TARGETING DIURETIC AGENTS
By: Jicheng Zhang
Chemistry
Faculty Advisor: Dr. Marc Anderson
Abstract: Functional studies in knockout mice show a crucial role for urea transporters in renal urea clearance and urinary concentrating mechanism. Lack of urea transporters in vasa recta and red blood cells reduces urea-induced improvement of urinary concentrating ability. Recycling of urea within the renal medulla greatly promotes the urine concentrating ability of the kidney. Urea transporter inhibitors are a new class of diuretics that can increase renal water and solute clearance in water-retaining states. However, we do not have potent and specific urea transport inhibitors. Dr. Alan S Verkman group screened a collection of 50,000 diverse and drug-like compounds to identify high-affinity, small molecule inhibitors of the urea transporter inhibitors. ～30 urea transporter inhibitors were discovered through the primary screening. ～700 structurally similar analogs were screened to identify more active compounds. One of the most potent lead compounds has IC50 value of 50 nM. However, it is not metabolically stable in the liver microsomes. The compound is oxidized and excreted by our kidney very promptly. Here, we are trying to synthesize not only potent but also metabolically stable UT-B inhibitors based on the synthesis and metabolism abilities. We have two building blocks, aryl sulfone and thiophene ester, for the basic synthesis approach. After cycloaddition with these two building blocks, the final products can be synthesized by amine dehydrative coupling reaction. The aryl sulfone and the amines are varied to optimize potency and metabolically stability. The compounds are then screened for *in vitro* and *in vivo* potency, as well as metabolic stability in the laboratory of our collaborator, Prof. Alan Verkman at (UCSF).

Entry Number: 43 GL
A NEW BAFILOMYCIN WITH HDAC INHIBITORY ACTIVITY FROM A MARINE-DERIVED *STREPTOMYCES* SP.
By: Jing Xiao
Chemistry
Faculty Advisor: Dr. Taro Amagata
Abstract: A primary goal of our research is exploring histone deacetylase (HDAC) inhibitors potential leads from marine obligate actinomycetes separated from marine sediments, algae and sponges. Bioassay-guided isolation is employed in the search of novel bioactive secondary metabolites. A combination of a yeast assay and cutting edge dereplication techniques is applied to identify active crude extract. After the bioactivity

of the secondary metabolites has been identified, we use large scale cell culture and elucidate structures by concise methods, including gradient 2D NMR techniques.

Entry Number: 44 GL
ORGANIC SYNTHESIS OF IGF-1R INHIBITOR ANALOGS FOR BREAST CANCER THERAPY
By: Juri Fukuda
Chemistry
Faculty Advisor: Dr. Marc Anderson
Abstract: The insulin-like growth factor 1 receptor (1GF-1R) system is an attractive target for the development of new anti-cancer drugs. The signaling pathway triggered by this system leads to a crucial mechanism of cell growth and survival. IGF-1 is one of two ligands (IGF1, IGF2) that the IGF-1R system employs, and the receptor IGF-1R is a member of the tyrosine kinase (RTK) super-family. Activation of the pathway by binding of the growth factor IGF-1 to the receptor IGF-1R triggers a complex signaling cascade that stimulates cell growth, proliferation and differentiation that are necessary for cells in the state of homeostasis. However, the IGF-1R cascade system also causes malignant transformation, mitogenic growth and anti-apoptotic activity once undesirable cell mutations occur. In general, IGF-1R is over-expressed in cancerous cells promoting the proliferation of malignant cells. Development of kinase inhibitors in this class has been receiving considerable attention given its important role in tumor biology including breast cancers, prostate cancers, and gastrointestinal tract malignancies. In this poster, we will show our lead inhibitor PQ-401 and its structural modification.

Entry Number: 45 GL
SYNTHESIS OF AMINO ACID-SUBSTITUTED TETRAPHENYLPORPHYRINS FOR THE USE IN PHOTODYNAMIC THERAPY OF CANCER
By: Lisa van Diggelen
Biochemistry
Faculty Advisor: Dr. Ursula Simonis
Abstract: To pursue the hypothesis that mitochondria-localizing porphyrins are better photosensitizers (PSs) for photodynamic therapy (PDT) of cancers, we synthesized and characterized amino acid-substituted tetraphenylporphyrins with properties, which promise to increase their photosensitizing efficacy and provide a sustainable addition to mainstream cancer therapies. Compound synthesis and yield were optimized using trifluoroacetic acid as catalyst. To determine efficacy, the PSs were incubated in androgen-sensitive human prostate adenocarcinoma LNCaP cells. Cell studies revealed that amino acid-substituted porphyrins that are positively charged in the slightly acidic medium of cancer cells allow for increased localization to mitochondria and lysosomes. Preliminary evidence suggests that these compounds are promising photosensitizers due to their increased amphiphilicity, acidic properties, and ability to provoke apoptotic cell death. These PSs reassure our attempts toward rational drug design and a sustainable cancer treatment due to their low-cost production, minimal need of additional resources, and convenient administration due to their water solubility.

Entry Number: 46 GP

" DEBUGGER" - THE MULTIPLATFORM EDUCATIONAL GAME
By: Manori Thakur (Student id- 909914127, email-manori@mail.sfsu.edu, graduate level), Gary Ng(email id-garyng02@gmail.com)
Computer Science
Faculty Advisor: Dr. Ilmi Yoon
Abstract:

Entry Number: 47 GP
EFFICIENT FINITE DIFFERENCE-BASED SOUND SYNTHESIS USING GPUS
By: Marc Sosnick
Computer Science
Faculty Advisor: Dr. William Hsu
Abstract: Finite Difference (FD) methods can be the basis for physics-based music instrument models that generate realistic audio output. However, such methods are compute-intensive; large simulations cannot run in real time on current CPUs. Many current systems now include powerful Graphics Processing Units (GPUs), which are a good fit for FD methods. Based on our previous work, we have implemented a real-time FD-based sound synthesis package, demonstrating the feasibility of constructing a realistic software percussion instrument

Entry Number: 48 GP
ANDROID DEBUGGER GAME WITH FEATURES LIKE TREASURE HUNT, WEAPONS AND AMMUNITION AND FRIEND'S LOCATION TRACKER
By: Nandeesh Channabasappa Rajashekar, Ian Umemoto, and Hunvil Rodrigues
Computer Science
Faculty Advisor: Dr. Ilmi Yoon
Abstract: The android debugger application game provides the user with a very good experience of "Learn while you play" technique. It keeps the user at the tip of his/her toes, answering Object Oriented Programming questions which are timed. Upon failing to answer, the bugs would kill the user and end the game. Although it provides a good gaming experience, the debugger lacked some features which would have made the game extremely interesting. Imagine having to play this game as a team as opposed to playing alone. Think of the fun the user would have, if the user had the weapons and ammunition to kill the bugs. Imagine having a bonus level of treasure hunt in the real world to get extra points. We also have an advantage to track the location of our friends in real time. All the features have been incorporated in the components that have been developed by us which takes the gaming experience to the next level with multiplayer features, weapons and ammunition, treasure hunt and friend's location tracker.

Entry Number: 49 GP
WICE — AN EXTENSIBLE WEB INTERFACE FOR SCIENTIFIC COMPUTATION CHAINS
By: Teague Sterling and Cassidy Kelly
Computer Science
Faculty Advisor: Dr. Ilmi Yoon

Abstract: The Web-based Interactive Computation Environment (WICE) is a simple, customizable, web-based system for executing programs within a scientific computation chain. Typically these tools are used in an ad-hoc manner on remote servers via the Linux command line. While this provides a high level of control, it can be daunting to both researchers and students. The steep learning curve can hinder research as users struggle with an unfamiliar interface. WICE allows a single knowledgeable user to outline the workflow for a particular series of computations, enabling them to be used by others. The outline is automatically translated into a web interface for setting up jobs, allowing distribution of resource-intensive processes over multiple servers, progressing through the computation chain, visualizing results, and organizing/sharing files between users. This interface serves as a simple, familiar means to run complex scientific applications, allowing users to focus on their intended research without requiring familiarity with largely technical and unrelated details.

Entry Number: 50 GP
FEATURE 2.0 - A SOFTWARE COLLABORATION BETWEEN STANFORD AND SFSU
By: Teague Sterling and Trevor Blackstone
Computer Science
Faculty Advisor: Dr. Dragutin Petkovic, Mike Wong, Dr. Russ Altman (Stanford), Grace Tang (Stanford)
Abstract: FEATURE is a computational system for modeling proteins for the purpose of functional site discovery. This is accomplished by calculating and comparing sets of 3D structural and physicochemical properties present within specific microenvironments. Originally produced by numerous researchers over many years by Stanford's Helix Group, the code eventually became unwieldy and hard to maintain. FEATURE 2.0 represents a major improvement over previous versions. A collaboration between SimBIOS and San Francisco State University's Department of Computer Science, the development of FEATURE 2.0 utilized industry-proven software engineering techniques to produce a robust, professional software product. In addition to numerous other improvements, this release increased biological accuracy, ensured numerical correctness across all supported operating systems and hardware configurations, improved performance and reduced resource usage, provided an easy-to-use installation system, and reorganized the code base to facilitate future improvements. The release was extensively tested for usability and accuracy and is now publicly available under the LGPL licence from https://simtk.org/home/feature.

Entry Number: 51 GP
AUTOMATIC LESSON PLANNER
By: Tingting Sun
Computer Science
Faculty Advisor: Dr. Kazunori Okada
Abstract: The topic of this project is Automatic Lesson Planner for Department of Special Education. It's an online teaching system designed to assist teachers and students in Department of Special Education perform teaching activities. The design involves web application technologies and data mining technologies, and the goal is to enhance the

current teaching system via performing evidence-based study and direct the users to identify a sound evidence-based teaching strategy automatically.

Entry Number: 52 GP
ANONYMOUS COMMUNICATION IN MOBILE AD HOC NETWORKS
By: Avissa Tehrani
Embedded Electrical & Computer Engineering
Faculty Advisor: Dr. Hamid Shahnasser
Abstract:

Entry Number: 53 GP
DESIGN AND OPTIMIZATION OF MEMS IMPLANTABLE PASSIVE SENSOR FOR BIOMEDICAL APPLICATIONS
By: Di Lan
Electrical Engineering
Faculty Advisor: Dr. Hao Jiang
Abstract: A wireless batteryless implantable pressure sensor that can be used deeply inside human body is highly desired by the biomedical applications. With the development of microelectronics and MEMS (micro electrical-mechanical systems) technology, semiconductor based implantable sensors are becoming viable tools in modern medicine. In my research, a miniaturized biocompatible wireless pressure sensor that consists of a MEMS *LC* resonator and an external orthogonal-coil radio-frequency probe has been successfully demonstrated.

Entry Number: 54 GP
A HIGH-POWER VERSATILE WIRELESS POWER TRANSFER FOR BIOMEDICAL IMPLANT
By: Jimmy Zhang
Electrical Engineering
Faculty Advisor: Dr. Hao Jiang
Abstract:

Entry Number: 55 GP
RELIABILITY ENHANCEMENT OF POWER GATING TRANSISTOR UNDER TIME DEPENDANT DIELECTRIC BREAKDOWN
By: Xu Zhou
Electrical Engineering
Faculty Advisor: Dr. Hamid Mahmoodi
Abstract: As the technology shrinks to nano-scale, CMOS transistors pose more challenges to circuit design. One of the reliability challenges is time dependant dielectric breakdown. Power gating is an effective method for leakage power reduction. However the power gating transistor has the highest change of dielectric breakdown. We propose a breakdown detection and repair method to enhance the reliability of power gating in nano-scale by optimally introducing sleep transistor redundancy. We also propose a modeling and optimization framework to optimize the trade-off between area overhead and overall breakdown probability. The results of implementation in a predictive 32nm

technology shows that with an area constraint of 2% overhead for a benchmark circuit, the failure probability is reduced to 7.5e-18 and with the constraint of 1e-6 failure probability, the area overhead is 1.3% of the area of the benchmark circuit.

Entry Number: 56 GP
DOMAINS OF BEST APPROXIMATION
By: Alex Broley
Analysis Mathematics
Faculty Advisor: Dr. Yitwah Cheung
Abstract: The domain of best approximation defines a region of real valued points which have as a fixed rational point v as best approximation. The size and shape of the region is determined by v and the choice of norm. In this study we primarily work with the Euclidean norm in the plane of real numbers. It is currently known that the domain of approximation for a fixed v is contained in a ball of radius 2r centered at v, where r is an invariant which depends only on v. We show that under the Euclidean norm we can shrink the radius of the ball from 2r to 2r/sqrt(3). We then give an example showing that this new bound is sharp, in the sense that 2r/sqrt(3) is the smallest constant which still gives containment of the domain of approximation of v.

Entry Number: 57 GP
ON CARMICHAEL NUMBERS WITH THREE DISTINCT PRIME FACTORS
By: James Phillips
Mathematics
Faculty Advisor: Dr. Neville Robbins
Abstract: A Carmichael number is a composite number, n, such that b^{n-1} = 1 (mod n) for all integers b such that gcd(b,n)=1. A Carmichael number may also be called an absolute pseudoprime. Such numbers are of interest in computational number theory. It has been known since 1994 that there exist infinitely many Carmichael numbers. However, little has been established concerning Carmichael numbers with a fixed or limited number of distinct prime factors. Let a Carmichael number with exactly k prime factors be called a k-Carmichael number. A recent conjecture of Granville and Pomerance implies the existence of infinitely many k-Carmichael numbers for each k > 2. We are able to prove that (i) of the 78497 odd primes below 10^6, all but 543 of them are the least prime factor of a 3-Carmichael number; (ii) 53 of these exceptional primes are the second or third prime factor of a 3-Carmichael number, or the least prime factor of a 4-Carmichael number. Thus all but possibly 490 of the primes below 10^6 occur as factors of Carmichael numbers.

Entry Number: 58 GP
ANALYZING TNPI SITE-SPECIFIC RECOMBINATION AT HYBRID SITES USING THE TANGLE METHOD
By: Katrina Wono
Mathematics
Faculty Advisor: Dr. Maria Elena Vazquez
Abstract: The tangle method is a mathematical tool developed by Ernst and Sumners to analyze site-speci c recombination reactions (Ernst and Sumners, 1990). In 2002, this

method was mplemented in a computer software called TangleSolve (Saka and Vazquez, 2002). The tangle method has been used for example to describe the topological mechanism of action of the Xer system
from Escherichia coli (Darcy, 2000; Vazquez et al., 2004). The function of Xer recombination is to ensure the stability of plasmid inheritance by keeping multicopy plasmids in a monomeric state. The tangle method has also been used to analyze the TnpI-IRS system of Tn4430, a transposon from Bacillus thuringiensis (Zheng et al., 2007). B. thuringiensis is a bacterium that
produces speci c toxins lethal to a variety of insects species, but harmless to other organisms, thus used in organic farming to protect crops from harmful insects. We apply the tangle method to analyze TnpI recombination at hybrid sites. These sites are formed by interchanging the core sites and the accessory sequences of the TnpI system with those of a di erent system such as Xer. We analyze unpublished experimental data from Bernard Hallet's group (Universit e Catholique de Louvain, Belgium) where they hypothesize that the TnpI-IRS and Xer regulatory elements mediate the formation of topologically equivalent synapses in which three negative DNA supercoils are trapped. We show that the tangle representing these supercoils has three
crossings which is consistent with the hypotheses, and we aim to propose a mechanism of action for the enzyme.

Entry Number: 60 GP
ANALYSIS OF BREAST CANCER DATA USING TOPOLOGICAL AND GEOMETRICAL METHODS.
By: Mousa Rebouh
Mathematics
Faculty Advisor: Dr. Maria Elena Vazquez
Abstract: Here we study copy number variation using topological and geometric method. This provides a way to identify where large segments of DNA are amplified or deleted to advance the process of oncogenesis. We apply our method to CGH profiles of breast cancer patients. We focus our study on comparing data between younger (<40yo) and older patients (>70).

Entry Number: 61 GP
IDENTIFYING AVIAN VOCALIZATIONS THROUGH THE GABOR TRANSFORM
By: Steven Li
Mathematics
Faculty Advisor: Dr. Shidong Li
Abstract: We present a simple and successful algorithm for identifying the species of birds by analyzing their vocalizations using the Gabor transform.

Entry Number: 62 GP
TESTING CHROMOSOME PROXIMITY HYPOTHESIS USING LOG-LINEAR MODELS
By: Tatsiana Maskalevich
Mathematics
Faculty Advisor: Dr. Serkan Hosten

Abstract: Studying chromosome proximity and its effect on chromosome interchange within human interphase nuclei plays an important role in understanding of development of genetic diseases and cancer. The proximity-effect hypothesis states that the num- ber of radiation-induced exchanges is larger between chromosomes that are located close to each other. The validity of the proximity-effect hypothesis is tested on three previously published data tables derived from the experiments in which the 22 human autosomes of human lymphocyte cells have been irradiated in order to create exchanges. We used tools of algebraic statistics, namely, Markov basis of a log-linear model assuming no proximity-effect, to sample from a large space of ta- bles that have the same minimal sufficient statistic as the observed data table. The Markov Chain Monte Carlo approach did not provide sufficient evidence to reject the hypothesis of no proximity-effect. We considered a modified log-linear model where proximity-effect of individual pairs is included as an additional parameter.

Entry Number: 63 GP
COHEN-MACAULAYNESS OF INITIAL IDEALS OF NORMAL TORIC IDEALS
By: Ashley A Shimabuku
Mathematics
Faculty Advisor: Dr. Serkan Hosten
Abstract: In 1972, Hochster proved that all normal toric ideals have the Cohen-Macaulay property. Cohen-Macaulayness is a very nice property for an ideal to have when studying homological properties of the set of solutions to the polynomial equations given by the ideal. Bernd Sturmfels first asked the question whether there exists a term order such that the monomial initial ideal with respect to that term order of a normal toric ideal has the Cohen-Macaulay property. This conjecture has been shown to hold for specific kinds of normal toric ideals. However, the question remains open for the general case. We have conjectured that such a term order exists and it can be found by examining a related polytope. Through computational experiments we have investigated our conjecture further with positive results.

Entry Number: 64 GP
EXTENSION OF THE FROBENIUS COIN PROBLEM
By: Catalina Betancourt
Mathematics
Faculty Advisor: Dr. Matthias Beck
Abstract: The problem we are studying is on the extensions of the Frobenius coin problem. The problem asks: given any number of coins (a1 , a2 , . . . , an) with relatively prime values, what is the largest integer value that cannot be represented by some linear combination of the given coins? A definitive formula for this number, called the Frobenius number, is only known for two coins. Specifically, if the two coins have value a1 and a2 such that gcd(a1 , a2) = 1 then the Frobenius number is x = a1a2− a1 − a2 . We will look at the properties of the Frobenius number for more than two coins.

Entry Number: 65 GP
EVALUATION OF TAME AUTOMORPHISMS
By: Chris Chan

Mathematics
Faculty Advisor: Dr. Joseph Gubeladze
Abstract: Although we have a robust understanding of linear transformations, we have yet to fully develop an analogous theory that applies to non-linear coordinates. This project examines the tame subgroup of the automorphism group of R[x1,...,xn] and extends current results involving fields to arbitrary product of rings.

Entry Number: 66 GP
MARKED POSET POLYTOPES
By: Dido Salazar-Torres
Mathematics
Faculty Advisor: Dr. Federico Ardila and Dr. Thomas Bliem
Abstract: Richard Stanley showed how to associate polytopes to a given POSet. We generalize this idea to define marked posets and marked poset polytopes and use them to understand the relationship between the Gelfand-Tsetlin Patterns and Feigin-Fourier-Littelmann-Vinberg patterns associated to a partition of an integer.

Entry Number: 67 GP
POLYTOPE THEORY: MAPPING THE SQUARE TO THE LINE SEGMENT
By: Jack Love
Polytope Theory
Faculty Advisor: Dr. Joseph Gubeladze
Abstract: I intend to define Polytopes, motivate their study, describe maps between polytopes, show that collections of such maps form polytopes themselves, and flesh out an example: mapping the square to the line segment.

Entry Number: 68 GP
EXTENSION OF GRAPH POLYNOMIALS TO SIGNED GRAPHS
By: Logan Godkin
Mathematics
Faculty Advisor: Dr. Matthias Beck
Abstract: We extend the de definitions and theorems about certain properties of graph polynomials and their ideals to the graph polynomials of
signed graphs.

Entry Number: 69 GP
A NEW TWO-VARIABLE CHROMATIC POLYNOMIAL FOR SIGNED GRAPHS
By: Mela Hardin
Mathematics
Faculty Advisor: Dr. Matthias Beck
Abstract: A signed graph is a graph consisting of an unsigned graph along with a sign function that labels each edge and loop positive or negative. The function that counts the number of colorings of a graph is the chromatic polynomial. We compute this polynomial through the deletion contraction method involving the recursive combination of its sub-graphs. A signed graph has a chromatic polynomial with the same enumerative and

algebraic properties as for unsigned graphs. Signed graphs are useful in modeling social and political situations such as "The enemy of my enemy is my friend."

Entry Number: 70 GP
A NEW TWO VARIABLE CHROMATIC POLYNOMIAL FOR SIGNED GRAPHS
By: Nick Dowdall
Mathematics
Faculty Advisor: Dr. Matthias Beck
Abstract: The chromatic polynomial of graphs has long been studied. A two variable version was recently introduced by Babson and Beck in which the second parameter was a minimal coloring distance between adjacent nodes of the graph. We extend this idea to signed graphs using Ehrhart theory.

Entry Number: 71 GP
POSET SIMPLIFICATION OF RECONFIGURABLE SYSTEMS
By: Tia Baker
mathematics
Faculty Advisor: Dr. Federico Ardila
Abstract: A system that is reconfigurable consists of a set of possible states where coordination of local rules effect global changes in system states. Ghrist and Peterson have shown that any reconfigurable system defines a state complex which can be viewed as a certain type cubical complexes; these cubical complexes can be thought of as a reconfigurable system as well. Ardila has demonstrated that these types of cubical complexes can be simplified to a structure that contains all the necessary information to reconstruct the original complex. In my research I describe an example of one of these systems as explicitly as possible.

Entry Number: 72 GP
ENUMERATION OF GOLOMB RULERS
By: Tu Trung Pham
Mathematics
Faculty Advisor: Dr. Matthias Beck
Abstract: Generally a ruler is marked in equal increments. A 12 inch ruler has 12 markings, each 1 inch apart. We will study a special type of ruler called a Golomb ruler of length d with m measures where the distance between any two markings is unique. This ruler is useful in radio communications and signaling. We want to study Golomb rulers purely from a mathematical perspective. A Golomb ruler of m measures can be represented as a lattice point in the m-dimensional real space $\mathbb{R}^m$, therefore we will study it geometrically as well as combinatorially.

Entry Number: 73 GP
EFFECTS OF CLIMATE VARIABILITY ON RECHARGE IN REGIONAL AQUIFERS OF THE UNITED STATES
By: Amber Jean Kuss
Geosciences
Faculty Advisor: Dr. Jason Gurdak

Abstract: Groundwater responses to climate variability on interannual to multidecadal scales have substantial implications for water-resource sustainability, yet are poorly understood in the United States. This study quantifies the effects of the El Niño Southern Oscillation (ENSO) (2–6 year cycle), the North Atlantic Oscillation (NAO) (3–6 year cycle), the Pacific Decadal Oscillation (PDO) (10–25 year cycle), and the Atlantic Multidecadal Oscillation (AMO) (50–80 year cycle) on precipitation and groundwater levels in the Central Valley aquifer, the Basin and Range aquifer system, and the North Atlantic Coastal Plain aquifer system. Singular spectrum analysis (SSA) and wavelet analysis were used to analyze climate variability effects on hydrologic time series and to estimate recharge rates. In the Central Valley and the Basin and Range, the PDO contributes to the greatest amount of variance (ranging from 13.6–83%) in all hydrologic time series, with moderate lag correlations (ranging from 0.19–0.75). In the North Atlantic Coastal Plain, a 3–7 year cycle contributes to the greatest amount of variance (6.0–51.2%), and could be associated with the ENSO or the NAO. Wavelet analysis also reveals strong coherence with the hydrologic time series at the associated periodicities of the climate cycles. Recharge rates were accurately estimated using a modified lag-based hydrologic time series method. Evidence also suggests variations in the associated cycle and the relative strength of influence across the U.S. These findings support the conclusion that climate variability contributes to fluctuations in available groundwater, and is important to integrate into water resource management.

Entry Number: 74 GP
WAVE DAMPING ACROSS THE LOUISIANA SHELF
By: Anita Engelstad
Oceanography
Faculty Advisor: Dr. Tim Janssen
Abstract: Ocean surface gravity waves are attenuated as they propagate across muddy regions of continental shelves and coastal areas. However, the details of the wave-mud interaction process are not well understood, and thus it is unclear how these effects can best be represented in operational wave and circulation models.
To improve our understanding of the effect of a muddy seafloor on wave dynamics, and to assess our ability to represent these effects in a conventional third-generation wave model, we have analyzed a new data set collected on the muddy Louisiana coast in the spring of 2008. Waves were observed for two months at 32 locations along a 25 km transect between 13- and 2-m water depth for a wide range of wind and wave conditions. Of these sensors, two arrays aligned perpendicular to the coast will be the SWAN wave model is used to hindcast the observational period compare observations and model predictions of significant wave heights, energy flux, and wave spectra.
This research is supported by the Office of Naval Research and a National Security Science and Engineering Faculty Fellowship.

Entry Number: 75 GP
GEOCHRONOLOGY AND ZIRCON GEOCHEMISTRY OF GREATER HIMALAYAN LEUCOGRANITES, NW INDIA
By: Forrest Horton, Willie Hassett, and John Sommerfield
Geosciences

Faculty Advisor: Dr. Mary Leech
Abstract: SHRIMP (sensitive high resolution ion microprobe) and LA-ICP-MS (laser ablation inductively-coupled-plasma-mass-spectrometry) geochronology and zircon geochemistry analyses in NW India constrain magmatism along the Karakoram shear zone (KSZ) and within the Zanskar Greater Himalaya Sequence (GHS). Zircon rim ages for KSZ leucogranites suggest that crustal-scale shearing began prior to 22 Ma and persisted through at least 9 Ma. Radiogenic hafnium analysis of zircon cores provides εHf(T) values from +1 to +9, suggesting that they were primarily derived from a source with recent mantle input such as the adjacent Ladakh batholith. Anomalously low εHf(T) values also found in the KSZ can be attributed to input of older material from the Karakoram terrane or subducted Indian crust. Zircon and monazite ages from Zanskar GHS units demonstrate the abundance of pre-Himalayan Cambro-Ordovician Pan-African and Permian granites. These pre-Himalayan granite bodies, the low percentage of anatectic Miocene leucogranites, and the many domal structures in Zanksar suggest that mechanisms for mid-crustal exhumation in the NW Himalaya may differ from proposed numerical models for the eastern Himalaya.

Entry Number: 76 GP
OBSERVATIONS OF WAVE-DRIVEN SURF-ZONE DYNAMICS ON A HIGH-ENERGY BEACH, OCEAN BEACH, SAN FRANCISCO
By: Isaac Jones
Oceanography
Faculty Advisor: Dr. Tim Janssen
Abstract: Alongshore variations in wave energy,currents and water depth affect wave---driven surf---zone hydrodynamics and are important for near---shore transport processes and beach evolution. These processes are not that well understood, in part because most earlier field studies were conducted in areas characterized by alongshore---uniform conditions and moderate incident wave energy. In this study, we present observations of the surf zone circulation at Ocean Beach, San Francisco, an area Characterized by energetic wave conditions (near---shore wave heights can exceed 10m), strong tidal currents (>1m/s alongshore), refractive wave focusing, and alongshore inhomogeneity of the incident wave field. The experiment was specifically designed to capture the effects of spatially inhomogeneous wave fields and to quantify the contribution of the pressure gradient to the alongshore momentum balance. The data set includes detailed pressure, current, and wave measurements from a two---week long experiment at Ocean Beach, including a wide range of wave (significant wave heights of 1---5m) and wind conditions. In the analysis, the various terms of the mean---flow momentum balance have been extracted from observations. The momentum balance will be evaluated to determine the comparative role of wave---induced set---up and radiation stress gradients in driving circulation. We will present the field experiment set---up, time series of the bulk wave statistics over the duration of the experiment and a surf---zone momentum analysis to identify the role of wave inhomogeneity on the near---shore circulation. This experiment and research is funded by the U. S. Geological Survey.

Entry Number: 77 GP

LIGHT CURVES OF KUIPER BELT OBJECTS AND THE SEARCH FOR KUIPER BELT BINARIES
By: Andrew Fittingoff
Physics
Faculty Advisor: Dr. Joseph Barranco
Abstract: We analyze photometric images taken with the Magellan Telescopes in Chile to search for faint moons of known Kuiper Belt Objects (KBOs). We also construct photometric light curves of known KBOs to search for variability and rotation over the time scale of a few days. Understanding the Kuiper Belt gives us clues to the collisional processes in the early Solar System that lead to the formation of the Earth and other planets.

Entry Number: 78 GP
"DUALITY VIOLATIONS IN QCD"
By: James A. Osborne
Theoretical Particles
Faculty Advisor: Dr. Maarten Golterman
Abstract: QCD is the standard model theory of the strong force and the interactions between quarks and gluons. Quark bound states for hadrons such as the protons and neutrons we observe in nature. Yet inconsistencies arise between the quark-gluon picture and the hadronic picture seen in experiments, known as duality violations. Here we investigate the effects of these duality violations in the analysis of tau decay.

Entry Number: 79 GP
CENTER VORTICES AND QUARK CONFINEMENT
By: Patrick Dunn
Physics & Astronomy
Faculty Advisor: Dr. Jeff Greensite
Abstract: Quarks have never been observed individually in the vacuum; they have only been observed in bound groups of two or three, for reasons which are still not well understood. This unresolved problem is known as the quark confinement problem, and the center vortex theory of confinement is one proposed solution. Testing this proposal involves discretizing spacetime on a lattice and simulating a quantum field theory known as "quantum chromodynamics" on a computer. Center vortices can then be detected in these lattice simulations, and the strength of interaction between static quarks due to these vortices, as well as other vortex properties, may be determined. If center vortices are truly physical objects, then their properties should not depend on the lattice spacing. In order to test if this is true I ran lattice Monte Carlo simulations for several different lattice spacings, and have plotted the results.

Entry Number: 80 GP
A SEARCH FOR HELIUM-CORE WHITE DWARFS IN OMEGA CENTAURI
By: Suzanne Hayward
Physics and Astronomy
Faculty Advisor: Dr. Adrienne Cool

Abstract: We present initial results of an analysis of the white dwarf sequence in the globular cluster Omega Centauri aimed at testing for the presence of helium-core white dwarfs (He WDs) and identifying potential candidates. He WDs appear redward of the cooling sequence formed by carbon/oxygen white dwarfs; as recently shown in NGC 6397, they can provide a window into critical binary populations in a globular cluster (Strickler et al. 2009). We analyze a 10x10 arcminute mosaic of images we obtained with HST's Advanced Camera for Surveys in F435W (B435), F625W (R625), and F658N filters; it extends out to the half-light radius of the cluster. Using the "effective PSF" photometric technique developed for the WFC by Anderson and King (2006), we construct a B435-R625 vs. R625 color-magnitude diagram (CMD) for ~1.2 million stars in the mosaic. Of the ~570,000 stars that appear in at least three B435 and three R625 images, approximately 3400 lie in the region of the CMD occupied by WDs. Using the three independent measurements in each filter, we compute empirical uncertainties in the B435-R625 colors of the white dwarfs. We then compare these to the measured width of the WD sequence as a function of R to test for the presence of He WDs and identify potential candidates. We compare our results to those of Monelli et al. (2005) and Calamida et al. (2008) who first reported evidence for He WDs in Omega Centauri. This work was supported by NASA grant HST-GO-9442.

Entry Number: 81 UL
DNA METHYLATION IN THE RED HARVESTER ANT
By: Agni Naidu and W. Cameron Jasper
Physiology
Faculty Advisor: Dr. Christopher Smith
Abstract: Epigentics studies the activation and deactivation of genes, which helps us understand the mechanisms leading to phenotypic differences in individuals during development. Red Harvester ants (Pogonomyrmex barbatus) are hymenoptera (i.e. ants and bees) where workers and queens in a colony are much more genetically similar (75%) than human siblings (50%), but show extreme phenotypic differences such as size and the ability to reproduce. Other research groups have shown that bees and wasps exhibit methylated cytosine (C) residues in CG (cytosine-guanine) dinucleotides. Methylated residues can act like a 'switch,' turning methylated genes off via hindering access to promoters by the transcription machinery, for example. Over evolutionary time, methylated C can degrade into a uracil (read in DNA as thymine (T)) , resulting in fewer observed CG pairs than expected (CpG-OE). This allows us to predict which genome regions are methylated with bioinformatics. We hypothesize that P. barbatus have CG sites in their genome that are methylated. To test this, we first selected genes based on their predicted CpG-OE values from preliminary genome data. We chose three apoptosis and three reproductive genes, since these pathways are used by queens and not workers. To find methylated sites, we treated genomic DNA with with sodium bisulfite, which converts non-methylated C's into T's, and designed primers to putatively methylated regions. We then sequenced the treated DNA and compared it to the reference genome. We have found four genes which show evidence for methylation. Locating areas of methylation in P. barbatus will help us understand the differences of these genes in the development of the different ant castes and will shed light on how a single genome can be

'read' in multiple ways to produce individuals that have very different lifespans, body shapes, and behavior.

Entry Number: 82 UL
FRIZZLED10 IS REQUIRED FOR CELL SURVIVAL IN THE CHICK NEURAL TUBE
By: Camila Teng
Cell and Molecular Biology
Faculty Advisor: Dr. Laura Burrus
Abstract: β-catenin dependent and independent pathways have been implicated in neural tube closure defects. Wnt1/3a signal via β-catenin in the developing neural tube of amniotes and form dorsal to ventral gradients that control proliferation and cell specification. However, the Wnt receptors employed by target cells have not yet been identified. Our observation that Frizzled10 (Fzd10) transcripts are co-expressed with Wnt1/3a in the dorsal neural tube led us to hypothesize that Fzd10 mediates at least some of the downstream effects of Wnt1/3a. To test this hypothesis, we first tested whether Fzd10 could promote the ability of Wnt1/3a to promote β-catenin dependent signaling in a SuperTopFlash reporter assay in HEK293T cells. Indeed, we found that co-transfection of Wnt1/3a along with Fzd10 and LRP6 yielded a synergistic effect, thus suggesting that Fzd10 and LRP6 are likely to act as co-receptors for Wnt1/3a. As mutations in LRP6 are directly associated with neural tube defects, these data provide a possible link between Wnt1/3a and Fzd10 and neural tube closure. We then sought to test the requirement of Fzd10 in chick neural tube development by electroporating an siRNA construct targeted against Fzd10. As the electroporated side of the neural tube was overtly reduced in size, we screened for apoptosis using a TUNEL assay and found that Fzd10 is required for cell survival. We also noted that knock down of Fzd10 and inhibition of Pax3 caused similar phenotypes with respect to cell survival and neural crest migration. We are currently testing whether Pax3 is a downstream effector of Fzd10.

Entry Number: 83 UL
CATALOGING ARTHROPOD BIODIVERSITY THROUGH DNA BARCODING AT THE CALIFORNIA ACADEMY OF SCIENCES
By: Chaundra Cox, Travis Siapno, Jessica Van Den Berg, and Erik Young
Physiology, MARINE BIO/LIMNOLOGY
Faculty Advisor: Dr. Christopher Smith
Abstract: There are an estimated 10-100 million species on Earth, but only 2-20% have been described. Our project involves cataloguing arthropod biodiversity on the green rooftop of the California Academy of Sciences in San Francisco. We collected arthropods from several transects on the Academy roof, adjacent areas in Golden Gate Park, and throughout San Francisco over the course of a year and used morphology to identify many of the samples. We have generated numerous DNA barcodes from a 650 bp fragment of cytochrome c oxidase 1 gene, which is highly conserved in all animals. DNA barcoding will allow identification of morphologically similar species that cannot be distinguished physically. For instance, immature spiders usually make up the majority of spider samples, but are virtually impossible to identify to species-level using morphology. It is also difficult to associate larvae and adults of many species. Barcoding

larvae could also help us identify parasite/host relationships. For example, we found several introduced species as well as a novel record of a parasitic fly that parasitizes adult honeybees and bumblebees. Our ultimate goals are to compile a comprehensive species list, build a publicly accessible database describing all species for San Francisco, and develop a protocol to use shotgun sequencing to automatically sample biodiversity in a comprehensive and cost-efficient manner.

Entry Number: 84 UL
REGULATABLE GENE EXPRESSION IN THE PLANT SYMBIONT *SINORHIZOBIUM MELILOTI*
By: Jainee Lewis and Mina Mostafavi
Cell and Molecular Biology
Faculty Advisor: Dr. Joseph Chen
Abstract: *Sinorhizobium meliloti* is a member of the alpha-proteobacteria family, which includes many plant symbionts as well as mammalian pathogens, such as *Brucella abortus* and *Rickettsia rickettsii*. We are interested in studying genes essential for viability in *S. meliloti* because it serves as a model for understanding bacteria with agricultural and medical significance. However, unlike other well-studied bacteria, *S. meliloti* lacks known promoters with tight, regulatable expression, which facilitates depletion analysis of essential genes. Thus, we aimed to identify and characterize suitable promoters for such studies. We selected four potential promoters in *S. meliloti* from the literature--ParaA, PtauA, PrhaR, and PmelA--and constructed transcriptional fusions to the *uidA* reporter gene, which encodes the enzyme beta-glucuronidase. Using beta-glucuronidase assays, we measured expression from each promoter region in both rich and minimal media to determine which promoter exhibited low basal activity when the promoter was not induced and high expression when induced. We found PtauA to be most suitable for depletion studies, particularly in the rich medium PYE. We also measured promoter activity at different inducer concentrations over a period of time to examine the range of PtauA activity. Fusions of the PtauA promoter to various essential genes are being constructed to test if the promoter will be useful for depletion studies

Entry Number: 85 UL
DEFINING ROLES OF EVOLUTIONARY PP1 PHOSPHATASES IN SPERM FUNCTION AND MALE FERTILITY
By: Thais Cintra, Dr. Jui-ching Wu, Aiza Go, and Dr. Diana Chu
Physiology
Faculty Advisor: Dr. Diana Chu
Abstract: Male infertility affects over two million people a year in the US. One conserved factor known to play a key role in male fertility from mammals to worms are PP1 phosphatases. Studies in mice have shown that mutations in the PP1 gamma gene cause infertility of male mice; however, how they affect sperm development is unknown. We have found that two nearly identical PP1 genes in *C. elegans*, GSP-3 and GSP-4 (GSP-3/4), also cause male infertility. Our goal is to thus characterize how GSP-3/4 function in sperm development in *C. elegans*. We have found GSP-3/4 have multiple roles in male fertility. First, GSP-3 and GSP-4 are important in sperm meiosis for chromosome segregation. After meiosis, GSP-3/4 also function in the morphogenesis of sperm

required for motility. Interestingly, we also found the infertility of worms lacking GSP-3/4 may be due to a further role for these phosphatases in generating a sperm signal that prepares oocytes for fertilization. To determine if sperm signaling is generated and received by oocytes in the absence of GSP-3/4, we compared staining of dissected gonads from *gsp*-3 *gsp*-4 double mutants to wild-type animals. We performed immunocytochemistry experiments to label two signaling molecules activated downstream of the sperm signal: AIR-2 and MAP-kinase. AIR-2, is activated by the sperm signal to complete chromosome segregation in meiosis. As expected, in *him*-8 (wild-type) oocytes we noticed the presence of AIR-2 strongly localizing at maturing oocytes. In the maturing oocytes of *gsp*-3 *gsp*-4 double mutants, we also detected AIR-2, though at slightly lower levels. Likewise, when we examined activation of MAP-kinase, a mitogen-activated protein kinase that controls meiotic development, we noticed the MAP-kinase levels were also only slightly reduced. These results suggest that GSP-3 and GSP-4 proteins play only a minor role in sperm signaling to oocytes. As such, we are now investigating other functions of GSP-3 and GSP-4 in sperm that may contribute to male fertility.

Entry Number: 86 UL
ECTODERM PERIDERM CELLS UNDERGO MAJOR MORPHOLOGICAL CHANGES AT THE NEURAL TUBE AND MEDIAL SOMITES AND CORRELATE WITH NITRIC OXIDE SIGNAL PATTERNS
By: Tyler Curran and Seung Jong Lee
Cell and Molecular
Faculty Advisor: Dr. Wilfred Denetclaw
Abstract: Embryo development can be summarized as a series of 5 events: proliferation, pattern formation, morphogenesis, differentiation and growth. These events show overlap and unique molecular signaling gradients created in the embryo regulate changes in gene expression and stimulate specific dynamic cell behaviors and activities to instruct embryo development. The extent of molecular regulators signaling the embryo is still being determined and some like nitric oxide (NO) have yet to be associated with specific developmental changes. NO is a short live, messenger gas molecule that signals by both direct effects, binding to guanylnyl cyclase for cGMP production and activation of protein kinase G, and indirect effects, protein S-nitrosylation reactions and binding with reactive oxygen species. We show for the first time that in the chicken embryo a stable pattern of ectoderm NO signals is maintained over the dorsal neural tube and medial somite areas and that the ectoderm NO pattern changes relative to progressive stages in early embryo development. We hypothesize that this outer ectoderm cell layer called the periderm will exhibit cellular morphological changes to account for the specific NO signaling patterns represented at different embryo growth stages. To investigate, we used scanning electron microscopy to obtain high resolution images of the ectoderm periderm layer and subjacent tissues in 2.5 day-old chicken embryos previously shown to express high ectoderm NO levels. Our findings show that the ectoderm periderm layer exhibits unique cell morphologic changes that correlate with ectoderm NO signaling patterns. The ectoderm periderm layer has a morphology that is typically flat, irregular shaped, and cobble-stone like with tight junction contacts with other periderm cells. However, at the dorsal neural tube and medial somite areas, periderm cells exhibit compression-like

changes and are spindle-shaped with orientation in the anterior-posterior axis direction. At slightly more anterior locations, the periderm appears overcrowded with many cells being round and apoptotic. The presence of these unique periderm cells correlates strongly with the NO (and Ca2+) signals previously reported. We conclude that the ectoderm periderm layer is undergoing rapid growth and at the embryo mid-line, periderm cells achieve a high density to the point that many are ejected out of the periderm layer and begin apoptotic changes like increased intracellular Ca2+ and NO signals. We surmise that these early stable patterns of Ca2+ and NO initiates larger ectoderm NO signaling that we have shown previously to transition across the ectoderm layer and paracrine signal to underlying paraxial mesoderm tissues, like somites and the segmental plate mesoderm. NSF-IOS-0821324.

Entry Number: 87 UL
ANATOMY EDUCATION THROUGH DISSECTION: A REGIONAL APPROACH TO THE HEAD AND NECK
By: Alexandra Koba and Laura Johnson
Physiology
Faculty Advisor: Dennis Schulz and Remy Binder
Abstract: A hemi-section of the head and neck was performed in the context of an independent studies course in Human Anatomy. Both the dissection process and the resulting specimen were found to be educationally useful. Initial planning of the dissection and manipulation of structures during the process contributed to students' understanding of the head and neck. The dissection itself was used in class to teach the central nervous system (CNS), digestive system and respiratory system. A regional approach to teaching anatomy was also made possible by this specimen: organs were viewed in their anatomical context and students were encouraged to observe structures in relationship to one another and think critically about their functions. Overall, the hemi-section allowed for a better visualization of the structures of the head and neck and diminished the need for
student memorization.

Entry Number: 88 UL
ECDYSIS TRIGGERING HORMONE INDUCES MOTOR PATTERNS DURING THE INTERMOLT PERIOD IN THE HORNWORM
By: Ariel Aveo
Physiology
Faculty Advisor: Dr. Megumi Fuse
Abstract: Ecdysis Triggering Hormone (ETH) is a peptide synthesized from peripheral glands lining the body wall of many insects, including the hornworm, *Manduca sexta*. It is a main regulator of ecdysis, or the shedding of the old cuticle, at the end of each molt in hornworms. This behavior is noted *in vivo* by the onset of stereotyped pre-ecdysis and ecdysis muscle contractions, and by the onset of fictive pre-ecdysis and ecdysis bursting patterns in the isolated nervous system (Zitnan et al., 1996). The role of ETH between molts – periods called the intermolt - has not been well characterized. The beginning of the molt period is made distinct by a large increase in ecdysteroid titers, which has been suggested to be required for ETH activity. After the molt, ETH receptor mRNA is low,

and ETH does not induce motor patterns *in vitro* within the normal onset times (Zitnanova et al., 2001). It has thus been assumed that ETH is not active during the intermolt period. Our goal was to determine whether ETH had ecdysial activity by monitoring behaviors *in vivo* after multiple ETH injections as well as *in vitro* through extracellular electrophysiology, given prolonged periods of incubation in ETH. Animals were monitored post-ecdysis for 72 hours; a period prior to increases in steroid titers. Multiple and single injections of ETH did not induce pre-ecdysis or ecdysis behaviors *in vivo*. In contrast, motor patterns resembling fictive pre-ecdysis and ecdysis bursts occurred for up to 72 hours post-ecdysis, although with reduced success rates, and significantly delayed onset times. These data suggest that ecdysteroid-induced CNS activity may not be necessary for ETH-induced fictive pre-ecdysis and ecdysis in post-molt larvae. It also suggests that there are at least low levels of ETH receptors in the CNS that are sufficient for ETH activity *in vitro*.

Entry Number: 89 UL
TRACKING CELL MIGRATION DURING MUSCLE FORMATION IN THE X. LAEVIS EMBRYO
By: Armbien Sabillo and Vanja Krneta-Stankic
Physiology
Faculty Advisor: Dr. Carmen Domingo
Abstract: Mesoderm cells of the early embryo become the muscle fibers of the adult. During embryo development, mesoderm cells elongate into muscle fibers and form transient structures called somites. To understand how mesoderm cells of the early gastrula embryo organize to become the muscle fibers of the somites, we tracked cell movement in Xenopus laevis embryos. Using a cell-transplantation approach, we examined the movements that position these cells three dimensionally within somites and along the embryo's axis. We show that gastrula cells positioned in the upper lateral lip region (ULL) are directly adjacent to the notochord as they enter the presomitic mesoderm (PSM). These cells will eventually form muscle fibers in the central region of somites positioned along most of the anteroposterior axis. In contrast, cells positioned in the lower lip (LL) region of the gastrula migrate dorsally around the blastopore lip and appear to enter the PSM from the lateral edge. This population of cells then splits to flank ULL cells dorsally and ventrally to form muscle fibers in the dorsal and ventral quadrants of somites along the trunk and tail axis. Together, these results show that cells in the gastrula undergo different trajectories to give rise to muscle fibers positioned in distinct locations within somites and along the anteroposterior axis. These results offer new insights into how cells migrate as the embryo forms muscle, and contribute to our understanding of embryo development.

Entry Number: 90 UL
PROFILES OF CGMP ARE ALTERED DURING ARTIFICIALLY-INDUCED ECDYSIS BEHAVIORS IN DECEREBRATED *MANDUCA SEXTA*
By: Jared Geibig and David Canio
Physiology
Faculty Advisor: Dr. Megumi Fuse

Abstract: Understanding human behavior at a molecular level is a daunting challenge because of the numerous pathways involved. However, through understanding less complex behaviors in simpler model systems, such as ecdysis behaviors in insects, we can better understand the conserved mechanisms for neuroendocrine communication in a tightly-controlled environment. Ecdysis is the shedding of the old cuticle to accommodate continued growth, and it occurs in many invertebrates. It is a highly stereotyped behavior in the hornworm, *Manduca sexta*, with easily identifiable behavioral traits, making it ideal for studying the communication between neurons and hormones. The pathway for regulating ecdysis behaviors is still a working model. It has been suggested that Eclosion Hormone (EH) from the brain is a main initiator of ecdysis, and acts via the second messenger cGMP. cGMP is upregulated during ecdysis, and this has been shown, using a cGMP-specific antibody, within a network of neurons by the expression of highly stained cell bodies and axons during ecdysis and undetectable stain before and after ecdysis (Ewer and Truman, 1997). Removal of EH by decerebration results in inhibition of ecdysis behaviors unless high amounts of another hormone, Ecdysis-Triggering Hormone, are present. Under both of these conditions, cGMP levels have not been determined. The purpose of this study was to determine, immunohistochemically, whether the cGMP profile was conserved when EH was removed by decerebration and Ecdysis-Triggering Hormone was injected. It was hypothesized that because the ecdysis behaviors may be rescued in decerebrated animals after multiple hormone injections, the cGMP profile would be present. We found that decerebrated animals injected only once with Ecdysis-Triggering Hormone showed minimal to no cGMP while those injected multiple times showed elevated levels comparable to controls. However, these levels did not remain elevated for the same duration as controls. The current data indicate that cGMP is upregulated more transiently under these conditions, where levels are not sustained compared to control conditions. These data suggest that the loss of EH results in loss of the normal cGMP upregulation, but that Ecdysis-Triggering Hormone has the capacity to upregulate cGMP. Whether this upregulation is a direct effect by Ecdysis-Triggering Hormone, or is due to stimulation of alternate sources of Eclosion Hormone remains to be seen. The transient nature of upregulation may be due to loss of a sustaining factor in the brain or to the reduced availability of Eclosion Hormone from sources other than the brain.

Entry Number: 91 UL
MULTIPLE INJECTIONS OF ECDYSIS TRIGGERING HORMONE RESCUE LOST ECYDYSIS BEHAVIORS IN DECEREBRATED *MANDUCA SEXTA*
By: David Canio and Jared Geibig
Physiology
Faculty Advisor: Dr. Megumi Fuse
Abstract:

Entry Number: 92 UL
CHARACTERIZING THE HORMONE SIGNALING PATHWAY OF DAMAGE INDUCED DEVELOPMENTAL DELAY IN THE TOBACCO HORNWORM, *MANDUCA SEXTA*
By: Louie Ramos

Physiology
Faculty Advisor: Dr. Megumi Fuse
Abstract: The imaginal disc is a structure in the larvae holometabolous insects that gives rise to the unique structures of the adult form, from eyes to antenna and wings. These structures, when injured, display a remarkable capacity for regeneration, and despite the injury, the imaginal discs give rise to healthy adult organs. After injury, a developmental delay in the animal seems to occur to facilitate regeneration of the imaginal disc and give rise to the healthy adult. This developmental delay seems to be initiated by a blood borne factor. Injury dependent developmental delay has been demonstrated in the fruit fly, Drosophila melanogaster through both the expression of transgenes and targeted damage from x-ray irradiation. A similar delay from x-ray irradiation has been demonstrated in the Tobacco Hornworm, *Manduca sexta*. This study aims to more precisely characterize the hormone signaling pathway. Compared to the substantially smaller Drosophila, Manduca larvae provide the size and volume of hemolymph, the blood analogue in the insect circulatory system, necessary for a study which characterizes the role of the fluid component of hemolymph and the cellular component, the hemocytes, through transfusion. A total of 68 Manduca larvae were treated as either: non-injected controls; recipients of saline in lieu of hemolymph transfusion; recipients of hemolymph drawn from the same larva; or recipients of hemolymph drawn from a donor larva in an attempt to characterize any developmental delay that would result from the assay rather than induced tissue damage. These animals were timed for major life cycle events: wandering which signals preparation for pupariation, purapriation, and ecclosion. The data confirms that transfusion does induce a slight delay, but the delay is the same regardless of the material injected. Having confirmed the reliability of this assay, future applications will include the injection of hemocytes and hemolymphatic fluid from larvae which have experienced induced imaginal disc damage to specifically characterize the role of hemolymphatic fluid as the carrier of the delay inducing factor and the hemocytes as a potential producer of the delay inducing factor.

Entry Number: 93 UL
MICHAEL AND CONJUGATE ADDITIONS ONTO FULVENES AND 6-VINYLFULVENES
By: Marie Danica Obligacion
Physiology
Faculty Advisor: Dr. Ihsan Erden
Abstract: The 6-position on a fulvene (the exocyclic double bond) is particularly electrophilic due to the polarization of the molecule toward the cyclopentadienyl ring imparting aromatic character to the system. There have been sporadic reports on conjugate additions onto fulvenes, but these have been limited to hydrides and carbanions such as cuprates. In this study we report conjugate and Michael additions onto fulvenes as well as 6-vinylfulvenes. In the latter compounds the 6-vinyl group appears to be the electrophilic site accepting the Michael donor. In other similar systems we observed similar conjugate additions that confirm the greater electron deficiency at the terminal vinyl carbon rather than the 6-position. These novel aspects of conjugate and Michael additions onto fulvenes will be discussed and experimental procedures as well as spectral characterization of products will be described.

Entry Number: 94 UL
THE IMMEDIATE RESPONSES OF IMAGINAL DISCS AND HEMOCYTE POPULATION TO IRRADIATION OF LARVAL *MANDUCA SEXTA*
By: Nicholas Silva and Sayed Miry
Physiology
Faculty Advisor: Dr. Megumi Fuse
Abstract: Many organisms have the ability to regenerate tissue after extensive damage through a cascade of intracellular events. In the fruitfly Drosophila melanogaster, clusters of progenitor cells known as imaginal discs differentiate into adult structures such as wings and eyes, which show an astounding regenerative capacity after damage. This regeneration results in local and systemic responses as the tissues are repaired. For instance, irradiation damage to the imaginal disc results in apoptotic imaginal cells and delayed development, presumably through interactions with the endocrine system. Researchers suggest that the delay is due to potential blood-borne factors secreted by the damaged imaginal discs. However, due to limited hemolymph (blood) volume in the fruitfly, the physiological mechanisms involved are still unclear. In order to investigate a potential blood-borne factor we introduced an alternative insect model with greater hemolymph volume, namely the hornworm, *Manduca sexta*. Our lab has previously shown that M. sexta delays development after x-ray irradiation, but the local and systemic responses have not yet been characterized. In the current study, we monitored apoptosis in the imaginal discs using Acridine Orange and hemocyte population changes from the hemolymph using flow cytometry, after x-ray irradiation. Our results validate the work in D. melanogaster, where selective damage to imaginal disc following irradiation was noted by increased apoptosis in the imaginal discs but not in neighboring tissue. Additionally, several changes in hemocyte populations were noted, including changes in size, morphology, and population density. This data suggests that M. sexta is a strong complementary model to D. melanogaster due to the irradiation that results in selective damage to the imaginal discs. Moreover, the responses seen in the hemolymph have not yet been described in D. melanogaster, which lead us to hypothesize that the delay in development may be mediated via both the imaginal discs and the hemocytes.

Entry Number: 95 UL
THE ROLE OF A SECOND SHELL HYDROPHOBIC INTERACTION IN TRYPSIN-FOLD SERINE PROTEASE FUNCTION.
By: Anna Batt
Biochemistry
Faculty Advisor: Dr. Teaster Baird, Jr.
Abstract: In several co-crystal structures of trypsin and its macromolecular inhibitors, the backbone carbonyl of Phe41 accepts a hydrogen bond from the P2' backbone amide in the inhibitor (a "first
shell" interaction) suggesting that this hydrogen bond interaction is significant. Lys60 and Tyr39 form a "cage" around Phe41 (a "second shell" interaction), likely keeping its backbone carbonyl optimally positioned for hydrogen bonding. A variant, in which Tyr39 was replaced with an alanine (Y39A-Tn), was constructed to evaluate how removal of the cage around Phe41 affects activity. It is hypothesized that the removal will allow Phe41

more conformational freedom and thereby weaken substrate/inhibitor binding. The Y39A-Tn variant has been constructed using PCR mutagenesis, expressed in P. pastoris and purified using hydrophobic chromatography. Initial kinetic characterization will be carried out using commercially available, small (1-3 residues) peptide substrates. Given the location and proposed role of Phe41, and that the active site of the enzyme has not been modified, the substitution is expected to effect little change on the hydrolytic activity of said substrates. However, notable changes in cleavage of proteins and decreased affinity of macromolecular substrates are expected. (This work was supported by NSF Award MCB-0643988-02)

Entry Number: 96 UL
DESIGNING AND EVALUATING PORTABLE X-RAY METHODS FOR COUNTERFEIT PHARMACEUTICAL DRUG DETECTION
By: Charles Bupp
Chemistry
Faculty Advisor: Dr. Peter T. Palmer
Abstract: An estimated 10-50% of the global pharmaceutical trade is in counterfeits. Depending on the product, these counterfeits are either missing the active pharmaceutical ingredient (API) or contain a different or non-approved API. While the term caveat emptor would seem to apply, the fact remains that in some cases people have died from taking diet pills containing clembuterol and that thousands of people in Southeast Asia are affected by counterfeit anti-malarial drugs typically containing substandard quantities of API, increasing the likelihood that the pathogen will gain drug resistance, and often containing potentially toxic filler excipients such as pyrimethamine. Clearly, there is a need to establish rapid, sensitive, and cost-effective methods for detecting counterfeit drugs. With the increasing availability of handheld and portable X-ray fluorescence (XRF) and powder X-ray diffraction (pXRD) instrumentation, it has become feasible to bring these instrumental methods into use in the field as well as within regulatory facilities. With this in mind, protocols for the rapid detection and characterization of counterfeit artesunate (an anti-malarial drug), sildenafil citrate (Viagra), and levitracem (Cialis) have been designed and evaluated. Results indicate that the methods are viable for this application and further investigation is merited using these and additional types of commonly-counterfeited medicine. Discrimination between authentic and counterfeit artesunate was achieved using XRF analysis of pill calcium concentration requiring no sample preparation, 30 second runtimes, and yielding a significance level $p < 0.001$ for each counterfeit pill analyzed. pXRD methods, while requiring simple sample preparation and runtimes on the order of 10 minutes, provided more specific information regarding the identities of excipients present within the counterfeit drugs, including calcite, aragonite, sulfadoxine, and pyrimethamine within the counterfeit artesunate pills.

Entry Number: 97 UL
ELECTRON MICROSCOPE IMAGING OF PHOTO-DYNAMICALLY TREATED LNCAP PROSTATE CANCER CELLS
By: Conny Louridas
Chemistry
Faculty Advisor: Dr. Meden Isaac and Dr. Ursula Simonis

Abstract: LNCaP cells are prostate cancer cells which had been harvested from the lymph node of a patient. These cells are being used to investigate the effectiveness of a treatment with a photosensitizer, which is a light activated drug that induces apoptosis [1]. Scanning electron microscopy is used to image the cells and to determine the morphology of the LNCaP cells throughout the process. Additionally, STEM will be used to examine if the photosensitizer targets the mitochondria of the cancer cells, or if the drug is taken up in a different organelle. Non-cancerous PNT1A cells are being used as a control.

Entry Number: 98 UL
EFFECTS OF SAMPLE STORAGE ON DISSOLVED ORGANIC CARBON CONCENTRATION IN MARINE SEDIMENT PORE WATERS
By: Dug Mei and Leah Johnson
Biochemistry and Chemistry
Faculty Advisor: Dr. Tomoko Komada
Abstract:

Entry Number: 99 UL
EFFECTS OF CHRONIC B-BLOCKER INFUSION ON WILD-TYPE C57BL6/J MOUSE STRAIN
By: Jessica Angat, Megan Montgomery, Philip Swigart, Bat Myagmar, Croft Thomas, Marietta Paningbatan, and Paul C. Simpson
Biochemistry
Faculty Advisor: Dr. Teaster Baird
Abstract: Beta-adrenergic receptor (βAR) antagonists (beta-blockers, β-blockers) are standard of care in treatment of heart failure, one of the most important clinical problems, and work by reducing toxic effects of catecholamines (epinephrine, norepinephrine) on cardiac myocytes. However, β-blockers provide incomplete heart recovery, and new drugs are needed. Mouse genetic models are very important in new cardiac drug discovery, but β-blockers dosing in the mouse is poorly defined. We tested the hypothesis that physiological and biochemical effects of β-blockers share similar dose-effect relationships. We studied C57Bl/6J male mice age 11-15 weeks. We infused the β-blockers carvedilol or propranolol subcutaneously by osmotic minipump, measured blood pressure (BP) and heart rate (HR) by tail cuff manometry, and used quantitative immunoblot to measure phosphorylation in heart ventricle of the βAR target phospholamban, which controls calcium handling within the myocyte. Propranolol or carvedilol at doses 5-20 mg/kg/d for 2 weeks had no significant effect on HR or BP. However, both drugs at a dose 10 mg/kg/d eliminated basal phosphorylation of phospholamban. These β-blocker doses also prevented stimulation of phospholamban phosphorylation by intraperitoneal injection of epinephrine, a natural catecholamine βAR agonist, proving adequate βAR blockade. We conclude that β-blockers in the mouse can efficaciously inhibit βAR signaling without altering BP or HR. The dosing discovered in these experiments will be extremely useful in new cardiac drug discovery, to test drug effects in the presence of β-blockers, without confounding effects on BP or HR.

Entry Number: 100 UL

IMPROVED METHOD FOR SCREENING LEACHABLE ELEMENTS IN TABLEWARE
By: Jessica Shealor
Biochemistry
Faculty Advisor: Dr. Peter Palmer
Abstract: XRF technology was used to improve upon current FDA methods of screening leachable toxic elements in tableware. The qualitative method of using swabs was expanded upon using multiple standard solutions of 100, 50, 20 and 10 ppm were generated for chromium (Cr), cobalt (Co), copper (Cu), lead (Pb) uranium (U), cadmium (Cd), antimony (Sb) and barium (Ba). These standards created a standard calibration curve for use of leachable toxic element analysis in tableware. Tableware was analyzed using the current swab method of tartaric acid rubbed on the sample. The collected solution on the swab tips was then analyzed with XRF spectra [concentration levels determined]. The new method will allow for enhanced qualitative screening of tableware. With further analysis and experimentation with the method, semi-quantitative results should be able to be determined.

Entry Number: 101 UL
A NOVEL TANDEM INTRAMOLECULAR CYCLOPROPYLNITRONE CYCLOADDITION-CYCLOREVERSION
By: Kate Markham, Dr. Christian Gaertner, and Dr. Ihsan Erden
Biochemistry
Faculty Advisor: Dr. Ihsan Erden
Abstract: Uncatalyzed dipolar cycloadditions of nitrones onto cyclopropanes are unknown. C-Cyclopropylnitrones have been known for a long time. They do not exhibit any unusual reactivity in terms of intramolecular cyclizations with cyclopropane participation. We report here the first examples of uncatalyzed cycloaddition of C-cyclopropylnitrones to give 5,6-dihydro-(2H)-1,2-oxazines that spontaneously undergo Eschenmoser 1,2-oxazine cycloreversions to give cyclopentadienone (in dimeric form) or indenone. The corresponding C-spirocyclopropyl oxime derived from indene undergoes at elevated temperatures a prototropic shift to the NH-nitrone that exhibits the same tandem intramolecular cycloadditon-cycloreversion mode. Possible intramolecular cyclopropane-nitrone cycloaddition pathways have been evaluated by theoretical calculations. Details of the experimental and computational studies on these novel cycloadditions will be discussed.

Entry Number: 102 UL
A STUDY OF THE EFFECT OF POLARITY IN THE OROTODINE 5'-MONOPHOSPHATE DECARBOXYLASE MECHANISM
By: Ronald Tan
Biochemistry
Faculty Advisor: Dr. Weiming Wu
Abstract: The investigation of the hydrolysis of 2-chloro-1-methyl-4-pyridone and 6-chloro-1-methyl-2-pyridone will provide insight on the mechanism of the hydrolysis of 6-cyanouridine 5’-monophosphate (6-cyano-UMP) to B-D-ribofuranosylbarbiturate 5’-monophosphate (BMP), which is catalyzed by the enzyme orotodine 5’-monophosphate

decarboxylase (ODCase). ODCase plays a key role in the de novo synthesis of puridine nucleotides, and the mechanism on which it acts remains unknown. Hydrolysis of the synthesized pyridone structures will reveal how the polarity of the substrate structures affect their reactivity. Our hypothesis is that ODCase catalyzes the reaction by polarizing the substrate.

Entry Number: 103 UL
HOW CARGOS MOVE TOWARDS THE MICROTUBULE MINUS ENDS IN PLANT CELLS
By: Vedud Purde
Biochemistry
Faculty Advisor: Dr. Ahmet Yildiz (UC Berkeley) and Dr. Teaster Baird
Abstract: Our research aims to represent a focused study for the search of a unique kinesin motor that functions as an alternative of cytoplasmic dynein in the plant cell. We have identified 17 genes in Arabidopsis thaliana that express an unconventional class of C-terminal kinesins whose neck-linkers (mechanical element that power kinesin movement in an ATP dependent manner) are positioned at the N-terminus. We obtained the coding sequence from cDNA libraries and cloned it into a bacterial expression vector. We attempted to express these motor proteins in BL21.DE3 cell and the expressed proteins were purified by Ni-NTA chromatography. We then tested the motility of purified proteins on surface immobilized microtubules *in vitro*. Direction of their motion were tried to be identified by using polarity marked microtubule filaments. As a result we concluded that the protein we are trying to express was non-processive.

Entry Number: 104 UP
LOW TEMPERATURE SYNTHESIS OF {001} ORIENTED ANATASE FILMS
By: Brianne Mack, Shirin Usmani, and Diana Mars
Chemistry
Faculty Advisor: Dr. Andrew Ichimura
Abstract: Titanium dioxide finds extensive use in applications that range from coatings and pigments to oxidative photocatalysis and dye-sensitized solar cells (DSSC). In these and other applications, the properties depend on the material phase (anatase or rutile), particle size and morphology, and surface chemistry. Both computational and experimental work suggest that the {001} surface of anatase is the most reactive. Since the binding of fluoride to anatase lowers the overall surface energy, additional fluoride in the synthesis solution selectively stabilizes {001} relative to {101} facets, effectively increasing {001} surface area. The goal of this study was to examine the effects of temperature, fluoride source and concentration, and Ti4+ concentration on anatase film morphology and crystallinity. Anatase was prepared by hydrothermal synthesis from homogeneous solutions with TiF4 as the titanium source. Additional fluoride from NH4F and HF were used as crystallographic directing agents. Anatase film growth was studied as a function of temperature and reagent concentration. The temperature was varied at constant [TiF4], and then the amount of additional [F-] was varied at constant [TiF4] and temperature. Films were characterized by scanning electron microscopy and x-ray diffraction. At temperatures as low as 90˚C and up to 180˚C, continuous single phase anatase films grew from the gold surface to a thickness between 200 nm and 1000 nm.

Over this range of conditions, the crystals that covered the surface of the polycrystalline film varied in shape and morphology. At intermediate temperatures and concentrations, the exposed facets were square in shape and arrayed
~parallel to the substrate. On the basis of the grazing angle XRD and crystal symmetry, the square surfaces were {001} facets. Films synthesized at higher temperatures exhibited trapezoidal {101} facets at edges. Addition of excess fluoride improved the film density and created well-formed monoliths that spanned the film thickness. Thin films of oriented reactive crystals are promising candidates for photocatalysts, optoelectronics, and solar cells. Future studies include incorporating {001} oriented anatase films into DSSC.

Entry Number: 105 UP
ALKALI METAL DOPED ZEOLITES AS SOLID STATE REDUCING AGENTS
By: Devin Nelson
Physical and Materials Chemistry
Faculty Advisor: Dr. Andrew Ichimura
Abstract: Zeolites, a crystalline microporous material used commercially as catalysts, adsorbents, and for ion transfer, have the unique ability to act as molecular sieves, selectively sorting molecules based on their size and structure. The pores in the zeolite structure can also be doped with alkali metals resulting in a new compound, metal doped silica zeolites (M@SZ, M=Na-Cs). This gives the zeolite interesting properties, particularly the ability to act as a solid-state reducing agent. This study used cesium doped pure silica zeolites with MFI and ITQ-4 frameworks to carry out reduction of organic electron acceptors 2,2,4,4-tetramethyl 3-pentanone and 1,4-benzoquinone. These reduction products were characterized by Fourier transform infrared spectroscopy (FTIR), UV-vis optical spectroscopy, and electron paramagnetic resonance spectroscopy (EPR). The purpose of this study is to show (1) that M@SZ can carry out reduction based on molecular sieving within the pore and (2) that reduction involves 1 to 2 electron transfers. The study showed that 1,4-benzoquinone is reduced by one electron transfer in both Cs@MFI and Cs@ITQ-4 and that 2,2,4,4-tetramethyl 3-pentanone was reduced in Cs@ITQ-4. However, due to its dynamic molecular radius, 2,2,4,4-tetramethyl 3-pentanone could not fit into the pores of Cs@MFI and was only reduced at the surface if at all. This shows that depending on the shape of the molecule and the zeolite framework, certain metal doped pure silica zeolites can be novel solid state reducing agents.

Entry Number: 107 UP
MOBILE DEVICE CONTROLLED ROBOT
By: Enrique Maycotte
Computer Science
Faculty Advisor: Dr. William Hsu
Abstract: This project integrates several different hardware and software components into a remote-controlled robot. The robot can be used to gain access to spaces that are inaccessible to a human user, retrieve information about the environment, and perform simple tasks. The robot has a video camera with night vision capabilities along with a laser pointer, together they are used as a range finder to measure the distance of its targets. The laser pointer is projected onto an object in the field of view of a camera. This

laser beam is ideally parallel to the optical axis of the camera. An algorithm is run over the image looking for the brightest pixels to calculate the distance.
The robot also has a user controlled grip that is used to pick up objects. A built-in microphone enables the user to hear the robot's surroundings and an LED is attached for visual communication via Morse code.
The images from video camera can be viewed on the computer or through a set of video goggles which I will also bring to the show.
A customizable user interface on the iPhone, with buttons, sliders and accelerometers, can be used to control the following features of the robot:

- Tilt/Pan the camera.
- Move the grip up/down, open/close the grip.
- Move the robot back/ forward and left/right.
- A fully-integrated user-friendly keyboard interface to translate typed user messages to Morse code; these messages are displayed by the robot.

Work in progress includes controlling the robot using a PlayStation Wireless controller, and a video interface into the iPhone for the camera.

Entry Number: 108 UP
WAVE RIDER BUOY
By: Emilio Esposito and Richard Soss
Oceanography
Faculty Advisor: Dr. Tim Janssen
Abstract: Wave-current interaction is an important aspect of coastal dynamics. However, since reliable observations are very difficult to make, wave-current interaction dynamics is still very poorly understood. The dynamics of wave-current interaction in coastal areas can change rapidly in space, so that a large number of instruments is needed to make meaningful observations. With conventional instruments this is difficult due to the high cost of instruments and the fundamental inaccuracies of moored instruments in such areas. To develop observational capability of wave-current interactions in coastal areas, we have designed and constructed a low-cost wave-rider buoy system with a detachable handheld GPS device. The instrument is a fraction of the cost (about 1%) of conventional instrument systems, while sacrificing nothing in accuracy. The instrument will be field-tested in Raccoon Strait, San Francisco Bay, an area characterized by strong wave-current interactions. We will present our new buoy design, and a preliminary analysis of the data, including both wave and surface current observations. Since the observations of these Lagrangian drifters are highly non-stationary, we will present a wavelet analysis of the wave observations to identify the changes in dominant periodicity of the wave field as observed along the drifter path.

Entry Number: 109 UP
VERTICAL PROFILING OF THE SURFACE BOUNDARY LAYER USING THE CSU-MAPS VAISALA SOUNDING EQUIPMENT AND A KITE
By: Matthew Kassouf and Alexandria Andonian
Atmospheric Science
Faculty Advisor: Dr. Andrew Oliphant

Abstract: To achieve a vertical profile of the surface boundary layer using a flow form kite and the Vaisala sounding equipment from California State University – Mobile Atmospheric Profiling System (CSU-MAPS).

Entry Number: 110 UP
USING KNOT THEORY TO IDENTIFY AND ENUMERATE KNOTS OF CIRCULAR DNA MOLECULES
By: Alejandro Samaniego
Mathematics
Faculty Advisor: Dr. Maria Elena Vazquez
Abstract: Mathematical and computational tools can help identify the topology of circular DNA molecules when only limited experimental data are available. Knotted DNA occurs as a result of many biological processes. We have created computational tools to determine all knot types corresponding to a fixed regular projection of a knot. A projection is regular if every node in the projection maps back to exactly two points in 3-dimensions. This corresponds for example to the image of a DNA knot obtained under a microscope. In the context of DNA topology we call such image a knot shadow. We are able to identity all possible knot types that can result from the given shadow. In this poster we ask the question: how many different shadows exist of a given crossing number? We thus attempt to enumerate all knot shadows of small degree, or equivalently, to enumerate all 4-valent planar graphs with a small number of nodes. We identify families of knot projections with common properties.
A. Samaniego was supported by an NSF-LSAMP fellowship (grant #HRD-0802628). Other support to this research came from an NIH SCORE grant and an NSF Math Biology grant to M. Vazquez.

Entry Number: 111 UP
UNUSUAL BEAM DYNAMICS IN 3-DIMENSIONAL PHOTONIC LATTICES
By: Alexandra Miller
Physics
Faculty Advisor: Dr. Zhigang Chen
Abstract: We experimentally demonstrate that various three-dimensional (3D) photonic lattice structures can be established in a bulk nonlinear crystal by employing different optical induction techniques. These 3D photonic lattices bring about new opportunities for controlling the flow of light via coupling engineering originated from the lattice modulation along the beam propagation direction. By fine-tuning the lattice parameters, we observe a host of unusual behaviors of beam propagation in such reconfigurable 3D lattices, including enhanced discrete diffraction, light tunneling inhibition or better known as coherent destruction of tunneling (CDT), anomalous diffraction, negative refraction, as well as CDT-based image transmission. In addition, creation of 3D ionic-type photonic lattices by controlled Talbot effect is also proposed and demonstrated.

Entry Number: 112 UP
DOUBLE ARCHED BRIDGE
By: Clarence Li, Linh Ly, Nathan Miao, Misty Hasey, Chokri Sahkri, Patrick Babasa, and Leonard Lin

Civil Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: A double set of arches is implemented into the design of this unique bridge. The deck and pedestrians on this bridge is supported through rods and arches, spanning 3.8m.

Entry Number: 113 UP
GEOTECHNICAL HOME DEVELOPMENT AND FOUNDATION DESIGN
By: Daniel Aguirre, Ryan Oldham, Carlos Arias, Michelle Quan, and Ramon Cabral
Civil Engineering
Faculty Advisor: Dr. Tim D'Orazio
Abstract: As a geotechnical engineering team, we have been "hired" to analyze four parcels of land and create particular elevations at particular dates for each parcel. Construction of homes commence at the aforementioned dates, where ultimate settlement on each parcel is limited to 0.1 feet. Economic constraints have been placed and we must find the most cost effective method to create the desired elevations. We have also been given the task to develop foundation design options for a structure through our experience of foundation engineering.

Entry Number: 114 UP
ARCH NEMESIS TIMBER BRIDGE
By: David Cahill, Stephen Ramos, Melissa Roncal, Randy Dilag, Averill Salonga, Gonzalo Escudero, Sergio Estrada, and Johnson Young
Civil Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: The purpose of our senior project is to design, build, and test a functional wooden bridge capable of withstanding a load of 20 kN for 1 hour. During the duration of the load we measured deflection along key points as stated by the rules of the National Timber Bridge Design Competition. The competition required a maximum bridge deflection of 9.5mm and a maximum deck deflection of L/100.

Entry Number: 115 UP
GEOTECHNICAL ANALYSIS AND DESIGN, SENIOR PROJECT GROUP 2
By: Dmitriy Lashkevich, Benjamin Zhang, and Steven Pagaza
Civil Engineering
Faculty Advisor: Dr. Tim D'Orazio
Abstract: Analysis of 5 parcels of land. Improvement of soil conditions and calculations settlement rate, foundation design for the fifth parcel of land.

Entry Number: 116 UP
GEOTECHNICAL HOME DEVELOPMENT SETTLEMENT ANALYSIS AND FOUNDATION COMPARISON
By: Jonathan Potter, Ghazal Oshagi, Daniel Kwok, and Zico Hamdani
Civil Engineering
Faculty Advisor: Dr. Tim D'Orazio
Abstract: Geotechnical analysis of soil profiles to determine the best way to achieve the home developers goals of a specific elevation and a settlement constraint, and an analysis

of multiple foundation types for a large building to find the best foundation type for the given situation.

Entry Number: 117 UP
SFSU STEEL BRIDGE TEAM
By: Nicholas Schulz, Lisette Berumen, Corey Wageman, Ruben Donahan, Chris Prokop, Andrew Manosca, and Amin Belkhalfia
Civil Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: Myself and 6 additional team members will work over the next two semesters to construct a steel bridge, given specific guidelines, to compete in this years Student Steel Bridge Competition. Duties have been assigned to each member of the SFSU Steel Bridge team. Each job will prove their individual importance to bring the project from where it is today, to a fully constructed, competition ready bridge. Each member will dedicate a specific number of hours working on the bridge that will be logged and credited towards each individuals final grade. It will be my duty to schedule and orchestrate each process from deciding on a project direction, to design and structural analyses. From manufacturing of the bridge to actual timed construction of the bridge. Each stage will prove to be incredibly important and we must work as an organized, efficient group in order to complete this project and take home a medal.

Entry Number: 118 UP
SFSU 2011 EERI SEISMIC DESIGN COMPETITION TEAM
By: Randy Leonard, Oskar Garcia, Qi Ming Zeng, Sean Lennan, Elliot House, Jian Hui Zhou, Shirley Altamirano, Lea Limbo, Luis Rodriguez, Maher Dabit, Khalil Dabit, and Laurent Lindquist
Civil Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: Our team entered the Earthquake Engineering Research Institute's annual Seismic Design Competition, which was held in February 2011 in San Diego. The project consist of building a model of a 30 story office building out of balsawood, predicting its performance under three ground motions using structural analysis software, and then using a shake table to simulate the ground motions to test the accuracy of the predictions. This was San Francisco State University’s first year competing.

Entry Number: 119 UP
CONSTRUCTION SCHEDULING AND ESTIMATING
By: Vincent Diep, Omid Masoui, José E. Pérez, Mauricio Rivera, Gary Yung, and Moiz Mansuri
Civil Engineering
Faculty Advisor: Dr. Timothy D'Orazio and Dr. Ghassan Tarakji
Abstract: The purpose of this project was to conduct work relating to the field of construction management. Construction management is the process of planning, overseeing, and controlling a construction project from inception to completion. Those involved in construction management work closely with architects, engineers, consultants, and clients to successfully complete the project at hand. While construction

management has many functions including the managing of resources, personnel, quality, and safety, our project mainly focused on two of the most important ones—scheduling and estimating.

Scheduling

In construction management, scheduling is the process of determining how a project is to be built and how long it will take to build it. Scheduling often involves the need to determine the best way and time to devote resources to specific project activities. It plays a crucial role in maximizing efficiency and reducing construction time and costs.

Estimating

The main objective of estimating is to establish beforehand the expected cost of a project. Estimating is essential in determining the amount a perspective contractor should bid for a particular project and, if done properly, can be the determining factor in whether or not they are awarded the project.

Entry Number: 120 UP
SMART CHESSBOARD
By: Thomas Pedersen and Shaun Dern
Computer Engineering
Faculty Advisor: Dr. Tom Holton
Abstract: Create a "smart" chessboard which allows the user to play against another human (in person or online) or AI, without requiring a host computer. The board must maintain the appearance of a "normal" chessboard, so no contact terminals or lights on each square. The board must be cheap and user-friendly, requiring minimal setup and user instruction. The project will consists of a chess board capable of sensing binary changes in layout, a chess daemon to synchronize communication between the board and chess engine, and a microcontroller which polls the state of the board.

Entry Number: 121 UP
AUTOMATED DOOR LOCK
By: Aaron Miller and Bader Alroqi
Mechanical and Computer Engineering
Faculty Advisor: Dr. Tom Holton and Dr. Morris Megerian
Abstract: Our automated door lock project aims to improve the residential door lock by creating a system that is more secure than today's current offerings. In order to meet and exceed the safety standards of a typical entry lock, our system will integrate a motor-actuated deadbolt and electronic key authorization, while simultaneously giving home owners the ability to observe and fully control all aspects of the lock on an online control panel.

Entry Number: 122 UP
INTERNET ALARM CLOCK
By: Sean Carrington and Lorenzo Were
Electrical Engineering
Faculty Advisor: Dr. Thomas Holton
Abstract: This is an alarm clock and LCD screen that gets updated information from the internet and displays it so people can get out of bed informed.

The clock is controlled by an Atmega micro-controller that drives four, seven-segment, LED displays and a de-multiplexer. The LCD is controlled by another micro-controller that connects to an Ethernet cable which can be plugged into any Ethernet hub or router.

This project involves three programs we designed to run simultaniously. The first is wriiten in 'Python' and it chops up information from the internet and re-serves this info on our own website. The other two programs are written in 'C++' and are compiled onto the micro-controllers.

Entry Number: 123 UP
HYDROJET RC
By: Antoine Griffin, Henry Slonsky, Haris Alijagic
Mechanical and Electrical Engineering
Faculty Advisor: Dr. Thomas Holton & Dr. Morris Megerian
Abstract: The premise of this project is to design and build an aesthetically pleasing apparatus that hovers using the force from jets of water. The device must lift off a water surface, elevate to a height of 3 feet, hover predictably, and bank without becoming unstable. To achieve these requirements, the device will use 3 water pumps to provide the necessary volumetric flow, 3 nozzles, and pulse-width modulation to meter water flow from the pumps. For portability, a DC battery will power the apparatus. Lastly, an accelerometer, a magnometer, and a gyroscope will be used as control sensors for feedback in order to stabilize the craft.

Entry Number: 124 UP
SMART IRRIGATION SYSTEM
By: Jose Herrera, Santee Hernandez, and Raymond Cooper
Mechanical and Electrical Engineering
Faculty Advisor: Dr. Thomas Holton
Abstract: The project scope is to create a smart irrigation system that is economical and that can be implemented both for small field and house irrigation by creating a closed loop automatic control system to measure the moisture of ground and distribute the optimal amount of water to a field or yard. The two types of options we have are: Creating an irrigation system for large fields using RF communication and a closed loop irrigation system with lab view as an HMI. Creating a smaller scale system for household use, possibly having a small crop in a yard that can be watered automatically and will also be communicated via RF comm. Drip Irrigation.

Entry Number: 125 UP
THERMOACOUSTIC REFRIGERATION TEST UNIT
By: Daniel Lake and Nathan Taylor
Mechanical Engineering
Faculty Advisor: Dr. Morris Megerian
Abstract: The goal of this project is to design and build a complete, working scale model of a thermoacoustic refrigeration system. When completed, it will consist of a cooled space which maintains an internal temperature of 15 degrees Celsius below the ambient,

the thermoacoustic refrigeration resonator itself, and a radiator with which to reject the heat.

Entry Number: 126 UP
HUMAN-POWERED FORWARD-PROPELLED ROWING MECHANISM
By: Heather Esposito
Mechanical Engineering
Faculty Advisor: Dr. Morris Megerian and Dr. Thomas Holoton
Abstract: The goal is to create a human-powered, forward propulsion mechanism for a rowing shell (similar to a flat water kayak) used for recreation, exercise, and training. The mechanism is inspired by the annoyance of facing backwards in a traditional row boat, which requires that the operator regularly turn around to see in the direction of travel. It is not necessary that the mechanism be more efficient than a competitive rowing shell. It is necessary, however, that the craft be almost as fast and that the experience of rowing be natural to the human body. Project Website:
https://sites.google.com/site/espositoseniorproject/

Entry Number: 127 UP
RAPID PLASMA-ASSISTED, AMBIENT-PRESSURE DEPOSITION OF CONFORMAL NANOCRYSTALLINE ZINC OXIDE THIN FILMS FOR SOLAR CELL APPLICATIONS
By: Joachim Pedersen, Heather Esposito, and Mark Brunson
Mechanical Engineering
Faculty Advisor: Dr. Kwok-Siong Teh
Abstract: A method of synthesizing polycrystalline zinc oxide thin films on a variety of substrates is presented. A pulsed inductively coupled plasma assisted process allows vapor phase deposition of films on various substrates ranging from Si (100), fused quartz, glass, muscovite, c- and a-plane sapphire (Al_2O_3) and the common polymer polyimide (KaptonTM). Films range in thickness from 20nm to 200nm with growth rates of 2-50nm/min. Substrate deposition temperatures are as low as 180°C. X-ray diffraction shows films are highly c-plane orientated. SEM shows highly conformal non-porous films.

Entry Number: 128 UP
THE WALKER ROBOT
By: Shifteh Shannon and Thomas Jimenez
Mechanical Engineering
Faculty Advisor: Dr. Morris Megerian
Abstract: Our project is a six legged robot that walks autonomously. The purpose of this project was to put everything we had learn in use and come up with a prototype and proof of concept.

Entry Number: DISPLAY 1
UNLOCKING THE CAGE: THE EFFECT OF A Y39F SUBSTITUTION ON SERINE PROTEASE ACTIVITY
By: John Youngblood

Biochemistry
Faculty Advisor: Dr. Teaster Baird
Abstract: Trypsin, a pancreatic serine protease hydrolyzes proteins in the digestive system. Interestingly, many other serine proteases that are structurally similar to trypsin have been proposed to play roles in the progression of certain diseases such as cancer. As a well-studied serine protease, trypsin is a desirable model for protein engineering experiments to help understand structure-function relationships in this family of enzymes. The results of such experiments may help combat cancers and other deadly diseases in the future. In wild-type trypsin, tyrosine-39 forms a hydrogen bond with lysine-60 to create a "cage" around phenylanine-4. The backbone carbonyl oxygen of phenylanine-41 accepts a hydrogen bond from backbone amide hydrogen of macromolecular inhibitors, an interaction that is likely to occur in proteinacious substrates. This cage may help keep the backbone carbonyl oxygen of the phenylanine-41 in a fixed position to optimize this interaction. We propose that if the hydroxyl group of tyrosine-39 is removed (Y39F-Tn). The "cage" around the phenyl ring of phenylanine-41 will become "unlocked" and the phenylanine-41 backbone carbonyl oxygen may reposition itself resulting in less efficient interaction with substrates and macromolecular inhibitors. In this study, the concentration of active trypsin variant was determined by active- site titration with the substrate MUGB. The hydrolytic activity of each variant was measured with the substrate Z-GPR-pNA and the results were then analyzed using the program KaleidaGraph. The results showed that wild-type had a kcat =1.2x104/min-1 and KM = 46mM while the Y39F variant had a kcat ≈ 1.0 x103/min-1 and KM ≈ 26mM. These values show that Y39F binds tighter to the substrate but hydrolyzes it less efficiently. It is clear that the substitution affects the kinetic parameters but we will run tests in the future to determine if the removal of the hydroxyl group from the tyrosine-39 affects substrate selectivity.

Entry Number: DISPLAY 2
DETERMINATION OF NATURAL 14C ABUNDANCES IN DISSOLVED ORGANIC CARBON IN ORGANIC-RICH MARINE SEDIMENT POREWATERS BY THERMAL SULFATE REDUCTION
By: Leah Johnson
Applied Geosciences
Faculty Advisor: Dr. Tomoko Komada
Abstract: The abundance of natural 14C in dissolved organic carbon (DOC) in marine sediments provides insight into the biogeochemical cycling of organic carbon in the ocean. Isotopic signatures of marine DOC can be obtained with high precision by ultraviolet (UV) irradiation, but this method is resource intensive and can be difficult to implement for small-volume (<60mL) samples. To resolve this, a thermal sulfate reduction (TSR) method, previously developed to determine 13C in seawater DOC, was modified and rigorously tested to determine 14C abundances in marine sediment porewater DOC. Results indicate that porewater DOC can be quantitatively recovered as CO2 with no detectable isotopic fractionation. The analytical blank is constant in size and isotopic composition. TSR is a low cost method that requires only a standard preparatory vacuum line, making it a promising and accessible technique to oxidize small, concentrated marine DOC samples for 14C analysis.