Entry Number: 1 GL

THE ROLE OF INDIRECT HYDROPHOBIC INTERACTIONS IN SUBSTRATE RECOGNITION

By: Raniel Alcantara
Biology
Faculty Advisor: Dr. Teaster Baird, Jr.

Abstract: Trypsin is well-characterized serine protease that is found in most animals, including humans. Trypsin has broad substrate selectivity, preferentially cleaving C-terminal to arginine or lysine in several peptide contexts. Current research has demonstrated that by altering certain amino acids in the S1' subsite of trypsin, extended selectivity may be introduced or altered. Phenylalanine 41 is located in the S1' subsite of trypsin and is kept in a bent conformation by its hydrophobic interactions with tyrosine 39 and lysine 60. In crystal structures of trypsin bound to several macromolecular inhibitors the carbonyl oxygen of phenylalanine 41 accepts a hydrogen bond from the P2' amide hydrogen of the inhibitor, suggesting that this interaction is important for substrate/inhibitor binding. By introducing point mutations into this location one may determine if this specific interaction is important for substrate and/or inhibitor binding to trypsin. To help determine the importance of this interaction, phenylalanine was substituted with several less hydrophobic amino acid leucine, and will initially be characterized using the substrate Z-Gly-Pro-Arg-pNA. It is hypothesized that leucine 41 variant will exhibit similar characteristics to wild type in binding and cleavage of Z-Gly-Pro-Arg-pNA since leucine is a truncated version of phenylalanine.

Entry Number: 2 GL

ISOLATING AND MAPPING SUPPRESSOR MUTATIONS OF *ΔSMC02230* IN SINORHIZOBIUM MELILOTI

By: Charlene Navarrete
Cell and Molecular Biology
Faculty Advisor: Dr. Joseph Chen

Abstract: Specific proteins control the three-dimensional organization of cells but may behave differently in cells that are morphologically distinct. We are using two related model bacteria, Sinorhizobium meliloti and Caulobacter crescentus, to investigate how conserved proteins contribute to the synthesis and localization of specific organelles to programmed subcellular sites. The two species appear quite different under the microscope but many genes that contribute to cell morphology are shared between the two genomes. In C. crescentus, the protein PodJ acts as a subcellular localization factor required for chemotaxis and biogenesis of polar organelles. Two homologs of the podJ gene have been identified in S. meliloti: *SMc02230* and *SMc02231*. A mutant with a deletion of the *SMc02230* gene exhibits a novel defect: it is unable to grow on Luria Bertani plates with low salt concentrations (LBLS). We isolated colonies of the *ΔSMc02230* mutant that were able to grow on LBLS, apparently due to acquisition of suppressor mutations. Using transposon mutagenesis and arbitrary PCR, we are mapping and identifying these suppressor mutations to help elucidate the defect caused by the *ΔSMc02230* mutation. Functional comparison of conserved proteins in related species will contribute to an understanding of how cellular factors evolved to suit the particular needs of different cell types.

Entry Number: 3 GL

THE EFFECTS OF WNT6 IN SOMITE PATTERNING

By: Eugenel Espiritu
Cell and Molecular Biology
Faculty Advisor: Dr. Laura Burrus

Abstract: During the embryonic development of vertebrates, mesenchymal mesoderm cells orient into epithelial ball-like structures called somites. In vertebrates, somites bud from the paraxial mesoderm of the segmental plate in pairs along both sides of the neural tube, segmenting the early embryo along the anterior-to-posterior axis (Palmeirim et al.1997). As each somite matures, it compartmentalizes into sub-domains. The ventral half, the sclerotome, returns to a mesenchymal state fated to give rise to vertebrae, while the dorsal half, the dermomyotome, maintains an epithelial state. The dermomyotome subsequently delaminates to form the dermatome and myotome, which will give rise to dermis and skeletal muscle, respectfully (Brand-Saberi et al. 1996).

Somites require exogenous signals for their proper formation and differentiation. In particular, Wnt signals secreted from the neural tube and ectoderm contribute to the somites progression. Ectoderm-expressed Wnt6 plays an important role in the epithelialization of new somites. In chick embryos, I have found that Wnt6 transcripts are expressed in the ectoderm overlying the segmental plate, epithelial somites, intermediate mesoderm, and lateral plate mesoderm. As the somites compartmentalize, Wnt6 expression in the overlying ectoderm decreases and becomes restricted to the ectoderm overlying the lateral plate mesoderm and neural tube. Tissue ablation studies have demonstrated that the ectoderm is necessary for somite epithelialization. Implanted Wnt6 expressing cells in ectoderm-ablated embryos are able to rescue the epithelial-somite marker, Paraxis (Schmidt et al. 2004). These results suggest Wnt6 is important in somite formation, but it is still unknown if Wnt6 plays a further role in the patterning of the somite. Also, it is not clear what pathway Wnt6 acts through in developing somites. In the adjacent neural crest, Wnt6 acts through a β-catenin independent pathway (Schmidt et al. 2008). However, researchers postulate that Wnt6 acts through a β-catenin dependent process in somites, since there is active β-catenin present within the somite (Linker et al. 2005).

I hypothesize that Wnt6 uses a β-catenin dependent pathway to regulate the epithelial state of the dermomyotome. To test this hypothesis, I will identify the pathway used by Wnt6 in the dermomyotome. In mammalian fibroblast-like Cos7 cells, I have found that Wnt6 inhibits β-catenin dependent Wnt signaling. These experiments are now being extended to the somites. I will then determine whether Wnt6 is sufficient and necessary to maintain the epithelial state of the dermomyotome. To determine if Wnt6 is sufficient to maintain the dermomyotome, I have ectopically expressed Wnt6 in the neural tube.

Entry Number: 4 GL

TOWARDS THE STUDY OF A PHYSICAL INTERACTION BETWEEN CDC24 AND THE CDS1 CHECKPOINT KINASE IN *SCHIZOSACCHAROMYCES POMBE*

By: Noel Cruz
Cell and Molecular Biology
Faculty Advisor: Dr. Sally G. Pasion

Abstract: Cdc24 is a protein required for DNA replication in the fission yeast *Schizosaccharomyces pombe*. Its function in this process is unknown, yet it interacts physically and genetically with conserved DNA replication proteins. A sequence similarity to proteins in other organisms has yet to be found. Cdc24 mutants - cdc24-M38 and cdc24-G1- as well as mutants defective in the conserved replication proteins DNA ligase and Dna2 helicase undergo chromosome breakage in fission yeast cells. This failure to maintain the structural integrity of the genome can be indicative of a genetic interaction between Cdc24p and proteins involved in the checkpoint response pathway. It is also known that cells lacking cdc24+ function arrest replication in a checkpoint-dependent manner, with a 2N DNA content. Cds1, the ortholog of Chk2 in humans and an effector of the replication checkpoint is a protein kinase that works in the fission yeast checkpoint response pathway. Cells defective in both cdc24+ and cds1 function exhibit a synthetic growth defect. The goal of this project is to use Western immunoblot and Immunoprecipitation techniques to determine if Cdc24 and Cds1 interact physically. The Cdc24 protein was tagged at its C-terminus with GFP in a recombinant plasmid. The plasmid (pNC1) suppressed the temperature-sensitive phenotype of transformed cdc24-M38 mutant cells. A Western immunoblot analysis of a 30 □g/15 □L sample of whole cell proteins using anti-GFP polyclonal antibodies detected an 85 kDa band corresponding to Cdc24-GFP. A 27 kDa band matching GFP was observed in cell lysates of cells transformed with a plasmid carrying the GFP gene. A 67 kDa Cds1-3HA tagged protein has previously been detected in our lab using Western immunoblots. If Cdc24 and Cds1 are physically associated, I should be able to detect Cds1-3HA in a Cdc24-GFP immunoprecipitate. The results of my research will help in establishing the role of Cdc24 in the DNA replication of fission yeast.

Entry Number: 5 GL

THE ROLE OF P53 IN APOPTOSIS OF GASTROINTESTINAL TISSUE STEM CELLS OF LATE GENERATION TERT –/– MICE

By: Terry Reyes
Cell and Molecular Biology
Faculty Advisor: Dr. Sally G. Pasion

Abstract: Telomeres are repeated DNA sequences located at the end of chromosomes. These specialized structures are involved in chromosome end stability and linear DNA replication. They also serve as a substrate for Telomerase, a reverse transcriptase (RT) that adds DNA repeats to the telomere ends. Telomeres shorten progressively in humans during consecutive rounds of cell division in cultured cells and in certain tissues with advancing age. Telomere shortening disrupts telomere function and morphology, which results in the activation of signaling cascades that trigger either cellular senescence or apoptosis. Senescence in telomerase (-/-) tissues has been observed in regenerating liver,

lymphomas and in the context of a p53 mutant that lacks the ability to induce apoptosis. Moreover, telomerase serves an essential role in stem cell function and tissue homeostasis. This role depends on its ability to synthesize telomere repeats in a manner dependent on the reverse transcriptase (RT) function of its protein component telomerase RT (TERT), as well as on a novel pathway whose mechanism is poorly understood. To begin to understand the relationship between telomerase deficiency and apoptosis in progenitor stem cell populations, we compared the level of apoptosis in the intestinal crypts of late generation (G4-G6) TERT –/– mice with a p53 background via TUNEL assay. Apoptotic cells were rare in early generation TERT –/–, p53+/+ mice, consistent with preservation of telomere function in early generation telomerase knockout mice. In contrast, late generation TERT –/–, p53+/+ mice had a profound increase in the number of apoptotic cells in the crypts. Late generation TERT –/–, p53 +/- mice had comparable levels of apoptosis as their p53+/+ counterparts. This data suggests that one copy of p53 is enough to induce cell death. Interestingly, late generation TERT –/–, p53 null mice do appear to have slightly lower levels of apoptosis than their p53 +/+, +/- counterparts, these results suggest that there could be an alternative mechanism that these cells are employing to induce programmed cell death. TERT's effects on progenitor cell dynamics and stem cell biology closely resemble those of developmental pathways regulating progenitor cell morphogenesis. To understand the relationship between telomerase deficiency and Wnt signaling pathway, we determined the nuclear beta-catening status in the intestinal crypts of late generation TERT-/- mice with a p53 background via IHC. . Positive cells for beta-catenin were found in the intestinal crypts of both the late generation TERT –/–, p53 +/+ and p53 null mice respectively. This data suggests that beta-catenin might be acting as a transcription factor, allowing for the proliferation of progenitor cells in the intestinal crypts of TERT –/– mice. Furthermore, there is a possibility that TERT might be activating tissue stem cells, not through its RT function, but by controlling a Wnt-related transcriptional program.

Entry Number: 6 GL

WNTLESS-DEPENDENT DISTRIBUTION AND ACTIVATION OF WNT1 AND WNT3A

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

Abstract: Wnts are a family of secreted proteins critical for proper embryonic development. The dosage of Wnt1/3a in the neural tube is crucial for proper patterning of the central nervous system, therefore characterizing factors regulating Wnt1/3a concentration is of great importance. Given the role of Wntless (Wls) in promoting Wnt secretion, we hypothesize that Wls coordinates Wnt1/3a distribution and activity in cultured mammalian cells and the developing chick neural tube. Initial experiments showed that Wls protein localizes to the Golgi and to distinct punctae in cultured cells while Wls transcripts are expressed nearly ubiquitously in the neural tube. To examine the effect of Wls on Wnt1 distribution, we coexpressed Wls and Wnt1 in cultured cells and found little colocalization. We then used a density gradient separation to test whether Wls promotes Wnt association with lipid rafts. We found that Wls does not increase Wnt1 levels in lipid-raft fractions. In order to characterize the effect of Wls on

Wnt activity, we cotransfected Wls and Wnt1/3a and found that Wls increases b-catenin-dependent Wnt signaling in cultured cells. To investigate the role of Wls in establishing the neural tube Wnt1/3a gradient, we knocked down Wls (via shRNA) by electroporation and found a reduction in Wnt activity range. Surprisingly, we found overexpression of Wls also shortens the range of Wnts and impairs the level of Wnt activity. Although Wls promotes Wnt signaling in cultured cells, our data suggest that Wls restricts Wnt activity range and reduces Wnt signaling activity in the chick neural tube.

Entry Number: 7 GL

PROTEIN 3D STRUCTURAL MATCHING USING RESIDUE CONTEXTS

By: Jay Kim
Marine Biology
Faculty Advisor: Dr. Rahul Singh

Abstract: We introduce a method for comparing protein structures using the notion of residue contexts based on protein C?-atom backbones. The residue context is derived from the set of vectors from a given C?-atom to each other C?-atom in the molecule. A three-dimensional histogram is generated from these vectors, containing a relative distribution of the other C?-atoms for each C?-atom on the backbone for a protein. Histograms are compared using the ?2 test, resulting in a cost for matching any two given C?-atoms in a pair of protein molecules. The sum of the ?2 values define a score for aligning consecutive (gap-less) C?-atoms between two similar substructures called 'seeds'. A non-sequential alignment between two protein molecules is made by chaining the highest scoring seeds using a greedy algorithm.

Entry Number: 8 GL

SPHINGOMYELIN IN MEMBRANE RAFTS REGULATES C2C12 MYOBLAST DIFFERENTIATION AND MYOTUBE FORMATION

By: Jung Lim and Yuko Okamoto
Cell and Molecular Biology
Faculty Advisor: Dr. Wilfred Denetclaw

Abstract: Skeletal muscle cells differentiate by myoblast proliferation, cellular migration, alignment, and fusion to produce multinucleated, elongated myotubes that express muscle specific genes and proteins. Muscle differentiation is regulated by many factors including membrane rafts, which are small, organized lipid platforms enriched in sphingomyelin (SM), cholesterol, and certain proteins. SM can undergo sphingolipid metabolism to produce several signaling lipids: ceramide, sphingosine, and sphingosine-1-phosphate, known to regulate differentiation, apoptosis and proliferation activities. However, it is unknown how SM in membrane rafts affects myoblast differentiation. C2C12 muscle cells were treated with methyl-β-cyclodextrin (MBC), a reagent that disrupts membrane rafts by cholesterol-extraction, and were monitored for proliferation and differentiation by cell morphology and myosin heavy chain (MHC) immunofluorescence. The presence of SM was determined by lysenin toxin binding. Cultures treated with MBC show no expression of MHC and myotube formation over a 144-hour period of differentiation. On the other hand, control cultures show MHC expression and extensive myotube development. On average, the MBC treated cells show low and punctuated lysenin expression, while the control cells show higher and

evenly distributed expression in both proliferating and differentiating cultures. MBC cultures, which were recovered after 96 hours of treatment by normal medium, start to show some increase in MHC and lysenin expression as early as 1 hour, compared to the MBC cultures. Since there was no differentiation as a consequence of SM removal from membrane rafts, we conclude that SM is an important regulator of myoblast differentiation. Moreover, the inhibition of differentiation is a reversible process. Additional studies involving the role of SM and its lipid products in membrane rafts need to be carefully assessed for further understanding of myotube formation.
NIH-RIMI-P20MD000544; NSF-IOS-0821324.

Entry Number: 9 GL

THE ATF3 TRANSCRIPTION FACTOR INDUCIBLY BINDS TO THE IFN-β PROMOTER IN MACROPHAGES DURING SIMULATED MICROBIAL INFECTION

By: Marvin J. Sandoval, Ami Antani, and Dr. Steve Weinstein
Cell and Molecular Biology
Faculty Advisor: Dr. Steve Weinstein

Abstract: The cytokine Interferon-beta (IFN-β) is produced by many cell types in response to infection, which results in the activation of critical anti-microbial defenses. However, inappropriate production of IFN-ß is associated with some types of autoimmunity as well as other pathologies. The IFN-ß gene is highly regulated at the transcriptional level, being silent in the absence of infection, but strongly induced by microbial stimuli present during infection. Although much is known about the mechanisms that turn on the gene in the presence of microbial stimuli, the mechanisms that turn-off the gene after its induction remain to be elucidated. In this regard, recent work from our lab has identified the ATF3 transcription factor as a possible transcriptional attenuator of the IFN-ß gene. We have found that macrophages lacking ATF3 exhibit significantly elevated induced levels of IFN-β mRNA compared to normal ATF3-expressing cells. To determine how ATF3 represses IFN-ß transcription, we have examined whether ATF3 binds to the promoter region of the IFN-ß gene. Using the chromatin immunoprecipitation (ChIP) assay, we have determined that ATF3 binds to the IFN-β promoter in mouse macrophages treated with various microbial stimuli, but not in untreated macrophages. These results provide further support for the idea that ATF3 acts as a transcriptional attenuator of the IFN-β gene. A more thorough understanding of the role of ATF3 in regulating IFN-ß may aid in the development of new therapies for autoimmune disorders associated with dysregulated IFN-β expression.

Entry Number: 10 GL

THE DISTRIBUTION OF LEUCOKININ IMMUNOREACTIVITY IN THE TOBACCO HORNWORM, *MANDUCA SEXTA*, IN THE PROCESS OF ECDYSIS

By: Roth Ea
Cell and Molecular Biology
Faculty Advisor: Dr. Megumi Fuse

Abstract: In addition to its role in fluid retention and diuresis, leucokinin may be involved with the metamorphic process of ecdysis. Different stages of larvae were immunostained with leucokinin antibodies. Neurosecretory cell pairs immunoreactive for leucokinin were

found in abdominal ganglia 1-7 of larvae. Pre-ecdysis stage larvae exhibit significantly more leucokinin neurosecretory cells than ecdysis stage larvae but were similar to post-ecdysis larvae. It is proposed that the increased leucokinin activity corresponds with the diuretic processes that occur before and after ecdysis. In contrast to Chen et al. 1994, bilateral pairs of leucokinin neurosecretory cells appeared in the second abdominal ganglion when previously described as absent.

Entry Number: 11 GL

ECTODERM PLASMA MEMBRANE SPHINGOMYELIN REGULATES SOMITE MYOTOME FORMATION IN CHICK EMBRYOS

By: Tenzin Bhutia and Dr. Wilfred Denetclaw
Cell and Molecular Biology
Faculty Advisor: Dr. Wilfred Denetclaw

Abstract: Sphingomyelin (SM) is a signaling lipid that is expressed in high abundance in the ectoderm and endoderm layers of the chicken embryo, but not in mesoderm or neural tube tissues. The unique location and function of SM suggests that in the ectoderm it may regulate the dorsal somite for myotome formation. It is unknown what role SM has in the ectoderm or if it signals to somites and other dorsal tissues (neural tube). To investigate this problem, we used bacterial (neutral) sphingomyelinase (bSMase) at100 mU/mL and treated the ectoderm layer 2.5 day-old chicken embryos, in ovo, for 6 hours to eliminate SM and verified its presence or absence by lysenin toxin labeling. Our results show that SM in the ectoderm periderm layer is greatly reduced by bSMase as shown by primarily only residual lysenin labeling in cell junction areas versus lysenin labeling over the whole cell surface to show significant loss of the lipid. When embryos were allowed to recover for 15-20 hours from the bSMase ectoderm treatment, an expected 12-14 new somites were made from the segmental plate mesoderm (PSM). The cranial-most 1/3 of somites from the PSM become ssXI-XIV after recovery and they didn't make myotome at DML, but myotome from other parts of dermamyotome in somite. Somites arising from the middle 1/3 region of the PSM become ssVII-X and there was absence of myotome at DML region of somite, but other parts of dermamyotome did made some myotome. Finally, somites made from cells arising from the gastrulating epiblast and the caudal-most 1/3 area of the PSM become ssI-VI and they showed no myotome. In contrast, normal embryos at similar stages of development showed myotome formation in all but the caudal-most 2-3 somites. Overall, the earliest somite to make myotome was ssVII and the latest somite to make myotome was ssX. Moreover, some somites (ssV, VI, VIII) expanded laterally and some cranial somites showed abnormal myotome fibers i.e fibers did not expanded fully from cranial to caudal ends of somite. These results show that SM, the second major lipid type in cell membranes, regulate myotome development in PSM possibly by the formation of other signaling lipids that derive from its catabolic breakdown.

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Entry Number: 12 GL

DESCRIBING ECDYSIS BEHAVIOR IN STICK INSECTS

By: Andrew Carriman
Physiology & Behavioral Biology
Faculty Advisor: Dr. Megumi Fuse

Abstract: A circadian clock controls daily changes in the physiology and behavior of an organism by restricting biochemical, physiological, and behavioral processes to the most advantageous times of the day. This internal temporal organization allows the organism to anticipate the daily changes in environmental conditions. Ecdysis is the shedding of the cuticle, and is a process common to all insects. Ecdysis facilitates the growth, development and survival of the organism, and has been shown to have a circadian rhythmicity in some insects such as the fruit fly and the tobacco hornworm. Both of these organisms are holometabalous organisms, or organisms that undergo complete metamorphosis. In this research I looked at the hemimetabalous insect, the stick insect, which undergoes incomplete metamorphosis, to determine if the ecdysis neural network is conserved between hemimetabolous and holometabolous insects. Using a simple model such as the stick insect should help shed light on the general mechanisms of circadian control, but may also aid in developing environmentally-friendly insect-specific pesticides. Specific Aims: a) Determine whether ecdysis in the stick insect is governed by a circadian rhythm. b) Determine whether the same ecdysis regulatory hormones of the Central nervous System (CNS) found in other insects such as the tobacco hornworm and the fruit fly are conserved in the stick insect. c) Describe the ecdysis behaviors in the stick insect. Methods: Stick insects were stored in regulated light and dark cycles and checked twice daily or multiple times. The CNS of the stick insect and hornworm were tested by immunohistochemistry for expression of 3 compounds, namely the second messenger, cGMP, and two peptides, leucokinin and eclosion hormone. Ecdysis behaviors were monitored videographically and analyzed by eye. Results: We found that a) ecdysis in the stick insect is under circadian control, occurring just before early "dawn", while mechanical

Entry Number: 13 GL

DUAL ROLES OF THE CONSERVED GLC7/PP1 PHOSPHATASES, GSP-3 AND GSP-4, IN CHROMOSOME DYNAMICS AND SPERM ACTIVATION

By: Aiza Cathe A. Go, Bernadette Nera, and Mark Samson
Physiology & Cell and Molecular Biology
Faculty Advisor: Dr. Diana Chu

Abstract: Reproduction depends on sperm accomplishing two goals: traveling to the oocyte and delivering intact paternal DNA. During sperm formation, DNA first undergoes meiosis, then tight compaction that excludes transcription. Thus sperm rely heavily on post-translational regulation to become motile. Glc7/PP1 phosphatases are required for male fertility in mouse, with roles in sperm meiosis and sperm activation required for motility. We identified two Glc7/PP1 phosphatases in C. elegans called GSP-3 and GSP-4. Preliminary analysis has shown GSP-3 and GSP-4 are important for sperm meiosis; however, their role in sperm activation and motility is unknown.

GSP-3 and GSP-4 are 98% identical and function redundantly. Single gsp-3D or gsp-4D mutants display only slight decreases in fertility compared to wild-type.

However, gsp-3D gsp-4D double mutants are completely sterile. To determine GSP-3 and GSP-4 function in sperm for fertility, gsp-3D gsp-4D males were mated with fog-2 mutant hermaphrodites that produce only oocytes. Though fog-2 mated with wild-type produced progeny, none were generated when fog-2 was mated with gsp-3D gsp-4D males. Thus GSP-3 and GSP-4 are required for sperm function. To determine GSP-3 and GSP-4 function in oocytes, wild-type males were mated with gsp-3D gsp-4D hermaphrodites. Mating could be achieved; however, fertility was not fully rescued suggesting a factor blocks wild-type sperm from fertilizing oocytes. This factor may be immotile sperm from the mutant hermaphrodite. In fact, we have observed that gsp-3D gsp-4D sperm exhibit abnormal size, shape, and activation compared to wild-type sperm.

Further supporting dual roles for GSP-3 and GSP-4, immunostaining shows that GSP-3 and GSP-4 localize around sperm chromatin during later stages of spermatogenesis as well as a crescent shape pattern on the cell periphery, reminiscent of the asymmetric localization of the pseudopod. Because PP1 phosphatases work in concert with regulatory subunits, we are conducting both immunolocalization and coimmunoprecipitation experiments to find interacting partners of GSP-3 and GSP-4 that target them to specific sites for function. The finding that these phosphatases have conserved function between C. elegans and mammals is remarkable, considering that mammalian sperm are flagellar and rely on actin for cytoskeletal function, whereas C. elegans sperm are ameboid and utilize MSP for motility.

Entry Number: 14 GL

SENSITIZATION IN *MANDUCA SEXTA*

By: Marissa McMackin and Emily Merchasin
Physiology and Behavior Biology
Faculty Advisor: Dr. Megumi Fuse

Abstract: Behavioral research of the defensive responses in the tobacco hornworm Manduca Sexta has led to motivating questions about the physiology behind the pain response in invertebrates. Although vertebrate research has clearly implicated cAMP and nitric oxide (NO)-cGMP for roles in the pain response, very little is known about the cellular mechanisms underlying the invertebrate pain response. The use of Manduca as an invertebrate pain model has the advantages of both a robust behavioral response to nociceptive stimuli, and an easily accessed central nervous system for observation of cellular changes. The neural signals controlling sensitization are investigated in this paper on both the in vivo and in vitro biology of pain in Manduca. The novel behavioral assay used was created for these studies using a modified Dixon's Up-Down technique, and Von Frey monofilaments for measurement of sensitivity. In these experiments the "strike" behavioral response is used to measure sensitization in the behavioral assay, and is then correlated with the underlying NO-cGMP and cAMP cellular changes in a parallel set of caterpillars under the same stimuli and time points. The time course of sensitization following presentation of noxious stimuli was thoroughly investigated and classified. Injection of both agonists and antagonists of compounds thought to play a role in the nociceptive response were correlated with behavioral changes in nociceptive sensitivity at "acute pain" time points. Immunohistochemistry techniques were used to stain for changes in second messenger concentration in vitro, following in vivo stimuli presentation. In this research sensory neurons were found to undergo cellular changes in

response to pharmacological administration of NO-cGMP agonist compounds, which corresponded to increased sensitivity in the behavioral assay. Our results indicate a conserved mechanism for pain between vertebrates and invertebrates.

Entry Number: 15 GL

DETERMINATION OF THE NEUROTRANSMITTER THAT INHIBITS THE CNS DURING ECDYSIS IN THE HORNWORM, *MANDUCA SEXTA*

By: Laura Mendoza, Sabina Bera, and Adrian Chase
Physiology and Behavioral Biology
Faculty Advisor: Dr. Megumi Fuse

Abstract: Part of the neural mechanisms regulating behaviors includes modulation such as inhibition. In insects, ecdysis, or the shedding of the old cuticle, has become a model for understanding neuromodulation. Part of the regulatory mechanism for ecdysis involves the inhibition of central nervous system neurons. While inhibition has been demonstrated in the tobacco hornworm, Manduca sexta (Zitnan and Adams, 2000; Fuse and Truman, 2002), putatively in the subesophageal ganglion, the neurotransmitter responsible for the inhibition has not yet been determined. Using M. sexta, we propose to determine 1) if GABA (a classic inhibitory neurotransmitter) is localized in the putative inhibitory neurons of the subesophageal ganglion, and 2) if GABA can mimic inhibition of ecdysis onset. These inhibitory neurons show up regulation of cGMP during ecdysis, and cGMP can be identified in these cells immunohistochemically. Thus, the presence of double labels for GABA and cGMP will confirm the presence of GABA in these cells. We have confirmed the findings of previous studies, where the onset of ecdysis occurs significantly sooner when the subesophageal ganglion is removed (removal of inhibition). We will look at the effects of GABA agonists and antagonists in altering timing of ecdysis onset in a similar manner.

Entry Number: 16 GL

EXPANDING YOUR HORIZON PRE-POST SURVEY ANALYSIS

By: Chia Teoh
Cell and Molecular Biology
Faculty Advisor: Dr. Kimberly D. Tanner

Abstract: Each year at SFSU there is Expanding Your Horizon conference. The goal of the conference is to encourage local middle school girls to take more maths and sciences courses and pursue careers in math, science and technology. My project is to analyze the pre-post conference surveys collected from 386 middle school girls.

Entry Number: 17 GL

INVESTIGATING THE EXPERIENCES OF WOMEN OF COLOR IN BIOLOGY

By: Carol Umanzor
Cell and Molecular Biology and Biological Education
Faculty Advisor: Dr. Kimberly Tanner

Abstract: Women of color are one of the most underrepresented populations within the science community. According to National Science Foundation, Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT), in 2006 about 44% of all scientists in Biological/Life science were women, of that 31% were

white women and Asian/Pacific Islanders, black, Latino and American Indian/ Native American women all together made up the remaining 12% (National Science Foundation 2008). Although there have been attempts to promote diversity by scientific institutions such as the NSF and governmental commissions diversity within the sciences still lags. This study aims to examine whether women of color mentors, peers, or models are influential in the success of women of color biology graduate students at SFSU. Through this study, we hope to gain insights that could encourage future generations of women of color to pursue a career in biological research.

Entry Number: 18 GL

MOLECULAR SYSTEMATICS OF *PHACELIA* (BORAGINACEAE).

By: Genevieve K. Walden
Ecology and Systematic Biology
Faculty Advisor: Dr. Robert Patterson

Abstract: *Phacelia* (Boraginaceae) contains two hundred species occurring in North and South America, with California as the center of diversity. Historical taxonomy is based on morphology and chromosome number, recognizing multiple groups within the large genus. This project addresses sectional phylogenetic patterns within Phacelia, with the goal to address sampling gaps across the genus. Analysis uses chloroplast sequence variation to evaluate infrageneric relationships; with preliminary results supporting previous studies that suggest species group Pulchellae and Humiles are not monophyletic. Future work includes comprehensive fieldwork and analyses with additional molecular markers.

Entry Number: 19 GL

ARTHROPOD DIVERSITY ON THE CALIFORNIA ACADEMY OF SCIENCES' GREEN ROOF

By: Jessica Van Den Berg and Christopher Quock
Ecology and Systematic Biology
Faculty Advisor: Dr. John Hafernik

Abstract: I am conducting a comprehensive survey of arthropod diversity on the California Academy of Sciences' green roof. The sampling regime includes pitfall and pantraps and is performed monthly for one year, August 2007 to July 2008. DNA barcoding and digital macro photography will be used to assign individual arthropods to morphospecies to provide an accurate number of total arthropod species.I will use a variety of statistical methods to identify seaonal and temporal patterns in arthropod composition and density and the rate of colonizationfrom the surrounding park. I predict that the arthropod diversity will be positively correlated with plant species diversity. I also predict that the various mircohabitats on the roof will support different arthropod assemblages. This database will serve as a baseline to detect changes in insect assemblages as the roof matures over time. I addition, the results of this research will help fill a void in green roof knowledge and hopefully influence future green roof designs in regards to enhancing urban ecosystems.

Entry Number: 20 GL

METABOLIC RESPONSES TO ENVIRONMENTAL SALINITY IN THE CLAM CORBULA AMURENSIS

By: Adam Paganini and Dr. Jonathon Stillman
Marine Biology
Faculty Advisors: Dr. Jonathon Stillman and Dr. Wim Kimmerer

Abstract: METABOLIC RESPONSES TO ENVIRONMENTAL SALINITY IN THE CLAM CORBULA AMURENSIS Adam Paganini and Jonathon Stillman Romberg Tiburon Center, SFSU, 3150 Paradise Drive, Tiburon CA 94920 The Asian or overbite clam Corbula amurensis is believed to have caused a large shift in the pelagic food web in the northern part of San Francisco Bay since its introduction in the 1980s. This shift is believed to be due to the clam?s high density and filtration rates. We have investigated the metabolic responses of C. amurensis following acclimation to constant or fluctuating salinities. We measured growth rate, feeding rate, respiration rate, and activities of enzymes involved in metabolism and ion regulation in acclimated clams. On average, clams did not grow during a three-month period at either high or low salinity. Clams fed faster following acclimation to high salinity. Activity of malate dehydrogenase (MDH), an overall indicator of metabolism, did not differ significantly with respect to acclimation salinity, however means were higher at high salinity. In comparison to other bivalve species Venus mercenaria and Venerupis japonica, C. amurensis had significantly higher MDH activities. Activities of citrate synthase had a positive relationship with respect to acclimation salinity, suggesting higher respiration rates at higher salinities. Activity of Na+/K+ ATPase, an ion regulation enzyme, may be higher following acclimation to elevated salinity, suggesting that the higher metabolic rates could be to support osmoregulation. Overall, our data suggest that clams experiencing higher salinities may have a higher metabolic demand and filtration rate, but put less of their metabolic energy into growth or reproduction.

Entry Number: 21 GL

IDENTIFYING NOVEL PROTEIN STABLIZERS BY CO-IMMUNOPRECIPITATION IN PORCELAIN CRABS, GENUS *Petrolisthes*

By: Andrea Cayenne
Marine Biology
Faculty Advisor: Dr. Jonathon Stillman

Abstract: Biochemical adaptation of enzymes, specifically those involving sequence variation among orthologous homologues, allows organisms to conserve metabolic kinetic properties in a wide range of environmental conditions. However, the role(s) of protein-protein interactions in enzyme adaptation are less well understood. Previous examination of the glycolytic enzyme lactate dehydrogenase (LDH) in porcelain crabs showed that interspecific differences in thermal stability were related to both intrinsic and extrinsic protein stabilizers. Here, we attempted to identify the extrinsic stabilizing proteins in porcelain crab muscle tissue using co-immunoprecipitation. IgG anti-Petrolisthes cinctipes LDH along with Protein-A sepherose beads were used to isolate LDH from a crab muscle tissue homoginate, along with its stabilizing proteins. The resulting protein samples were then run on a 12% SDS-PAGE and Coomassie Blue

stained. We found bands with molecular weights of 190, 90, 85, 80, and 45 kDa that were not present in either the purified LDH, IgG, or Protein-A beads samples. These bands were excised from the gel and the proteins were digested and analyzed using peptide mass fingerprinting (MS/MS) using MALDI-TOF/TOF mass spectrometry. Sequencing results identified these proteins to be actin, myocin, and hemocyanin. Further seperaration of protein samples were achieved using 2D gel electrophorsis. Mass spec. analysis of resulting spots identified several glycolitic enzymes Additonal species will be examined using the same methods including Petrolisthes cinctipes. Funded by: NIH MBRS-SCORE to JHS, and NIH-RISE

Entry Number: 22 GL

INVESTIGATING BAY AREA FILIPINOS' IDEAS TOWARD ENVIRONMENTAL CONSERVATION IN A MUSEUM SETTING

By: Courtney Scott
Marine Biology
Faculty Advisor: Dr. Kimberly D. Tanner

Abstract: Over the last three decades, many science centers have shifted their focus to a more conservation-oriented agenda. One population that is absent from the museum education research literature is the Filipino-American population. My study aims to understand how effective the California Academy of Sciences' (CAS) Philippine Coral Reef exhibit is at educating a segment of the public on the importance of coral reefs while teaching the public about the threats and conservation efforts. To conduct this research, I have collect pre- and post-assessment responses from Bay Area Filipinos' before and immediately following their viewing of the exhibit. A subset of these subjects have been interviewed to further probe emerging themes and enduring impressions. Preliminary data shows that viewing the exhibit creates a shift in conceptual knowledge. Analysis of a question on participants' understanding of corals in a coral reef revealed that 54% of participants incorrectly thought that coral was a plant before seeing the exhibit. After viewing the exhibit, 77% correctly answered that corals are animals. Perhaps surprisingly, preliminary data also shows that when participants were probed to discuss what was most memorable about the Philippine Coral Reef exhibit at CAS, only 5% commented on the exhibit's connection with the Philippines. We predicted that this population would express a stronger cultural grounding with the exhibit. Drawing insight from this subset of Filipino-Americans' recorded conceptual knowledge and attitudes may aid in the inclusion of the perspectives of people of color in museum exhibit development and informal education curriculum.

Entry Number: 23 GL

MICROARRAY ANALYSIS OF HEAT STRESS IN SAMOAN CORALS

By: Tyler Waterson and Dr. Jonathon Stillman
Marine Biology
Faculty Advisor: Dr. Jonathon Stillman

Abstract: This project analyzes gene expression during heat stress of corals hosting different clades of algal symbionts and corals with different thermal history (microhabitat)

Entry Number: 24 GL

EFFECT OF BINDING FATTY ACIDS ON THE GLYCATION OF HUMAN SERUM ALBUMIN

By: April Ranney and Emelia Padilla
Biochemistry
Faculty Advisor: Dr. Raymond Esquerra

Abstract: Diabetes is a disease, which according to the World Health Organization, affects more than 180 million people, causing roughly 1.1 million deaths in 2005. The number of people suffering from diabetes is expected to double in the next two decades. Diabetes is categorized as several types of diseases characterized by hypoglycemia, or elevated blood glucose levels. Hyperglycemia results in the formation of non-enzymatically glycated human serum albumin (gHSA), which eventually forms advanced glycation end-products (AGEs). AGEs have been linked to nearly all of the complications associated with diabetes. Glycation and AGE formation occurs primarily on lysine residues in HSA, which are the same residues that stabilize the binding of fatty acids to HSA. We hypothesize that the binding of fatty acids will decrease the amount of HSA glycation. To test this hypothesis we examined the effect of binding fatty acids on the glycation and AGE formation in HSA through several different techniques: a fructosamine assay, tandem mass spectrometry, and fluorescence spectroscopy. Our results are indicating that the binding of fatty acids alters how glycation occurs in HSA. This may help explain why certain individuals with similar glycemic indexes exhibit different diabetic complications. Understanding the chemistry controlling how glycation and AGEs are formed and differ amongst individuals is crucial in discovering the molecular mechanism behind the course of diabetic complications, and in developing treatments and therapies.

Entry Number: 25 GL

ROLE OF CONFORMATIONAL CHANGES IN SOLUBLE GUANYLATE CYCLASE

By: Jasmin Kristianto, Kensuke Yamamoto, Stephanie Wood, and Makena Muchunku
Biochemistry
Faculty Advisor: Dr. Nancy Gerber

Abstract: Nitric Oxide (NO) is an important signaling molecule that is involved in many physiological processes. In cells, NO is produced by Nitric Oxide Synthases (NOs) then bind to its principal receptor Soluble Guanylate Cyclase (sGC). Upon NO binding, sGC activity increases as it catalyzes the conversion of its substrate GTP to cGMP. As a second messenger, cGMP regulates series of proteins further downstream in the signaling cascade that promotes smooth muscle relaxation, vasodilation, and also inhibits platelet aggregation. Hence, sGC is targeted as a possible therapeutic agent for treatment in pulmonary hypertension and prevention of blood clot formation. Recent interest revolves around the different sGC effectors that may increase the enzyme activity and cGMP production. Intrinsically, CO and NO bind to sGC inducing different activity levels of 5 fold and 400 fold respectively. Synthetic compound, such as YC-1 and BAY 41-2272, activates sGC up to 10 fold independently from NO. However, the presence of both NO and YC-1 molecule pose an additive effect on sGC activity. YC-1 has also been noted to

work synergistically with CO increasing activation level that is comparable to NO. Our objective is to distinguish of the sGC activation mechanism between sGC/CO/YC-1 and sGC/NO/YC-1 complex from a structural perspective. Current information has indicated that sGC/CO/YC-1 forms a 6-coordinate complex while sGC/NO/YC-1 forms a 5-coordinate complex. Unfortunately, there are limited information on the binding sites interactions and the overall structure of the enzyme upon activation. We employed fluorescence spectroscopy and Fluorescence resonance energy transfer (FRET) to detect any local environment perturbation upon activation.

Entry Number: 26 GL

S-NITROSYLATION OF SOLUBLE GUANYLYL CYCLASE

By: Kensuke Yamamoto
Biochemistry
Faculty Advisor: Dr. Nancy Gerber

Abstract: Soluble guanylyl cyclase (sGC) is a main receptor for the signal transduction of nitric oxide (NO). The signaling molecule, NO plays important roles in physiology including vascular and smooth muscle relaxation, blood vessel relaxation, cerebral blood flow, platelet aggregation, neurotransmission, egg fertilization. sGC is a heme-containing heterodimer composed of a and b subunits. sGC catalyzes a reaction in which guanosine 5'-triphosphate (GTP) is converted to the 3', 5'-cyclic monophosphate (cGMP) and pyrophosphate (PPi) with stimulation by NO. sGMP is the secondary messenger that binds to down stream cGMP-dependent regulators such as Ca2+ channels or enzymes including cGMP-dependent proteins kinase (PKG) and phosphodiesterase (PDE). S-nitrosylation, the formation of a thionitrite (-S-N=O) group on cysteine residues, is a post-translational modification that can result in altering the structure, function, activity, and stability of various proteins. The purpose of this study is to determine the mechanisms of sGC including the location of the effectors binding sites and posttranslational modification sites by biotin switch method and mass spectrometry. Since the crystal structure of sGC has not been obtained yet, the studying the S-nitrosylation site could be one of aspects to approach the determination of the structure of the protein.

Entry Number: 27 GL

USING TIME-RESOLVED FLUORESCENCE TO LOOK AT PROTEIN CONFORMATION

By: Stephanie Wood
Biochemistry
Faculty Advisor: Dr. Nancy Gerber

Abstract: Fluorescence Resonance Energy Transfer (FRET) uses two different fluorophores, a donor and an acceptor. Excitation of the donor creates an energy transfer to the acceptor, assuming they are close enough to each other. The acceptor will then emit light, which can be observed. Time-resolved FRET can look at individual lifetimes of donors and acceptors, eliminating the background fluorescence scattering. Since this is a new instrument to the university, the first step is to make sure that known lifetimes can be replicated. Free tryptophan in solution absorbs light at about 290 nanometers. It is being excited at 295 nanometers in the time resolved fluoremeter. The literature value for

free tryptophan's decay lifetime is 5 nanoseconds. On this time resolved fluoremeter, the lifetime of free tryptophan is 4.5 nanoseconds. The instrument can also be used to determine unknown lifetimes of fluorescent molecules. It will be used to determine lifetimes of the four tryptophans which soluble guanylate cyclase possesses, our lab's protein of interest. This information will give important conformation details about the protein.

Entry Number: 28 GL

THE ORIGIN OF THE pH DEPENDENCE ON LIGAND RECOMBINATION FOLLOWING PHOTOLYSIS OF SPERM WHALE CARBONMONOXYMYOGLOBIN

By: Benjamin Lintner and Ignacio Lopez
Chemistry
Faculty Advisor: Dr. Raymond Esquerra

Abstract: The rate of ligand recombination of carbon monoxide following laser photolysis of sperm whale myoglobin exhibits a large pH dependence, with the rate becoming considerably faster as the pH is lowered below 5. The origin of this effect has been previously explained by the protonation of the proximal histidine, forming a tetracoordinate heme moiety. We hypothesize that the observed pH dependence of ligand binding kinetics is primarily due to the protonation of the distal histidine, thusly altering water occupancy within the distal pocket. We measured the pH dependence of the recombination kinetics in the Soret band absorption for a series of distal histidine mutants including H64V, H64Q, H64A, H64G and H64L. The large pH dependence of the CO recombination kinetics disappears in these distal histidine mutants, indicating that the protonation of the distal histidine is primarily responsible for the large pH dependence to the ligand recombination kinetics in sperm whale myoglobin. We have measured water occupancy via time-resolved spectroscopy in order to detect the perturbation of the heme visible band absorption spectrum, which is caused by water entry, post CO photodissociation [J Biol Chem. 2008;20,14165]. We demonstrate, in this case, that the largest effect from changes in pH is an indirect effect on water occupancy. Internal water molecules are often obscured in x-ray crystallography by positional disorder but their importance in controlling protein function is becoming more evident. Because water plays such an important role in regulating ligand binding and catalysis in myoglobin and other proteins, this work provides a chemical description on how the protein matrix controls internal water molecules

Entry Number: 29 GL

THE EFFECT OF CALMODULIN AND CALCIUM BINDING ON THE REACTIVITY OF THE HEME ACTIVE SITE IN NNOS

By: Mike Minton, Pooncharas Tipgunlakant, Luiz Galdino, and Christopher M. Bernt
Chemistry
Faculty Advisor: Dr. Raymond Esquerra

Abstract: Multichannel (380-480 nm) nanosecond time-resolved absorption spectroscopy following carbon monoxide (CO) photolysis of neuronal nitric oxide synthase (nNOS) was used as a function of Ca2+/calmodulin binding to probe the nNOS active site environment. We found that Ca2+/calmodulin binding directly influences the

heme active site reactivity. The addition of the calmodulin cofactor significantly increased the observed geminate and bimolecular CO binding rates in nNOS. The change in the observed rebinding kinetics indicates that calmodulin binding induces conformational changes that directly alter active site exposure to the solvent and lower the barrier to CO binding at the heme active site. The nNOS CO rebinding kinetics shows two observable biomolecular recombination phases, which are distinguished by small shifts in the absorption maxima and may reflect a slowly converting conformational equilibrium between two species with different CO rebinding rates. The effect of Ca2+/calmodulin binding is described in terms of a model in which calmodulin binding shifts the equilibrium towards the faster CO rebinding species. We have also studied the binding affinity of nNOS to and the effect of Ca2+ ions in solution. We have determined that this divalent metal lowers CO binding energy at the heme active site suggesting perhaps a local metal binding mechanism yet unknown that modulates conformational changes at the heme pocket making it more accessible. Activity curves for calcium using metal depleted, cofactor bound nNOS indicate an expected increase in activity up to 1mM, followed by a decrease at concentrations over 10mM. Knowledge of how calmodulin and divalent metals induce conformational changes that modulate active site reactivity helps in understanding how nitric oxide production is regulated physiologically.

Entry Number: 30 GL

SOLUTION STRUCTURE OF PROTEINS BY MD SIMULATION

By: Qiuting Hong
Chemistry
Faculty Advisor: Dr. Sergio Aragon

Abstract: Hydrodynamic properties, such as viscosity, and transport properties describe how a particle moves in a fluid. The study of these properties is one of the major ways to know the molecular weight, shape, and size in solution. Usually, coordinates from X-Ray crystallography are used for the hydrodynamic properties computation. However, for some small proteins, our computational result is different from the experimental result. In this project, molecular dynamic simulation is done for these molecules. A shift of hydrodynamic properties will be observed along with time if the structure changes in solution state.

Entry Number: 31 GP

ORDERED TITANIUM DIOXIDE FILMS GROWN ON SELF-ASSEMBLED MONOLAYERS

By: Shirin M. Usmani, Diana Mars, and Dr. Andrew S. Ichimura
Chemistry
Faculty Advisor: Dr. Andrew S. Ichimura

Abstract: Titanium dioxide finds extensive applications as pigments, in medicine, wastewater remediation, oxidative photocatalysis, and in dye-sensitized solar cells. Applications such as hybrid solar cells utilize thin films of titanium dioxide as the electron transport material. Typically, the films are prepared from TiO2 nanoparticle containing sols that are spin-coated onto substrates and subsequently sintered to induce phase transformation and interparticle contact. We have pursued a strategy of thin film

preparation that involves growth of crystalline TiO2 directly onto a functionalized surface from homogeneous solutions. In this approach, a densely packed self-assembled monolayer (SAM) with a terminal Ti-OH functional group is used to chemically bond the film to the underlying gold substrate.
The advantage of this method is that resultant films are highly ordered polycrystalline arrays in which monolithic crystals span the film from substrate to external surface. This arrangement may facilitate charge transport across the layer and thus decrease the probability of electron-hole recombination. In a larger sense, SAM chemistry allows us to explore avenues for controlling crystal growth through a tailoring of the surface of the substrate. In this work, anatase and rutile films grown on Ti-OH terminated SAMs from homogeneous solution will be described. Characterization methods include powder X-ray diffraction, HR-SEM, IR, UV-vis-NIR spectroscopy, and 4-probe conductivity studies.

Entry Number: 32 GP
XMAS: EXPERIENTIAL VISUALIZATION, MINING, AND ANALYSIS OF TIME-SERIES MICROARRAY EXPERIMENTS
By: Ben Dalziel
Computer Science
Faculty Advisor: Dr. Hui Yang and Dr. Rahul Singh
Abstract: XMAS (eXperiential Microarray Analysis System) is software for time-series microarray data visualization, analysis, knowledge discovery, and hypothesis formulation. The design paradigm underlying XMAS facilitates a harmonious synergy between human and computer, where the human skills of domain knowledge application, contextual reasoning, and purpose-driven exploration are seamlessly combined with computable operations that support large-scale data analysis, multifaceted data visualization, and multi-source data integration.

Entry Number: 33 GP
DIRECTIONAL MEAN SHIFT
By: Mehran Kafai and Yiyi Miao
Computer Science
Faculty Advisor: Dr. Kazunori Okada
Abstract: In this research project we introduce directional mean shift (DMS). Mean shift is a well-known adaptive step-size mode seeking algorithm for kernel density function, which has been widely adapted to various vision and pattern analysis problems. The proposed DMS extends the mean shift for handling directional statistics; toward analyzing directional data which occurs commonly in vision problems. Defining a metric for measuring directional distances, we derive DMS algorithm as a convergent mode seeker for a kernel density function defined over circular domains. As our further contributions, we provide a formal convergent proof and demonstrate adaptations of DMS to two different applications: 1) image segmentation in the HSV color space and 2) 3D medical structure topology classification. For the former, DMS is used to perform image segmentation with the circular hue component. For the latter, DMS is used to solve a clustering problem with a 2D image unfolded from a 3D spherical data. In both applications, our experiments demonstrate the effectiveness of DMS in contrast to the original mean shift defined in Euclidean domain.

Entry Number: 34 GP

AUTOMATED IMAGE-BASED PHENOTYPIC SCREENING FOR HIGH-THROUGHPUT DRUG DISCOVERY

By: Michalis Pittas and Ido Heskia
Mathematics
Faculty Advisor: Dr. Rahul Singh

Abstract: At the state-of-the-art in drug discovery, one of the key challenges is to develop high-throughput screening (HTS) techniques that can measure changes as a continuum of complex phenotypes induced in a target pathogen. Such measurements are crucial in developing therapeutics against diseases like schistosomiasis, trypanosomiasis, and leishmaniasis, which impact millions worldwide. These diseases are caused by parasites that can manifest a variety of phenotypes at any given point in time in response to drugs. Consequently, a single end-point measurement of 'live or death' (e.g., ED50 value) commonly used for lead identification is over-simplistic for such diseases. Given this problem context, in this paper, we present a method that constitutes a significant advancement. In the proposed method parasites are tracked during the entire course of (video) recorded observations and changes in their appearance-based and behavioral characteristics are quantified using geometric, texture-based, color-based, and motion-based descriptors. Subsequently, within the on-line setting, a collection of SVM-based classifiers analyze the descriptors and classify the exhibited phenotypes into well defined categories. Important advancements introduced as a consequence of the proposed approach include: (1) ability to assess the interactions between putative drugs and parasites in terms of multiple appearance and behavior-based phenotypes, (2) automatic classification of pathogen phenotypes, and (3) quantification of phenotypes leading to the possibility of creating robust quantitative structure-activity models for developing drugs. Experimental data from lead identification studies against the disease schistosomiasis validate the proposed methodology.

Entry Number: 35 GP

WEB-BASED TOOLS FOR ENHANCING TEACHER PREPARATION PROGRAMS

By: Xinhang Shao and Ngoc Lam-Miller
Computer Science
Faculty Advisor: Dr. Kazunori Okada

Abstract: This project is to deploy a web-based support tool for pre-service credential candidates in special education at SFSU. Our web-based application is divided into two major components: E-portfolio Manager and Lesson Plan Creator. E-portfolio will move paper-based assignments, artifacts and evaluation forms into digital format for efficient management and assessment of credential candidate work. Lesson Plan Creator system is designed with the idea of shortening the amount of time required for creating sound lesson plans. Additionally, the whole system collects and manages statistical data for program improvement, thus increasing the quality of teaching.

Entry Number: 36 GP

ANALYSIS OF SRAM RELIABILITY UNDER VARIATIONS AND TRANSISTOR AGING EFFECTS IN NANO-SCALE

By: Harwinder Singh
Electrical and Computer Engineering
Faculty Advisor: Dr. Hamid Mahmoodi

Abstract: As dimensions of MOS devices have been scaled down, new reliability problems are coming into effect. One of these emerging reliability issues is aging effects which result in device performance degradation over time. NBTI (Negative biased temperature instability) is a well known aging phenomenon which is a limiting factor for future scaling of devices. NBTI results in the generation of trapped charges which cause Vt (threshold voltage) degradation of PMOS. It is observed that a sharp Vt shift occurs in just a few seconds after turning on the MOSFET. In nano-scale CMOS technologies, process (threshold voltage) and temperature variations are also crucial reliability concerns. On the other hand, NBTI itself is dependent on temperature and threshold voltage. In this paper, the combined effect of NBTI, process and temperature variations on the reliability of the 6T SRAM (Static Random Access Memory) in 32nm CMOS technology is analyzed. It is observed that: (1) Vt abruptly increases initially and afterwards Vt shift is very small, even for prolonged time; (2) Low Vt transistors age faster than high Vt transistors; and (3) NBTI Vt degradation is more significant at higher temperature. Along with these observations, we also quantified our results in terms of number of faulty cells. It is observed that: (1) number of faulty cells rise over time (from 5.45% to 6.32% for the inter-die nominal Vt chip over 10 years) due to SNM degradation; (2) rise in the number of faulty cells over time due to write failures under NBTI effect is practically negligible; (3) Leakage improves due to NBTI Vt degradation and low Vt chips gain more leakage improvement (2.73% leakage reduction) as compare to high Vt chips (1.76% leakage reduction); and (4) access time is not impacted by NBTI.

Entry Number: 37 GP

RAIL TRAFFIC CONTROL SIMULATOR FOR MAXIMIZING THROUGHPUT

By: Ko Narita
Electrical Engineering
Faculty Advisor: Dr. V.V. Krishnan

Abstract: This project is the first step of the new transportation system to realize high throughput and lower construction cost than conventional transportations. The idea is that a single-lane road, which includes several passing-through areas, is used, and makes the traffic flow more smooth adopting a new control scheme. Simulations will confirm that the control scheme makes the traffic flow smooth and efficiently, and investigates its crash. In addition to simulations, I form the maximum throughput of this unique transportation system. After the confirmation of the preliminary control schemes, the error analyses are discussed in this thesis. When these errors are fatal, doubled or tripled safety measures are considered.

Entry Number: 38 GP

POST-MIDDLE-PLEISTOCENE TECTONIC DEVELOPMENT OF THE CONFIDENCE HILLS, SOUTHERN DEATH VALLEY, CALIFORNIA

By: Joshua T. Goodman, Dr. S. John Caskey, Dr. Elmira Wan, Dr. David B. Wahl, and Dr. Andrei M. Sarna-Wojicicki
Geology
Faculty Advisor: Dr. S. John Caskey

Abstract: We used detailed geologic mapping and tephrochronology to provide new constraints on the style, timing, and rates of young (i.e., Quaternary) deformation in the Confidence Hills (CH). Geometric relationships suggest that the earliest demonstrable deformation in the CH began as fault-propogation folding above a blind thrust fault(s). This earlier folding initiated in the southern CH after deposition of the upper tuffs of Glass Mountain tephra (1.1-0.9 Ma), and prior to deposition of an older fanglomerate unit; it subsequently migrated into the north-central CH following deposition of the older fanglomerate, which is folded concordantly with Plio-Pleistocene strata of the underlying Confidence Hills Formation. The cessation of the earlier folding is constrained by an unconformably-overlying younger fanglomerate unit, which contains tephra tentatively correlated to the Bishop (0.76 Ma) and Lava Creek B (0.64 Ma) tuffs. The northernmost margin of the younger fanglomerate, which was likely controlled by the earlier folding, is right-laterally offset ~700 m across the active trace of the Southern Death Valley fault zone (SDVFZ). This yields a minimum post-middle-Pleistocene slip-rate of ~1 mm/yr.

Entry Number: 39 GP

STUDENT CONCEPTIONS OF WEATHER PHENOMENA ACROSS MULTIPLE COGNITIVE LEVELS

By: Elizabeth Polito
Geosciences
Faculty Advisors: Dr. John Monteverdi and Dr. Kimberly Tanner

Abstract: Meteorological content is presented in K-12 educational standards and in university general education courses, yet little research has been done to explore how students conceptualize weather phenomena. My project goal is to explore the question: what are students conceptions of wind, fog, and tornadoes, and how do they compare across cognitive levels—middle school students, university non-science students, and university meteorology major students. My research utilized a two-phase methodological approach to identify conceptions and misconceptions about these weather topics. Preliminary results from phase I probing student conceptions of wind show that students do not necessarily see a connection between the energy received from the sun and the generation of wind. One emerging theme in student responses was that because the sun is not present at night, but there can be wind at night, and as such the sun couldn't possibly play a role. This idea was found repeatedly, with 11% of middle school students and 11% of university non-science students presenting the same rationale. By identifying students' misconceptions about weather, scientists and educators can create experiences that will help students move toward a more scientific viewpoint.

Entry Number: 40 GP

A 3-D MAP OF THE BARTLETT SPRINGS FAULT, LAKE AND MENDOCINO COUNTIES, CALIFORNIA

By: Johnathan Brown
Geosciences
Faculty Advisor: Dr. S. John Caskey

Abstract: Using corrected magnitude and location data for northern California earthquakes, I am creating a 3-D map of the Bartlett Springs Fault zone in Lake and Mendocino Counties as a part of my overall thesis project. The seismicity shows the active subsurface portions of the fault zone that, when combined with mapped surface traces, shows which ones are the most likely to be (or have been) recently active.

Entry Number: 41 GP

M2K: A SEARCH FOR PLANETS ORBITING LATE K AND EARLY M DWARF STARS

By: Kelsey Clubb
Astronomy
Faculty Advisor: Dr. Debra Fischer

Abstract: Radial velocity surveys for exoplanets are monitoring almost every bright, chromospherically inactive solar-type star (late F, G, and early K-type) within 30 parsecs, however, fewer than 10% of late K and early M dwarf stars in the same volume are being monitored. In September 2008, we launched a spectroscopic survey of late-type stars with a goal of detecting planets as small as our Earth that might be orbiting them. Observations of over 100 stars in our survey have already been obtained with the Keck I telescope in Hawaii and our preliminary results will be presented. This ongoing project will nearly double the total number of late K and early M dwarfs currently being surveyed, significantly improving our ability to understand the relationship between stellar mass and planetary mass and perhaps allow us to discover the first Earth-mass exoplanet.

Entry Number: 42 GP

DECODING DARK MATTER: A DYNAMICAL CODE FOR THE JOINT ANALYSIS OF CLUSTER OBSERVATIONS

By: Alison Mansheim
Physics
Faculty Advisor: Dr. Andisheh Mahdavi

Abstract: Here I present a new module that adds a dynamical with anisotropy and dark matter slope? component to the JACO (Joint Analysis of Cluster Observations). JACO is a massively parallel codebase for deriving constraints on the structure of galaxy clusters using X-ray, weak gravitational lensing, and Sunyaev-Zel'dovich data. The new module augments the existing codebase by calculating line-of-sight velocity dispersion profiles through solutions of the Jeans equation for arbitrary spherical mass and velocity anisotropy profiles. The resulting dynamical constraints will allow us to probe the dark matter distribution in a cluster of galaxies using line-width spectroscopy of the Brightest Cluster Galaxy as well as redshift surveys of member galaxies at large radii. Dynamical observations are expected to be the most robust mass

indicators (other than rarely occurring strong lenses) in the innermost regions of clusters where steep central dark matter profiles are expected.

Entry Number: 43 GP
PROVING THE BERNOULLI-DEDEKIND SUM ANALOGUE OF POMMERSHEIM'S THREE-TERM DEDEKIND SUM RELATION
By: Anastasia Chavez
Mathematics
Faculty Advisor: Dr. Matthias Beck
Abstract: In the 1880's, Richard Dedekind derived a finite arithmetic sum that today is called the Dedekind sum. Since then the Dedekind sum has appeared in many areas of mathematics such as topology, geometry, and combinatorics. Apostel, Carlitz , and others have introduced Dedekind-like sums involving Bernoulli polynomials. Bernoulli polynomials are defined by a generating function and give rise to the Bernoulli numbers when a polynomial is evaluated at 0, which has also appeared in various mathematical areas. In recent work by Beck, Haase and Matthews (2008) a polynomial analogue of Dedekind sums, the Carlitz polynomial, was used to prove results using discrete geometry. I present the formulas for Dedekind sums, Carlitz polynomials, Bernoulli polynomials and numbers, and give motivation for my thesis work to reprove known theorems and hopefully discover new results of Dedekind sums involving Bernoulli polynomials.

Entry Number: 44 GP
USING HOMOLOGY TO DETECT COPY NUMBER VARIATION ASSOCIATED WITH BREAST CANCER RECURRENCE
By: Daniel DeWoskin
Mathematics
Faculty Advisor: Dr. Javier Arsuaga
Abstract: Adjuvant chemotherapy is prescribed to large numbers of breast cancer patients, yet current methods for predicting the effectiveness of this treatment are insufficient. In this presentation, we introduce a new mathematical model for characterizing tumors based on their comparative genomic hybridization (CGH) profiles. CGH provides a method for describing genomic abnormalities in tumor cells by measuring sequence copy number variation. Using a computational homology approach for analysis of a patient’s CGH profile, we are able to find aberrations associated with breast cancer recurrence in the absence of chemotherapy.

Entry Number: 45 GP
MODELING SOCIAL NETWORKS USING A RANDOM WALK ON A TORUS
By: Elizabeth Gross
Mathematics
Faculty Advisor: Dr. Arek Goetz
Abstract: While there are several techniques to model the spatial properties of social networks, there are few models that capture the dynamics of such systems. We explore a stochastic model for the dynamics of social networks and compare the results with observed data and analyze the long-term behavior.

Entry Number: 46 GP

EXIT STRATEGIES FOR STARTUP COMPANIES: A GAME THEORETIC APPROACH

By: Jasdeep Gambhir
Mathematics
Faculty Advisor: Dr. Jean-Pierre Langlois

Abstract: We use Game Theory to model exit strategies for startup companies.

Entry Number: 47 GP

TANGLESOLVE: A TOPOLOGICAL TOOL USED IN THE ANALYSIS OF SITE-SPECIFIC RECOMBINATION

By: Jennifer Lopez, Wenjing Zheng, and Dr. Mariel Vazquez
Mathematics
Faculty Advisor: Dr. Mariel Vazquez

Abstract: TangleSolve is a java applet that implements the tangle method for site-specific recombination. Site-specific recombinases catalyze the exchange of genetic material between specific sites on a DNA molecule. In general, substrates and products of recombination belong to a well characterized family of knots and links called 4-plats. The tangle method models site-specific recombination by a system of tangle equations which are easy but tedious to calculate. These equations can be solved for rational or sums of rational tangles. TangleSolve offers an interactive tool to compute these tangle equations and displays their solutions pictorially (Saka and Vazquez, 2002).
In (Buck and Flapan, 2007), the authors propose a characterization of solutions arising from site-specific recombination reactions. This characterization is independent of the tangle method. We plan to incorporate the assumptions and findings of D. Buck and E. Flapan into TangleSolve.
This work is done in collaboration with Mariel Vazquez, Wenjing Zheng, and Yuki Saka.
Buck, D, Flapan, E. (2007) A topological characterization of knots and links arising from site-specific recombination, J. Phys. A: Math. Theorm. 40, 12377 – 12395.
Saka, Y.& Vazquez, M. (2002). TangleSolve: topological analysis of site- specific recombination. Bioinformatics, 18, 1011-1012

Entry Number: 48 GP

COUNTING STANDARD AND SEMISTANDARD TREES

By: Jupei Hsiao
Mathematics
Faculty Advisor: Dr. Federico Ardila

Abstract: Standard and semistandard trees are certain graphs which arise in the study of triangulations of the root polytope A_n. Through observations from the drawings of these trees, some important charaterizations were made which lead to an algorithm that gives all the semistandard trees on n vertices and a formula for the number of semistandard trees on n vertices.

Entry Number: 49 GP

ORIENTED MATROIDS AND SUBDIVISIONS OF PRODUCTS OF SIMPLICES

By: Kristen Freeman
Mathematics
Faculty Advisor: Dr. Federico Ardila

Abstract: I want to show there is a one to one correspondence between the subdivisions of the product of simplices and tropical oriented matroids. A tropical oriented matroid is a combinatorial object which is modeled after tropical hyperplane arrangements and tropical polytopes. One direction of this conjecture has already been shown, that tropical oriented matroids correspond with subdivisions of the product of simplices, and in the opposite direction for the special case of d=3 which I will try to expand on.

Entry Number: 50 GP

THE STUDY OF DNA PACKING ORGANIZATION OF P4 BACTERIOPHAGE

By: Mela Hardin
Mathematics
Faculty Advisor: Dr. Mariel Vazquez

Abstract: Packaging of linear double-stranded DNA in icosahedral bacteriophages is a process that involves the compression of large amounts of DNA into a small confined space, the capsid. This process has been shown to be correlated to distinct distributions of knotted DNA, which highly suggests non-randomness. While knotting has been known to occur, the processes that create these knots are not fully understood. The distribution of knots extracted from P4 bacteriophages are analyzed using 2-D high-resolution gel electrophoresis. Our group has developed Monte Carlo computer simulations of DNA knots in free space and in confined volumes. Our simulations provide evidence that the knot distribution observed experimentally is not due to confinement alone, but also to writhe biases. Several models have been suggested to explain this packaging process, but the coaxially spooled model is one that accounts for both the distributions of complex knots as well as the chirality biases. I will present an overview of this work here.

Entry Number: 51 GP

A SURVEY THE ENTROPY OF SELF-AVOIDING POLYGONS IN THE SIMPLE CUBIC LATTICE

By: Zoe Talbot
Mathematics
Faculty Advisors: Dr. Yitwah Cheung, Dr. Rob Scharein, and Dr. Mariel Vazquez

Abstract: Self-avoiding polygons (SAP) are a widely used model for studying the dynamics of polymer chains. Because of their topological property of being closed, we can use them to study covalently closed circular DNA forms also known as plasmid DNA. The goal of this project is to determine the extent to which SAP's restricted to the simple cubic lattice explore topological and geometric variation within the thermal fluctuations of plasmid DNA forms. To generate sample spaces of SAP's we use the BFACF algorithm which a Monte Carlo simulation method that samples the space of SAP's restricted to the simple cubic lattice Z3. We use the entropy of an SAP under the BFACF algorithm and the potential energy as used by Tesi et. al. to determine how well

the algorithm samples the space of SAP's within a knot class. Here, we define entropy of an SAP as the number of possible BFACF moves allowed after one iteration of the algorithm. Intuitively, entropy tells us how much room an SAP has to move around in Z3, which implicitly tells us something about levels of supercoiling and overall entanglement a polygon exhibits. We here present some basic definitions and lemmas relating to entropy, show probability distributions of entropy to length ratios for varying classes of knots, prove an interesting relationship between the entropy and length of an SAP, and make comparisons between the entropy and energy of an SAP.

Entry Number: 52 UL

STUDYING SPOOLING-LIKE CONFORMATIONS FOR DNA KNOTS IN WRITHE-DIRECTED ORGANIZATION OF DNA IN PHAGE CAPSIDS OF BACTERIOPHAGE P4

By: Ariff Moolla and Mela Hardin
Biology and Mathematics
Faculty Advisors: Dr. Sally G. Pasion, Dr. Javier Arsuaga, and Dr. Mariel Vazquez

Abstract: When linear double-stranded DNA is packed inside the phage capsids of icosahedral bacteriophage P4, it achieves one of the highest levels of DNA compaction found in nature. A high percentage of DNA extracted from bacteriophage P4 are closed circular knots (Arsuaga et al., 2002). Furthermore, DNA extracted from tailless mutants of P4 phage was found to be cyclic and knotted with a probability of 0.95 (Arsuaga et al., 2002). Previous works have shown that an association of decreased size of deletion of DNA with a decreased fraction of knotted genomes illustrating a direct relationship between knots in genome and size of the genome (Wolfson et al., 1985). To study the mechanism behind packaging of DNA into phage capsids, we can utilize knots as an indicator of DNA organization in confined space. Mathematical analysis has shown that a randomized spooling model explains global organization of DNA in phage capsids (Arsuaga & Diao, 2008). In our experiment we investigate the relationship between knotting of DNA in P4 phage and the spooling-like model. First, we analyze and quantify the knots formed inside P4 phage as well as P4 mutants. Next, we compare these results with computer stimulation programs like Monte Carlo analysis in Knot-Plot to draw a relationship between the spooling-like model and Knotting probability. This study bridges the gap between biology and mathematics, using tools and techniques from both the fields and gives us some insight on DNA packaging geometry inside phage capsids. Moreover, this study has future applications in understanding DNA arrangements in herpes virus and Lipo-DNA complexes used in gene therapy since all icosahedral bacteriophages with double-stranded DNA pack their chromosomes in a similar fashion (Arsuaga & Diao, 2008).

Entry Number: 53 UL

ANNOTATION OF SEVERAL DICISTRONIC GENES IN 12 DROSOPHILID SPECIES

By: Henry Hunter, Teresa Laird, Christina Staubus, and Dr. Christopher D. Smith
Cell and Molecular Biology
Faculty Advisor: Dr. Christopher D. Smith

Abstract: Multicistronic genes, where a single mRNA encodes multiple proteins occur frequently in prokaryotes and viruses, but very rarely in eukaryotic species. However, detailed gene annotation in the fruit fly, Drosophila melanogaster, has revealed ~100 dicistronic genes, where two non-overlapping proteins are expressed from a single transcript. Eukaryote ribosomes recognize a modified guanine cap at the 5' end of each transcript to initiate translation and since the internal gene in dicistronic genes has no cap the ribosome cannot initiate at the downstream gene by this mechanism. In viruses, a stretch of sequence called internal ribosomal entry site (IRES) can fold into an RNA secondary structure that is capable of recruiting the ribosome directly to the second, downstream gene and initiate translation. However, it is controversial as to whether IRES elements function in normal eukaryotic genes. We hypothesize that conserved RNA secondary structure may be involved in expression of Drosophilid dicistronic genes. To figure out the conservation of the dicistronic genes and IRES elements throughout all of the Drosophila species, the genes need to be identified in many of genomes and carefully annotated. Once annotated, dicistronic gene annotations can be compared for conserved regulatory features such as IRES elements or cryptic promoters that drive expression of the downstream gene. We have identified and annotated orthologs of the lat/CG34315, Tim9b/CG12788, Shawn/Tyler, waw/bbx, and Pmi/PGRP dicistronic genes in several Drosophilid species and show conservation of the dicistronic genes and putative IRES regions. These gene annotations will be used to design quantitative PCR primers to directly measure the expression of these genes in live cells and design molecular reagents to test IRES function in tissue culture cells.

Entry Number: 54 UL

CHICKEN EMBRYO DEVELOPMENT: REGIONAL AND TEMPORAL DEVELOPMENT OF SOMITES

By: Remy Binder and Meghan Lane
Cell and Molecular Biology
Faculty Advisor: Dr. Wilfred Denetclaw

Abstract: In order to understand the biological processes guiding the formation and development of multi-cellular organisms, the study of cell proliferation is essential. As the chicken embryo develops, spheroidal masses of mesoderm tissue, known as somites, begin to form along both sides of the neural tube. Somites, by well ordered cell division, eventually become the sclerotome, dermatome, and myotome. During cell division, chromosomal condensation gives dividing cells a unique appearance when stained with DNA specific dyes, allowing for specific quantification of cellular proliferation. In using confocal microscopy, which allows for z plane imaging, one can localize mitotic figures. Regions containing a greater proportion of mitotic figures at a given time are developing at a more rapid rate than those areas containing fewer mitotic figures. If the regional specific growth that occurs at a specified developmental stage is mapped as a function of

time, then a constant wavelike pattern of growth should be produced. The mitotic activity of somites was investigated in whole chick embryos from 10-30 somites in size, a time of rapid proliferation. DNA specific staining and Histone3 (H3) antibody labeling allowed for the visualization and enumeration of mitotic figures through confocal and fluorescent microscopy, respectively. The medial border was observed as an area of elevated growth throughout these stages, while the highest rate of growth appeared to be at somite stage zero, which is the point at which somites epithelialize from mesenchyme condensation. Use of more versatile dyes and a larger body of embryos will most likely confirm these preliminary findings, and provide further insight into chicken embryo development.

Entry Number: 55 UL

ROLE OF WNT4 ON MYOGENESIS DURING EARLY EMBRYONIC DEVELOPMENT IN THE CHICK

By: Anthony Eritano
Cellular and Molecular Biology
Faculty Advisor: Dr. Laura W. Burrus

Abstract: During embryogenesis, the developing embryo is subjected to numerous biochemical signaling proteins that instruct cells either to proliferate or to differentiate into specific cell and tissue types. The Wnt family is comprised of twenty highly conserved signaling proteins that control proliferation, specification, differentiation and survival in numerous cell types. Wnt4, in particular, has been shown to regulate many important activities during embryogenesis, including sex determination, bone ossification/repair, and kidney development. In addition, several lines of circumstantial evidence have implicated Wnt4 in myogenesis. For instance, Wnt4 is expressed in the chick neural tube immediately adjacent to the medial edge of developing somites shortly before Myf5 and MyoD, two myogenic regulatory genes, appear in the medial somite. Further studies from another lab show that addition of Wnt4 to presomitic mesoderm explants causes an upregulation of Pax3 and Pax7, two very important transcription factors in somites. It has also been shown that overexpression of Wnt4 causes differentiation of C2C12 myoblast cells into muscle cells, thus further implicating Wnt4 as a possible promoter of myogenesis. Based on these studies, I hypothesized that Wnt4 plays a role in promoting the differentiation of myogeneic precursor cells into muscle. To test my hypothesis, I overexpressed Wnt4 in the neural tube of developing chick embryos via electroporation and analyzed transverse embryo sections that were stained for muscle specific markers that I wish to observe. Consistent with my hypothesis staining for myosin heavy chain revealed a statistically significant 1.2 fold increase in the area of the myotome as compared to control embryos that were electroporated with a construct expressing GFP alone. The increase in myotome size could indicate either cellular hypertrophy or an influx of myogenic precursor cells from the dermomyotome. To distinguish between these two possibilities, I stained for β- catenin and nuclear DNA. By staining for endogenous β-catenin on the cell membrane, I was able to measure the area of the cells in the myotome and determine that Wnt4 causes an increase in cell size when compared to controls. By using DRAQ5 to stain for DNA, I was able to count the total number of nuclei in the mytotome and assess whether more cells are entering the myotome from the dermomytome. My results show that the increase in the size of the myotome is due to hypertrophy of the cells and not by an increase in the number of cells.

Myostatin, a known antagonist of Wnt4, has recently been implicated in regulating the mTOR signaling pathway, which is responsible for cellular growth and hypertrophy. I am currently conducting experiments to see if Wnt4 plays any role in regulating the mTOR signaling pathway. In conclusion, I have shown that ectopic Wnt4 increases the overall size of the myotome in vivo via cellular hypertrophy.

Entry Number: 56 UL

FEEL THE DIFFERENCE: A STUDY OF THE BODY'S RESPONSE TO TACTILE STIMULI

By: Abraham Reynoso, Joe DeBattista, Ngo Nguyen, and Stephanie Cunningham
Physiology and Behavior Biology
Faculty Advisor: Anne Thilges

Abstract: "Feel the difference" is a study of the body's response to tactile stimuli. The researcher's measured the changes in heart rate, as well as brain activity (alpha, beta, delta and theda) to measure the body's response to material of decreasing softness.

Entry Number: 57 UL

PHYSIOLOGICAL EFFECTS OF DISSONANT AND CONSONANT MUSIC ON HEART RATE, EEG, AND GALVANIC SKIN RESPONSE

By: Kristina Millikan, Lisa Wise, and Inara Iskenderova
Physiology and Behavior Biology
Faculty Advisor: Anne Thilges

Abstract: We will be testing the effects of dissonant and consonant music on heart rate, eeg brain wave patterns, and galvanic skin response. We will be testing two classical songs; a consonant piece by Bach called Cello suite #1 in G major, as well as a dissonant piece by Arnold Schoenberg called six little pieces, Op 19. prelude. We will also be testing two rock songs; a consonant piece by Sufjan Stevens called to be alone with you, and a dissonant piece by Comets on Fire called The bee and the cracking egg. We will play each piece for two minutes and will also play two minutes of silence as a control. The songs will be randomized and in addition to testing the subject's physiological indicators we will be having them report on their level of relaxation before testing, and after each song, as well as their levels of enjoyment during each song.

Entry Number: 58 UL

MEMBRANE RAFT DISRUPTION IN CHICKEN EMBRYO SKELETAL MUSCLE CELL CULTURES

By: Dianna Baldwin
Zoology
Faculty Advisor: Dr. Wilfred Denetclaw

Abstract: Membrane rafts are found in the plasma membrane of skeletal muscle cell cultures and provide a cholesterol rich domain necessary for imbedded proteins that are involved with functional activity with the cell. Skeletal muscle cultures undergo regular stages in differentiation that include change in gene expression and myoblast fusion for myotube formation. Membrane rafts are know to be involved with myoblast fusion, but involvement with differentiation is currently unknown. We have shown that membrane raft disruption by MBC, a reagent that extracts membrane cholesterol and destroys rafts,

inhibits muscle differentiation. Calcium is necessary for differentiation but it is unknown if, when treated with MBC, calcium is sufficient to induce differentiation. The physiological effects of MBC on differentiation, shown by calcium response to Acetylcholine (Ach) through the Ach receptor, are also unknown. By exploring the physiological response of skeletal muscle cells to MBC treatment it is possible to explore multiple signaling pathways that may provide clues for the mechanism of differentiation. To investigate, skeletal muscle cultures were tested over 24 to 72 hours in differentiation conditions for their ability to respond to ACh with a rise in intracellular free calcium (Ca2+i) shown by fura-2 and calcium ratio imaging. Our results show that 24-hour cultures responded to ACh with variable increases in Ca2+i (slow to maximal rises) and became stronger (maximal) with additional days in culture. In contrast, MBC treated cultures showed no response to ACh. When MBC cultures were allowed to recover in normal differentiation medium, 24-hours did not allow recovery of Ca2+i response. Additionally, MBC cultures showed greater reduction in plasma membrane acetylcholine receptor (AChR) by antibody labeling compared with normal cultures. As a control, cholera toxin B labeling was used to show membrane raft loss in MBC treated cultures. In conclusion, membrane rafts regulate Ach gene expression and subsequent calcium signaling dynamics in differentiating cultures of muscle. NIH-RIMI-P20MD000544, MARC-T34-GM08574.

Entry Number: 59 UL

THE PRESIDIO BEE BIODIVERSITY SURVEY

By: Christopher Quock and Jessica Van Den Berg
Ecology and Systematic Biology
Faculty Advisor: Dr. John Hafernik

Abstract: This project builds on earlier studies of arthropod diversity in the Presidio of San Francisco (Wood, et al, 2005; Moore and Hafernik, 2007; Leong, et al 2008). Questions addressed include: 1.Whether restored sites show a pattern of increase in bee species composition and diversity over time. 2. What factors affect yearly and site-to-site patterns of bee diversity and abundance. 3. Can additional sampling add to the number of bee species known from the Presidio. To address these questions, bees were sampled at four locations within the Presidio for a one-year period. Transects were laid out at Thompson Reach, Lobos Sand Dunes, Baker Beach, and the World War II Memorial site. Study sites were selected to overlap those of the previous bee survey (Wood et al., 2005). Of particular consideration were sites, such as Thompson Reach, where dramatic environmental changes have taken place due to habitat restoration efforts. Collecting times and transect layouts also followed the procedures of the aforementioned survey. Permanent transects were lined with blue, yellow, and white pan traps from late morning to mid-afternoon for approximately one day per month. In line with the previous study, preliminary results indicate a high degree of native bee species richness in the Presidio. The presence of additional species/morphospecies not represented in the past survey suggests an even higher level of bee diversity within this urban park. On the other hand, the absence of some species found in the previous study suggests that the bee fauna of the Presidio experiences considerable yearly variation in composition and abundance.

Entry Number: 60 UL

EXERCISE-INDUCED STABILIZATION OF LDH IN CLAW MUSCLE OF TROPICAL PORCELAIN CRAB, *PETROLYSTHES DONARIO*

By: Haydee Medina
Marine Biology
Faculty Advisor: Dr. Jonathon Stillman

Abstract: Exercise-induced stabilization of LDH in claw muscle of Tropical Porcelain Crab, Petrolisthes donario

Porcelain crab of the genus Petrolisthes are excellent candidates for studies on responses to environmental stress because of their broad distribution and species richness. The genus Petrolisthes contains over 100 species distributed across both latitudinal and intertidal zonation throughout the Pacific Ocean. Previous studies on thermal stability of porcelain crab Lactate Dehydrogenase enzyme (LDH) have suggested that inherent properties of the LDH molecules in conjunction with other stabilizing proteins may act in synchrony to regulate protein stability. This study examines the exercise-induced stabilization of LDH on claw muscle tissue of tropical porcelain crabs, Petrolisthes donario, after the crabs were exhausted by physical exercise. Tropical porcelain crabs were brought to the lab and kept under normal temperature and water conditions as they would in their natural environment and divided into experimental and control group. Crabs from the experimental group were manually stimulated to run around continuously at different time intervals and in different sequences for 3 days. We examined the LDH activity by measuring the change in absorbance at 340nm which corresponds to the enzymatic oxidation of cofactor NADH to NAD+ from supernatants of claw muscle homogenates incubated at 70° C at different time intervals for a period of one hour. Preliminary analysis on tropical porcelain crabs indicates that under normal conditions (control group) the % activity loss of LDH incubated at 70° C decreases over time. However, for those exercise-induced crabs, the % activity loss of LDH was not significantly affected over time. These results suggest exercise-induced activity in tropical porcelain crabs may cause a change in LDH stability and protein configuration.

Entry Number: 61 UL

ARE SEA STARS OF THE GENUS LEPTASTERIAS SEPERATED BY HABITAT IN THE ROCKY INTERTIDAL OF NORTHERN CALIFORNIA? AN ANALYSIS USING MITOCHONDRIAL DNA AND MORPHOLOGY

By: Richard Coleman, Alyssa Lai, and Ashley Smith
Marine Biology
Faculty Advisor: Dr. Sarah Cohen

Abstract: Species of the six-rayed sea star, Leptasterias, are found in different habitats throughout the rocky intertidal. Being cryptic makes it difficult to distinguish based on morphology alone. Previous studies have suggested that different species of Leptasterias are partitioned by habitat.

This study examines genetic and morphological variation of Leptasterias across 3 different habitats in the rocky intertidal: surfgrass, cobble, and surge channels. Currently, there are four recognized species of Leptasterias found in Northern California and although there have been numerous studies regarding the systematics of Leptasterias their taxonomic status remains unresolved. A total of 105 specimens representing the 3

different habitats were collected at 7 sites throughout Northern California (from Greyhound Rock, Santa Cruz County to Fort Ross, Sonoma County). 300 bp of the mitochondrial control region (Dloop) were amplified and sequenced from 89 individuals. Preliminary analysis indicates that certain haplotypes are shared across all habitat types and that some haplotypes may be differentially distributed among specific habitats. Analysis of the color, pattern, ray girth and size shows varying amounts of differentiation within and between sites.

Entry Number: 62 UL

MEMBRANE COMPOSITION AND GENE EXPRESSION DURING THERMAL ACCLIMATION IN PORCELAIN CRABS

By: Daria Ronges
MarineBiology
Faculty Advisor: Dr. Jonathon Stillman

Abstract: Organisms that tolerate prolonged freezing temperatures use either chaperones, supercooling their internal fluids, or production of antifreezes to limit intracellular ice crystals. Intertidal zone organisms can experience transient freezing temperatures during winter low tides, but their extreme cold tolerance mechanisms are not known. Petrolisthes cinctipes is a temperate mid-intertidal crab species that can experience wintertime habitat temperatures below the freezing point of seawater. Thermal acclimation to 8˚C induces enhanced tolerance to freezing temperatures relative to crabs acclimated to 18˚C. We have investigated potential mechanisms for this enhanced tolerance, and present here an experiment conducted to reveal alterations in membrane lipids and gene expression that accompany the first 24 hours of physiological acclimation to cold. Crabs were collected from the field and held in aquaria at 12˚C, the water temperature at the time of collection. The experiment was initiated by transferring crabs to aquaria held at one of three temperatures: 8˚C, 12˚C, and 18˚C. At timepoints during the first 24 hours of acclimation crabs were exposed -2˚C for one hour, and then allowed to recover at their acclimation temperature. Most of the 8˚C acclimated crabs survived more than 36 hours after the cold shock, while the others did not. To examine acclimation-related changes in lipid composition and gene expression, heart tissues of n=16 crabs were dissected at each timepoint. From n=8 hearts per acclimation temperature and timepoint, phospholipid composition was determined. From the other n=8 hearts per group, RNA was extracted and a pooled RNA sample from 5 individuals was used for cDNA microarray analysis.

Entry Number: 63 UL

DESIGN OF A REVERSIBLY ACTIVATED TRYPSIN VIA AN ENGINEERED METAL BINDING SITE

By: Anna Gubeladze
Biochemistry
Faculty Advisor: Dr. Teaster Baird, Jr.

Abstract: Feel the difference" is a study of the body's response to tactile stimuli. The researcher's measured the changes in heart rate, as well as brain activity (alpha, beta, delta and theda) to measure the body's response to material of decreasing softness.

Entry Number: 64 UL

COMPUTATIONAL CHARACTERIZATION OF WATER ACCESSIBLE AREAS IN HYDROPHOBIC AREAS IN DISTAL HEME POCKET MUTANTS IN MYOGLOBIN

By: Ben Rodriguez
Biochemistry
Faculty Advisors: Dr. Anton Guliaev and Dr. Raymond Esquerra

Abstract: Internal water molecules are important to protein structure and function and may be highly conserved in homologous protein families, much like important residues. A non-coordinated water molecule in the distal pocket of a myoglobin has been shown to be the dominate factor in controlling the binding of CO to the heme active site. We previously developed a method to experimentally measure the entry of internal water into the distal
pockets of Mb mutants after photodissociation of CO [1,2]. We have found that there is no obvious correlation between water occupancy data for various distal pocket mutants with pocket hydrophobicity. Our current working hypotheses is that factors other than hydrophobicity, potentially cavity volume and the dynamic behavior of the distal histidine (H64), influence water occupancy. Using a computational approach, we calculated the internal volumes of myoglobin cavities for various mutants. We further characterized these cavities by investigating the dynamic behavior of the H64 residue using molecular dynamics. The preliminary data from the molecular dynamics shows high flexibility of the H64 in the wild type protein; this suggests a mechanism by which water is allowed access to the distal cavity. However, in the L29F mutant, the H64 adopts a more stable conformation thereby reducing water access to the cavity. These findings suggest that the flexibility of the distal histidine plays a key role in influencing water access to the distal cavity and the binding affinity for gaseous ligands.

Entry Number: 65 UL

SYNTHESIS, CHARACTERIZATION, AND SUBCELLULAR LOCALIZATION OF AMINO ACID-SUBSTITUTED TETRAPHENYLPORPHYRINS

By: Hnin Khin
Biochemistry
Faculty Advisors: Dr. Ursula Simonis and Dr. Meden Issac

Abstract: Photodynamic therapy is a treatment that uses light, a photosensitizer, and tissue oxygen to destroy cancer cells with minimal damage to normal tissues. In an attempt to synthesize improved photosensitizers, a potential photodrug was prepared using a 3 step reaction. The target compound 5, 10-(4-di-lysylphenyl)-15, 20-(4-di-hydroxyphenyl)porphyrin (4) was derived from 5,10-di-(4-hydroxyphenyl)-15, 20-di-(4-nitrophenyl)porphyrin (1) as starting material. After reduction of the nitro to the amine groups (2), a peptide coupling reaction was carried out to obtain boc-lysine protected 5, 10-(4-di-lysylphenyl)-15, 20-(4-di-hydroxyphenyl)porphyrin (3). After deprotection with HCl in dioxane, the target compound (4) was successfully obtained, which was confirmed using 1H NMR and UV-vis spectroscopy, and mass spectrometry. The UV-vis spectrum revealed the absorption band that is used for the photosensitizing process at 650 nm. The uptake of porphyrin (4) into LNCaP prostate cancer cells will be studied. Using confocal fluorescence microscopy co-localization studies, it will be determined that the target

compound will be taken up into the cells by co-staining with the mitochondria-specific and lysosome-specific stains.

Entry Number: 66 UL

EXPLORING THE REPRODUCIBILITY AND VALIDITY OF COMPARATIVE QUANTITATIVE POLYMERASE CHAIN REACTION

By: Laura Cooper and Yvonne Mak
Biochemistry
Faculty Advisor: Dr. Elizabeth Runquist

Abstract: Quantitative polymerase chain reaction (qPCR) is becoming a popular analytical tool that uses fluorescent probes or dyes to measure the amount of product formed during each cycle of the polymerase chain reaction. Comparative qPCR determines a ratio of gene expression by obtaining the ratio of mRNA from a target gene to mRNA from a reference gene. Reference genes are used to normalize for variations in RNA yields, RNA amount, reverse transcriptase reactions, RNA degradation and cell types being studied. The reproducibility and validity of these mRNA expression ratios obtained using the comparative qPCR method were explored for four genes of varying expression that had been isolated from a single RNA sample extracted from healthy mouse liver cells. The genes studied, from high to low expression were cyclophyllin, hypoxanthine guanine phosphoribosyl transferase (HPRT), malonyl CoA decarboxylase (MlyCD), and polymerase II subunit A. Six different ratios were calculated from raw fluorescence data using qAnal, a program designed to minimize error in the ratio values. Results confirmed that use of a housekeeping gene in comparative qPCR controls satisfactorily for variation in RNA sample amounts and concurrent RT reactions, however, it does not appear to control for mRNA degradation or quality, which is an issue that may be of concern to those who use this technique.

Entry Number: 67 UL

INVESTIGATION OF PROTEIN INTERACTIONS THAT CONTROL THE NITRITE REDUCTASE ACTIVITY OF HEME PROTEINS

By: Lea Lough
Biochemistry
Faculty Advisor: Dr. Raymond Esquerra

Abstract: Since it was shown that deoxygenated hemoglobin in red blood cells supports vasodilatation during hypoxia by converting nitrite (NO_2^-) to nitric oxide (NO) (Nat Med. 2003,12:1498), the nitrite reductase activity of heme proteins has been shown to play essential roles in physiology. For example, the nitrite reductase activity of myoglobin is essential for protecting the heart from myocardial infarction during ischemia (Proc Natl Acad Sci USA. 2008, 29:10256). To better understand how the protein matrix controls the nitrite chemistry of the heme active site, we compared the nitrite reductase activity of several myoglobin distal pockets. The mutants were designed to change the chemical properties of the heme active site. We hypothesize that the distal histidine (H64) plays an essential role in converting NO_2^- to NO, acting as a proton donor. To test this hypothesis we measured the nitrite reductase activity of the following mutants lacking the distal histidine, H64A, H64L, H64Q, and H64V. The nitrite reductase chemistry of these mutants occurs at a slower rate than wild type Mb,

indicating that the proton donated by the histidine facilitates the chemistry but is not essential. We also hypothesize that the rate of the reaction will be limited by the size of the distal pocket, as a smaller pocket will reduce accessibility of nitrite to the heme. We made mutants L29F and L29W which are known to reduce the size of the distal pocket and V68F which increases the size of the distal pocket. The reactions for the L29F and L29W mutants are slower then wild type Mb, which support the hypothesis that changes in pocket volume, favoring steric hindrance, result in slower chemistry. Understanding how the protein matrix controls the nitrite reductase chemistry of heme proteins is essential toward understanding how these proteins generate NO physiologically, and in designing therapeutics based on the nitrite reductase activity of heme proteins.

Entry Number: 68 UL

NADH AND METAL BINDING EQUILIBRIA OF PHENYLACETALDEHYDE

By: Levenlou Vender
Biochemistry
Faculty Advisor: Dr. George Gassner

Abstract: Phenylacetaldehyde dehydrogenase (PADH) is a member of the general class of enzymes known as pyridine nucleotide-dependent aldehyde dehydrogenases, which catalyze the transformation of aldehydes to carboxylic acids in oxidative metabolism. In the last step of the styrene catabolic pathway PADH catalyzes the NADH-dependent oxidation of phenylacetaldehyde to phenylacetic acid. The X-ray structure of the closely related mithochondrial aldehyde dehydrogenase (PDB ID:ICW3), shows NAD+ bound to the protein with a Manganese (Mn2+) ion coordinated with its pyrophosphate group. Magnesium (Mg2+) was also found to interact with the protein at a remote mononuclear metal-binding site, which suggests linkage of metal and pyridine nucleotide binding eqilibria. The thermodynamic mechanism of reduced Nicotinamide Adenine Dinucleotide (NADH)-binding has been investigated by using the plate-reader based Fluorescence Spectroscopy and Isothermal Titration Calorimetry. Fluorescence assay is used to evaluate the NADH binding equilibrium by monitoring the increase in fluorescence that occurs as a function of PADH-NADH complex formation. It is also used to investigate the fluorescence enhancement of NADH coupled to the binding of metal ions (Mg2+ and Mn2+). The interaction of the PADH-NADH complex is relatively weak and due to instrumental limitations it was possible to obtain only a partial saturation curve at the highest concentration of PADH used in this study. The Isothermal Titration Calorimetry assay suggests that the dilution of NADH is endothermic contributing about 150 ± 21cal/mole injected. NADH binding to PADH is exothermic about - (5.1 ± 0.7) x 104 cal/mole. NADH binding occurs with a large negative entropy change about -153 ± 34 cal/mole K. In conclusion, NADH binds PADH weakly under the conditions evaluated in this study. Magnesium and Manganese increases the binding affinity of NADH. The ITC studies suggest that in the NADH-binding interaction, the entropy change nearly compensates the enthalpy change and because of this the Kd is relatively large (172 ± 29 uM). Overall the fluorescence and ITC results are in reasonable agreement indicating that NADH binds PADH weakly under the conditions evaluated in this study.

Entry Number: 69 UL

MECHANISM OF STYRENEOXYGENASE WITH SUBSTRATE ANALOGS AND INHIBITORS

By: Mie Win
Biochemistry
Faculty Advisor: Dr. George Gassner

Abstract: Because of its solubility and ease of recovery, styrene monooxygenase (SMO), is the best system available for studying the mechanistic details of the flavoenzyme catalyzed epoxidation reactions. These reactions are of broad significance not only to understanding the synthesis of styreneoxide in the first step of styrene catabolism, but also the epoxidation of squalene to squalene oxide in the biosynthesis of cholesterol and in the conversion of zeaxanthin to antherxanthin in the biosyntheis of brightly colored plant pigments.

Styrene monooxygenase, is composed of two polypeptide components: SMOB, an NADH-specific flavin reductase that serves as the supply-line of reduced flavin for the epoxidation reaction and SMOA, an FAD-specific styrene monooxygenase, which uses reduced FAD in the reductive activation of molecular oxygen and the enantioselective addition of an oxygen atom vinyl sidechain of styrene in the synthesis of S-styrene-(7,8) oxide.

To obtain an improved understanding of this mechanism, a plate reader method has been developed and used successfully to evaluate the steady-state kinetics of the reduction reaction at 30˚C to yield apparent Vmax and Km values of 2.3μM/min 22μM, respectively. These results will be reported together with the design of a dual wavelength kinetic assay that allows the reduction and epoxidation reactions of SMO to be monitored simultaneously in the study of substrate analogs and inhibitors of SMOA. Through the application of this method, it will be possible to establish quantitatively factors contributing to substrate specificity (kcat/KM), inhibition (Ki), and Kc, the inhibition (Ki), and Kc, the efficiency of coupling the reductive and oxidative half reactions of styrene epoxidation

Entry Number: 70 UL

NEW FIELD METHOD FOR DETERMINATION OF ARSENIC IN WATER USING ION EXCHANGE AND XRF

By: Rene L. Johnson and Peter E. Baker
Biochemistry
Faculty Advisor: Dr. Pete T. Palmer

Abstract: Arsenic is a toxic chemical and a known carcinogen. Although the WHO and EPA have set a 10 ppb standard for arsenic in drinking water, levels exceeding this limit have been found in Bangladesh and many other parts of the world. The goal of this research was to develop a fast and simple method for measuring sub-ppm levels of arsenic in drinking water in the field based on X-Ray Fluorescence Spectrometry (XRF). In this method, an ion exchange resin is used to preconcentrate arsenic from the sample, and the resin is then analyzed using a handheld XRF analyzer. Several different resins were studied, including generic and arsenic-specific ion exchange resins. The latter are preferred due to the fact that they are not prone to interferences from other competing anions (i.e., carbonate and sulfate) that are commonly found in drinking water. A number

of optimization and calibration studies revealing the following metrics for this new method: sample volumes of 50 mL, resin masses of 8 mg, sample preparation and analysis times of 15 minutes per sample, linear response between 0 and 10,000 ppb, and a 4 ppb limit of detection (LOD). This new method shows promise as a simple, reliable, rapid, and relatively low cost means for getting a reliable estimate of environmentally significant arsenic concentrations in drinking water supplies.

Entry Number: 71 UL

INTRODUCING NOVEL SUBSTRATE SELECTIVITY INTO TRYPSIN THROUGH REDESIGN

By: Sayeeda Najibi
Biochemistry & Cell and Molecular Biology
Faculty Advisor: Dr. Teaster Baird, Jr.

Abstract: The serine protease trypsin cleaves C-terminal to arginine and lysine residues of peptides and proteins. The objective of this research is to understand the molecular determinants of substrate selectivity by this class of enzymes. A threonine protease variant of trypsin with modified selectivity has been previously obtained. This investigation presents the kinetic analysis of trypsin variant C42S/C58V/S195T to evaluate the effect of having a residue with hydrogen bond capability at position 42 on substrate selectivity in threonine protease variant of trypsin (SVT-Tn). Kinetic assays were used to determine the specificity of the SVT-Tn variant on substrate Z-Gly-Pro-Arg-nitroanilide (Z-GPR-pNA) compared with substrate Z-Gly-Pro-Arg-7-amino-4-methylcoumarin (Z-GPR-AMC), which does not have hydrogen bond capability. It was determined that SVT-Tn was ~10 fold more selective to AMC (kcat/KM=4.5 (± 0.3) x10-1mM-1 min-1) than substrate pNA (7.5(± 0.02) x10-2 mM-1 min-1). The reason for increase in selectivity may be due to the size of the substrate leaving group AMC. In addition, an inhibition with triple variant SVT-Tn was introduced by determining the dissociation constant of triple variant compared with wild type. Benzamidine, a competitive inhibitor derived from benzoic acid, was used to determine the dissociation constant value of SVT-Tn. As benzamidine concentration increases, the competitive inhibitor competes with the substrate for the active site in which it bids to Asp189 decreasing any ES complex formation.

Entry Number: 72 UL

SYNTHESIS OF ZEOLITE MFI FILMS VIA HYDROXIDE AND FLUORIDE ROUTES

By: Chris Reaves
Chemistry
Faculty Advisor: Dr. Andrew S. Ichimura

Abstract: Thin films of pure silica zeolite MFI were synthesized using the structure directing agent tetrapropylammonium (TPA), in the form of TPA-F and TPA-OH. These films were synthesized on both glass and an organic monolayer coated gold/silica wafer by various mole ratio solutions and crystallization times. Films were compared using FTIR, XRD and SEM to determine which conditions yield the most oriented growth of these crystal films, minimizing undesirable effects such as inner growth, incomplete crystallization and crystal defects. Films formed on glass and gold wafers were oriented

with the b axis normal to the substrate surface. The structure directing agent was removed from the crystal pores using UV ozone, instead of the traditional method of calcination, and the expected change in structure, indicating open pores, was observed. The goals of this study were to determine orientation and thickness of the films as they relate to synthesis time and mother liquor concentration

Entry Number: 73 UL

THE EFFECTS OF NON-ENZYMATIC GLYCATION ON THE NITRITE REDUCTASE ACTIVITY OF HEMOGLOBIN

By: Damon Robles,Yadiel K, and Kay Saw
Chemistry
Faculty Advisor: Dr. Raymond Esquerra

Abstract: Diabetes is a disease characterized by an increase in blood sugar level, resulting in an increase of glycated hemoglobin (HbA1c) in the blood. Diabetic adults are 2 to 4 times more likely to die from heart disease and stroke than adults without diabetes. In 2007, 21 million Americans were diagnosed with diabetes, making it the 6th leading cause of death in the United States.

Diabetics have an elevated risk of cardiovascular dysfunction, but the relationship between elevated blood sugar levels and increased cardiovascular complications is unresolved. Recent evidence shows that hemoglobin acts as a nitrite reductase, reducing nitrite to nitric oxide (NO) and contributing to vasodilation under low oxygen conditions. Our hypothesis is that glycation of hemoglobin alters its nitrite reductase activity, thereby disrupting normal NO homeostasis.

Entry Number: 74 UL

CHARACTERISTICS OF A PHEOPHORBIDE-A SERINE DERIVATIVE FOR THE POTENTIAL USE IN PHOTODYNAMIC THERAPY

By: Diem Huynh
Chemistry
Faculty Advisor: Dr. Ursula Simonis

Abstract: In an effort to synthesize a more effective photosensitizer for the photodynamic therapy of cancer, pyropheophorbide-a methyl ester reacted with O-t- Butyl –L – serine t-butyl ester Hydrochloride salt (H Ser (But) -OBut HCl) in a peptide coupling reaction. This reaction formed the Butyloxycarbonyl (boc) protected L-serine pyropheophorbide–a, and the protecting group was removed by HCl in dioxane to yield the target porphyrin that was serine substituted pyropheophorbide-a. Both the protected and unprotected target porphyrin were analyzed by 1H and 13C NMR, UV/Vis and FTIR spectroscopy. The 1H and 13C NMR results showed 14 singlet H, 2 doublet H, 4 triplet H and 1 quartet H, and 43 C which presented in the serine substituted pyropheophorbide-a. The UV/Vis result showed the 5 peaks of product, and the highest peak (413 nm) was pyropheophorbide-a, the serine peak was at 668 nm wavelength. The yield of the purified product was % comparing from 50g of pyropheophobide a and 64.51 g of boc protected L serine. The research of serine substituted pyropheophorbide-a synthesis was significant because the pyropheophorbide-a product can localize into the mitochondria to play an influential role in the photosensitize process. Therefore, serine substituted pyropheophorbide-a is an important agent in the PDT development.

Entry Number: 75 UL

GROWTH STUDIES OF ORIENTED MFI ZEOLITE FILMS AS A FUNCTION OF TIME

By: Dina Flamik
Chemistry
Faculty Advisors: Dr. Andrew S. Ichimura and Dr. Ursula Simonis

Abstract: To develop a new sensor material produced from zeolite thin film doped with cesium, and to explore its physical properties, thin films of pure silica zeolites were prepared. Zeolite thin films were synthesized at 150 OC by standard hydrothermal method on evaporated gold in chromium on silica wafer and quartz glass substrates. Tetrapropylammonium hydroxide (TPAOH), tetraethylorthosilicate (TEOS), and deionized water were reacted in a molar ratio of X TPAOH: Y TEOS: Z H2O. To control film thickness, the crystallization time was systematically varied from 2 hours to 4 hours, to 6 hours. The thin films obtained were qualitatively analyzed via scanning electron microscopy (SEM), X-ray diffraction (XRD), and infrared spectroscopy (IR). The peak intensities observed in the XRD spectra increased with time, implying that the thin film grew over time with a preferred orientation of b-normal to substrate. SEM showed that the density of the thin film layer and the crystal size increased as crystallization time increased. The research also showed that the orientation of the thin film formation was insensitive to the nature of the gold and quartz substrates. On the other hand, in agreement with the literature, our results showed that the kinetics of the film growth is influenced by the structural properties of the substrates.

Entry Number: 76 UL

SYNTHESIS AND CHARACTERIZATION OF AMINO ACID SUBSTITUTED PHEOPHORBIDES AS POTENTIAL AGENTS FOR PHOTODYNAMIC THERAPY OF CANCERS

By: Kara Cross
Chemistry
Faculty Advisor: Dr. Ursula Simonis

Abstract: To enhance the efficacy of photosensitizers in photodynamic therapy applications of cancers and other serious diseases, derivatives of pheophorbide-a were synthesized. To this end, L-serinylpheophorbide-a and L-lysylpheophorbide-a were prepared by a common peptide coupling reaction using L-serine and L-lysine. Analysis of the 1H NMR spectra of the target compounds compared to pheophorbide-a confirmed the formation of the desired products and that the macrocycle did not degrade under the synthesis conditions employed. UV-visible spectroscopy of L-serylpheophorbide-a and L-lysylpheophorbide-a revealed a red shifted and high intensity fourth Q band that is used for PDT. These bands are red shifted by 19 nm and 17nm, respectively, to the red when compared to Foscan®, which is currently one of the most potent photosentizers used in clinical practice. Although the red shift indicates that the target compound has improved UV-visible properties when compared to other porphyrins its water solubility is limited, which indicates that the target pheophorbides may require a vehicle for cellular delivery. However, preliminary cell studies confirm that L-lysylpheophorbide-a co-localizes to the mitochondria and the lysosomes. Initial PDT studies with the target

pheophorbides are extremely encouraging. At low light doses and two minute light exposure the cells are damaged, whereas at eight minute light exposure the nucleus is beginning to disintegrate indicating that PDT leads to effective cell death, thereby indicating that the target pheophorbides may be potent photosensitizers.

Entry Number: 77 UL

REDUCTION OF SELENIUM OXYANIONS BY ZERO-VALENT IRON SURFACES

By: Marisa Miller
Chemistry
Faculty Advisor: Dr. Bruce Manning

Abstract: Selenium (Se) is potentially toxic to both humans and wildlife. The development of inexpensive and effective remediation methods is of interest to both the scientific and regulatory communities. Zero-valent iron (ZVI), has been proven to be effective in immobilizing both selenate (Se(VI)) and selenite (Se(IV)). In this study, a new method was developed for the synthesis of iron nanoparticles (Nano Fe) which showed 69% greater removal of Se(IV) and 86% greater removal of Se(VI) than a conventional 100-mesh Fe powder. A commercial nano Fe material (Nanofer 25S), an iron nanoparticle suspension, was also tested for its reactivity and proved to be an even less effective remediation method than the 100-mesh Fe powder. The Se(IV)- and Se(VI)-reacted solids were examined using x-ray spectroscopic techniques, which indicated the presence of adsorbed Se and a crystalline Fe(III) oxide corrosion layer consisting of maghemite (γ-Fe2O3), lepidocrocite (γ-FeOOH), goethite (α-FeOOH) and bernalite (Fe(OH)3.(H2O)) . Our results suggest that synthetic nano Fe is an efficient remediation material for both dissolved Se(IV) and Se(VI).

Entry Number: 78 UL

ANAEROBIC DEGRADATION OF ORGANIC CARBON IN AN INTERTIDAL SEDIMENT: RELATIVE IMPORTANCE OF MAJOR ELECTRON ACCEPTORS

By: Mayu Kawaguchi and Jonathon A. Polly
Chemistry
Faculty Advisors: Dr. Tomoko Komada and Dr. Ursula Simonis

Abstract: Organic-rich, intertidal sediment from San Francisco Bay was incubated in order to investigate the factors that control net production of dissolved organic carbon (DOC) under anaerobic conditions. Homogenized and sieved sediment was incubated in glass tubes without headspace at 17 deg.C in the dark for 130 days. At 12 sampling points, 6 tubes were removed from the incubator and processed to monitor chemical and isotopic changes in the porewater and solids. From t=0 to t=130 days, a large increase in dissolved inorganic carbon (DIC) was observed, indicating active microbial respiration of sedimentary organic matter. DOC decreased during the first 9 days, but increased steadily thereafter at approximately 3 % of DIC production rate. Total dissolved Fe increased rapidly during the first 1-2 weeks of the incubation, most likely due reduction of Fe (oxy)hydroxides. Net loss of SO42- was evident by t=14 days. Using prescribed stoichiometry, approximately 75 % of the net DIC production can be attributed to SO42-

reduction. The remaining DIC production can only be explained as a combination of multiple respiration pathways including aerobic respiration and Fe-oxide reduction.

Entry Number: 79 UL

SYNTHESIS OF AN ARGININE SUBSTITUTED PEOPHORBIDE-A AS EFFECTIVE PHOTOSENSITIZERS FOR PHOTODYNAMIC THERAPY (PDT)

By: Soohwan Kim
Chemistry
Faculty Advisor: Dr. Ursula Simonis

Abstract: To enhance the photosencitizing ability of a phtosenstizer (PS) in photodynamic Therapy (PDT) for re-treatment of cancer a pheophorbide derivate was synthesized. First reaction of synthesis of an arginine substituted pheophorbide-a was coupling of Boc-protected arginine with peophorbide-a, know as peptide coupling that was vertified by H-NMR and analyzed by UV/Vis spectroscopy. From Uv/Vis spectroscopy, four peak were observed , but those peak were same as peak of pheophobide-a because an arginine attached to an external functional group present on the macrocycle, so that core of the ring is not being affected. Next reaction is deprotection of the Boc protected arginine substituted pherphorbide-a. the structure was verified by H-NMR

Entry Number: 80 UL

SURFACE CHEMISTRY UNDER PHOTOLYSIS

By: Stéphanie Cherdo
Chemistry
Faculty Advisor: Dr. Andrew S. Ichimura

Abstract: Photocatalysis is an important procès for the chemical oxidation of organic compounds that may occur as pollutants or contaminants. Titanium dioxide (TiO2) is a prototypical compound that absorbs light in the UV region to yield electron /hole pairs. A key mechanistic question concerns the products of reaction of the electron/holes with adsorbed molecules.

Entry Number: 81 UP

SELF-ASSEMBLED MONOLAYERS TO SUPPORT THE GROWTH OF INORGANIC FILMS

By: Diana Mars and Shirin M. Usmani
Chemistry
Faculty Advisor: Dr. Andrew S. Ichimura

Abstract: Self-assembled monolayers (SAMs) provide a direct route to modify the interfacial chemistry between a metal surface such as gold to organic or inorganic films. SAM chemistry and formation on gold substrates is well-known and organo-sulfur compounds such as hexadecanethiol self-assemble to form densely packed quasicrystalline 2D arrays.

Depending on the terminal functional groups, SAMs can be used to passivate a surface, control macroscopic surface properties such as wetting and friction, and block or permit charge transport across the film. Despite advances in SAM chemistry in recent years, considerable opportunities to develop new monolayers remain. For example, increasing

the thermal stability of SAMs and tailoring the terminal group to specific add-layers would extend the range of applications.
In this work, we have prepared SAMs through the reaction of SiCl4, TiCl4, P(O)Cl3, and P(S)Cl3 with densely packed -OH terminated monolayers. The result is a trithiolate or tripod SAM that has three thiolate bonds to the gold surface. The tripod SAM proves to have a higher thermal stability than single thiolate-Au bonds as measured by temperature programmed desorption (TPD) even for very short alkyl chains. By terminating the tripod SAM with a SiOH, TiOH, P=O, or P=S functional group, these films can be used as supports for the growth of inorganic films such as silica zeolites, TiO2, or other chalcogonide based films. The structures and properties of the monolayers were elucidated by fourier transform infrared (FTIR) spectroscopy, single wavelength ellipsometry (SWE), TPD, and density functional theory (DFT) and will be reported in this paper.

Entry Number: 82 UP

THE PLIOCENE RESPONSE TO WARMER THAN MODERN SEA SURFACE TEMPERATURES IN COASTAL UPWELLING REGIONS

By: Zi Zi Searles
Geology
Faculty Advisor: Dr. Petra Dekens

Abstract: In 1999 the USGS PRISM Group released PRISM2 a digital dataset prescribing boundary conditions for Pliocene paleoclimate modeling experiments. Recent proxy reconstructions for sites in the East Pacific and Atlantic suggest that the upwelling regions along the Californian, Peruvian, North African, and South African margins had higher sea surface temperatures than the PRISM2 reconstruction prescribed. This project seeks to test Pliocene climate sensitivity to warmer than modern SST using NCAR's CAM3 GCM with PRISM2 boundary conditions. Two experiments, Z_PRISM and 2Z_PRISM, were conducted to test the response of temperature, precipitation, specific humidity, wind velocity, and low-cloud level to warmer SST in the regions named above. The experiments have different spatial SST configurations so Z_PRISM and 2Z_PRISM produce different climate results. Overall 2Z_PRISM precipitation and temperature predictions are most consistent with available Pliocene proxy data. Both experiments predict a weakening of wind velocity in the North Pacific. This result is not consistent with ODP sediment cores that reveal high CaCO3 accumulation rates for the California margin that is interpreted to reflect increased upwelling due to stronger winds. On the other hand wind velocity results are consistent with decreased Pliocene diatom productivity which is interpreted to reflect a weakening of California Margin Pliocene winds. Z_PRISM and 2Z_PRISM predict decreases in low-cloud levels and increases in concentrations of atmospheric water vapor (specific humidity), demonstrating that warmer than modern Pliocene SST in these regions may have helped maintain a warmer than modern mid-Pliocene climate.

Entry Number: 83 UP

THE AVERAGE CROSSING NUMBER OF EQUILATERAL POLYGONS IN CONFINEMENT

By: Benjamin Borgo, Dr. Rob Scharein, Dr. Yuanan Diao (University of North Carolina, Charlotte), and Dr. Javier Arsuaga
Applied Mathematics
Faculty Advisor: Dr. Javier Arsuaga

Abstract: Quantification of polymer complexity remains a challenging problem. Measures such as the knotting probability, ACN, and writhe have been proposed. However, these measures have been mostly implemented using computational studies with no proposed analytic foundation. Here we provide an analytical argument on the scaling behavior of the average crossing number when a closed polymer is confined to a spherical volume. Numerical methods are used to generate large ensembles of knots which we compared to the analytical method. We then apply our model to the confinement of DNA inside bacteriophage P4 capsid by removing all extraneous crossings from the randomly generated knots. We find the same scaling law holds for the relaxed knots, and when compared to the experimental bacteriophage data, the crossing numbers and length of the random polygon are in close agreement.

Entry Number: 84 UP

MITOCHONDRIAL DNA STRUCTURE IN TRYPANOSOME

By: Chris Keown
Mathematics
Faculty Advisor: Dr. Javier Arsuaga

Abstract: Organic-rich, intertidal sediment from San Francisco Bay was incubated in order to investigate the factors that control net production of dissolved organic carbon (DOC) under anaerobic conditions. Homogenized and sieved sediment was incubated in glass tubes without headspace at 17 deg.C in the dark for 130 days. At 12 sampling points, 6 tubes were removed from the incubator and processed to monitor chemical and isotopic changes in the porewater and solids. From t=0 to t=130 days, a large increase in dissolved inorganic carbon (DIC) was observed, indicating active microbial respiration of sedimentary organic matter. DOC decreased during the first 9 days, but increased steadily thereafter at approximately 3 % of DIC production rate. Total dissolved Fe increased rapidly during the first 1-2 weeks of the incubation, most likely due reduction of Fe (oxy)hydroxides. Net loss of SO42- was evident by t=14 days. Using prescribed stoichiometry, approximately 75 % of the net DIC production can be attributed to SO42- reduction. The remaining DIC production can only be explained as a combination of multiple respiration pathways including aerobic respiration and Fe-oxide reduction

Entry Number: 85 UP

UNIMODALITY OF ORDER POLYNOMIALS

By: Christopher O'Neill
Mathematics
Faculty Advisor: Dr. Matthias Beck

Abstract: Order polynomials arise from counting the number of order preserving functions from a poset to a set of n integers. These polynomials can also be viewed as

the Ehrhart Polynomials of Order Polytopes. Using a program called Latte, we have written a program to explicitly compute the order polynomial for a given poset. There is a conjecture that all but a small class of these polynomials are unimodal, and we have used our program to generate a large number of examples of these polynomials in order to examine them and give strong evidence as to the validity of this conjecture.

Entry Number: 86 UP
CONSTRUCTION OF LATTICE KNOTS FROM THE GAUSS CODE
By: Nicholas Normandin
Mathematics
Faculty Advisor: Dr. Mariel Vazquez
Abstract: Knot theory is the study of the topology of knots and links.
In knot theory, a knot is defined to be a closed, self-avoiding curve in three dimensions. Our immediate goal was to effectively model lattice knots as a polygonal chain in the simple cubic lattice from the Gauss Code. We define the Gauss Code as an array of characters such that the knot and the knot diagram can be recovered.

Entry Number: 87 UP
HECKE OPERATORS ON PALINDROMIC POLYNOMIALS
By: Whitney Zeldow
Mathematics
Faculty Advisor: Dr. Matthias Beck
Abstract: Rational generating functions with a palindromic polynomial, of degree d or less and nonnegative integer coefficients, in the numerator have a corresponding formal generating function. If we dilate the corresponding polynomial in the new generating function by some positive integer n and find its resulting rational generating function, under what conditions is the numerator unimodal?

Entry Number: 88 UP
GUIDING AND ROUTING LIGHT ALONG DEFECT CHANNELS: FROM IMPERFECTION TO PERFECTION.
By: Ratna Lama
Physics
Faculty Advisor: Dr. Zhigang Chen
Abstract: Demonstration of nonconventional light guiding by photonic defects, including routing, blocking and controllable splitting of light along defect channels and surface channels - an impending technological revolution for optical computing and communication (supported by NSF and Air Force Office of Scientific Research).

Entry Number: 89 UP
FOUNDATION FOR A 20-STORY BUILDING
By: Adamross Lingad, Kimberly Sindac, Timothy Shu, and Raul Verduzco
Civil Engineering
Faculty Advisor: Dr. Tim D'Orazio
Abstract: This project has two main areas of concentration for us as a geotechnical foundation engineering group, one is the design of a retaining wall to resist a fill and the

second is the foundation design of a twenty story building. Gathering information of the site's soil profile from laboratory testing, we designed a gravity, anchor, and Mechanically Stabilized Earth (MSE) retaining, all of which will work with a factor of safety greater than one and a half. We also designed various foundations that meet our requirements of differential settlement as well as bearing capacities.
Initially we were given a plan to design the foundation of a twenty story residential building in downtown San Francisco. The area we are working with has a number of soil layers; one known as Bay Mud due to its familiarity in the bay area. This gives us a challenge in our designs as soil strengths vary in each layer. Required for each design, each layer of soil has to be analyzed for settlement and bearing capacity. Due to the small working space in the site we will design a wall that will resist a big fill in order to maximize the working area. Some of the foundation designs will need basements excavations; we will design an anchor retaining wall for these cases.
The objective is to provide a large selection of designs in the walls as well as in the foundations so that the owner can select the one that best fits his/her needs and price range. Considering the fact that this is a residential building safety factors is one of our main priorities. We want the building's design and the walls to be as safe as possible to maintain a secure environment for the public.
We start this project by getting soil samples and taking them to the lab to test them. From the test results we determine each soil layer's strengths and properties to start the analysis of settlement and bearing capacities.
The project requirements are following the residential building codes which ask for a factor of safety of 1.5 in stability, limit differential settlement to 1/300 and total settlement to 0.3 feet. In the wall designs we are using a factor of safety greater than 1.5. By meeting these criteria and analyzing cost for each design, we intend to provide several design recommendations to the client.

Entry Number: 90 UP
TRUSS BRIDGE
By: Ahlong Shin, Noris Gomez, Vu Le, Charles Njoroge, and Mesfin Agegnehu
Civil Engineering
Faculty Advisor: Dr. Norman Owen
Abstract: For this project, a bridge about 12ft long was designed and built. Calculations were based on the rules required by the National Timber Bridge Compeition. Building specialifcations on length, width and height were followed and testing procedure were completed to find if the bridge was able to within load applied.

Entry Number: 91 UP
AIR TRAFFIC CONTROL TOWER
By: Ahmed Thleiji, WenPei Kuang, and Patrick Howell
Civil Engineering
Faculty Advisor: Multu Ozer
Abstract: The ATCT dimensions are: 24 feet squared base and 130 feet in height.
The building will consist of four floors; Mechanical floor, electronic equipments floor, office floor, and a control cabinet floor. The structure of the building will be made of steel material. The design will determine the best beams, girders, and columns

dimensions to withstand shear, bending and buckling caused by determined loads. The lateral-force-resisting elements will be determined based on the magnitude of wind and earthquake. We are going to analyze the overturning moment of the structure based on height and width dimensions. The goal is to determine the lightest and safest members for the building following detailed analysis using ASCE codes and RISA software.

Entry Number: 92 UP

BROTHERHOOD WAY STORM WATER REMEDIATION

By: David Reber, Nick Birth, Adam Krakow, Mingming Yee, and Alvin Yim
Civil Engineering
Faculty Advisor: Dr. Elahe Enssani

Abstract: The objective of our project is to take storm water runoff from a proposed housing development site along Brotherhood Way, and to prevent this runoff from entering the city's combined sewer system. This project will use several Best Management Practices (BMPs), including various
combinations of retention, infiltration, and treatment. There are three criteria that we hope to achieve with this project: 1) Find successful combinations of BMPs that can treat the housing development runoff water before entering the water table. 2) Find the most economical and
feasible way of implementing our best designs. 3) Uphold local codes and regulations in our designs to further the possibility of actual implementation. Preventing water from entering San Francisco's current combined sewer system has two major beneficial impacts. Keeping water
out of the system reduces the chance of overflow of raw sewage feeding directly to the bay during heavy rainfall. Also, diverting water can directly place water into our depleted groundwater system. The ideal success of this project would be to create a feasible model for future development projects in the San Francisco Bay Area to build upon to help clean and replenish our water systems.

Entry Number: 93 UP

TIMBER ARCH BRIDGE

By: Fabian Gomez, Greg Paulson, Lewis Hernandez, Jack Chen, Mikhail Ermakovich, Yonata Andemariam, Miguel Escudero, and Jose Reynolds
Civil Engineering
Faculty Advisor: Mutlu Ozer

Abstract: The arched suspension bridge follows the standard specified by the Southwest Mississippi Resource Conservation and Development Inc. for participation in the National Bridge Design Competition. The project began with a conseptual design that led to in-depth analysis of the bridge members. Structural analysis software, RISA 2D, was used to model the bridge and predict its behavior; hand calculations verified the same behaviors. The result is an elegant arched structure capable of supporting a 20kN load with a max deflection of 6.58mm. Ultimately, the final product is aninnovative, practical design of minimal expense and weight that meets the load bearing capacity while maintaining a natural, elegant aesthetic of dual laminated redwood arches.

Entry Number: 94 UP

HIGH SPEED RAIL STATION

By: Robert Halliday, Colin Kemper, Lucas Zimmer, Marjess Tacoban, Shiraz Muzaffar, and Sunia Malolo
Civil Engineering
Faculty Advisor: Dr. Wenshen Pong

Abstract: Our group has designed a high speed rail station which will be constructed from steel and glass. The columns, beams, and girders of our structure will be constructed from steel members, and our arched roof will be made up of glass plates in between the beams and girders. Our focus is on the Archway that covers the waiting area and platform of the station.

Entry Number: 95 UP

NEW SFSU ENGINEERING HALL

By: Sean Jaime, James Go, Carrie King, and Tiffany Chin
Civil Engineering
Faculty Advisor: Dr. Wenshen Pong

Abstract: T2 Engineering Design Group is proposing to develop and design the future School of Engineering for San Francisco State University. The site is located on the Northeast corner of campus, where the old Women's Softball Field was, enclosed by 19th Avenue, Hensill Hall, and Thornton Hall at San Francisco State University. It currently houses numerous portable structures that are used as classrooms as well portable cargo sheds used to house tools and supplies for the school.
On-site there is ongoing construction of a greenhouse for the Botany/Science Department. T2 Engineering Design Group will be designing the entire infrastructure. Our group will be calculating the requirements for the beams, columns, girders, connections and necessary splices. We will also be analyzing seismic influences on our building's frame. Since the proposed site is located in an area where high seismic activity occurs, we must take this into consideration when designing our structure. We will be following current International and State Building Codes and ASCE 7 standards.

Entry Number: 96 UP

GEOTECHNICAL ENGINEERING OF FOUNDATION DESIGNS

By: Travis Haft, Radoslav Stanchev, Devon Crowe, and Stephen Jo
Civil Engineering
Faculty Advisor: Dr. Tim D'Orazio

Abstract: The project is a Geotechnical Engineering one designing different types of foundations and retaining walls for a 38 story building.

Entry Number: 97 UP

SMART MAGNETIC CARD READER FOR THE SCIENCE BUILDING

By: Noppol Setobol, Akeem Abodunrin, and Ronnie Roraldo
Computer Engineering
Faculty Advisors: Dr. Hamid Shahnasser and Dr. Hao Jiang

Abstract: Currently San Francisco State University's Science only allows students to enter building with a key that is given by the Engineering office. When a student wants

to enter the building on a non-school day during a non-school hour, that student will need a key. There are a lot of responsibilities if you are to get a key, you must never lose the key or you will face termination. Every student at SFSU is given a student identification card. This card is very similar to any other card that you may carry around with you (i.e. credit card, drivers' license). On the back of the card, there is a magnetic stripe that contains bits of your information. For the SFSU Student ID card, it contains your student ID number and other important information that SFSU needs to identify that you are in fact a student at the school.
With being able to use your student ID card as a way to access the science building on the weekend, it will become more available to students. With a magnetic card reader, students will be able to keep the science building doors closed and locked at all times. This will make the student feel more secure while studying in the building, especially when the student is in the building at night. The school will benefit from this project as well, since the school will not have to lend out a key to students who want to use the science building on the weekend. Logging information on who goes into and out of the science building is great security measures to ensure the safety of the students.

Entry Number: 98 UP
REAL-TIME IMPACT LOGGER & ANALYSIS
By: Christina Phan, Teo Limbo, and Eli Lyons
Electrical Engineering
Faculty Advisor: Dr. Tom Holton
Abstract: Data collection from boxing gloves can provide information that is useful for training applications, general fitness, and entertainment. By incorporating a flexible-sensor network with an accelerometer, and microcontroller/RF transceiver on PCB that will fit on a punching glove, impact data will be transmitted wirelessly to a computer for analysis. The data is then analyzed through National Instruments? Labview to display real-time plots of punch data.

Entry Number: 99 UP
DESIGN PROJECT FOR DIGITAL IC DESIGN COURSES IN 90NM CMOS TECHNOLOGY
By: Eli Lyons
Electrical Engineering
Faculty Advisor: Dr. Hamid Mahmoodi
Abstract: We have developed a full-custom IC design flow and custom design project that was used as a course project in teaching the "Digital VLSI Design" in the Electrical Engineering department. The design project is to design a 4-bit ripple carry adder in a full custom fashion from schematic to layout in generic 90nm CMOS technology

Entry Number: 100 UP
LOW POWER WIRELESS HEART RATE MONITORING SYSTEM
By: Di Lan, William Yu, and Dennison Lorenzana
Electrical Engineering
Faculty Advisors: Dr. Hao Jiang and Dr. Tom Holton

Abstract: Cardio Vascular and other heart related disease should be considered as one of the leading cause of deaths especially outside the hospital. Existing devices have limited display capabilities and lacks portability. Our goal in this project is to design a comfortable wireless device that can send data from a local computer network to a hospital or any other health facilities via the internet about the patient's heart condition. Our project is to build a medical monitor include heart rate and temperature and those data and info can be wirelessly transmit to a computer.

Entry Number: 101 UP
SONIC STICK
By: Danny Azar and Ho Yin Chan
Electrical Engineering
Faculty Advisor: Dr. Tom Holton
Abstract:

Entry Number: 102 UP
SOLAR TRACKER
By: Eugene Russiyanov, Jed Hewitt, and Kate Tun
Electrical Engineering
Faculty Advisors: Dr. Hao Jiang and Dr. Hamid Shannaser
Abstract: One solar panel will be held up with a sturdy, yet light weight skeletal structure. The moveable panel plane will be manipulated through two axes of actuators: one rotating motor and one telescoping arm. The actuators will be driven by an amplified microcontroller (model yet to be decided). The controller acts based upon the states of the array of photo-sensors (undecided quantity). The raw power is fed to a voltage regulator and charger, to be stored in a battery of sufficient storage capabilities.

Entry Number: 103 UP
ACCEL-O-MOUSE (CODENAME YODA)
By: Mathew Brady, Victor Manuel, and Lalesh Sharma
Electrical Engineering
Faculty Advisor: Dr. Hao Jiang
Abstract: Create a more ergonomic, natural movement computer mouse. Current mice require the user to move their hand from the keyboard, grab the mouse object, and manipulate it. These movements have been attributed to causing repetitive motion injuries. The goal of this project is to remove the need for the user to move their hand from the vicinity of the keyboard while maintaining the ability to manipulate the mouse through very natural, unstressed hand positions. This is accomplished through use of a tridactyl glove with conductive fabrics to register clicks, and an accelerometer to track movement.

Entry Number: 104 UP

WIRELESS POWER TRANSFER

By: Mojan Norouzi, David Munguia, Akhil Malik, and Zeeshan Ali
Electrical Engineering
Faculty Advisor: Dr. Hao Jiang

Abstract: A study of wireless power transfer in different conditions is carried. Two coils are placed next to each other while varying the distances and the angle of allignment. Using a computer interface, an spectrum analyzer and matlab the best frequency for power transmission is found for each case. The conclusions stated from this research are of relevant importance for future work of implantable devices.

Entry Number: 105 UP

SOLAR POWERED BATTERY CHARGER

By: Scott Siordia,Yves Fotso, James Carolino, and Kris Quismorio
Electrical Engineering
Faculty Advisor: Dr. Hao Jiang

Abstract: This project is taking a natural energy source, in the sun, and converting that energy to charge small electronics such as a cell phone, ipod or mp3 player. There is a back up source in the form of a battery to store energy so the small electronic can be charged even when there is no sun/light.

Entry Number: 106 UP

AUTONOMOUS MICROMOUSE

By: Hailu Keremo, Harrit Bains, and Loon Phang
Electrical Engineering
Faculty Advisor: Dr. Hao Jiang

Abstract: The aim of this project is to develop a Micromouse which is going to move autonomous in a maze. To achieve this objective, successful technologies used in the past will be combined together to obtain a good design for the Mouse. This Micromouse is basically being designed around the microcontroller, chasis, sensors and motors areas. The control system we will use is called proportional Control. The idea behind proportional Control is to have an output, in this case our motors, and a feedback input, our IR sensors, and use the data from the feedback to change the output value accordingly and proportionally.

Entry Number: 107 UP

BEER BOT: AUTOMATIC BEER POURING MACHINE

By: Jonathan Hughes, Marvic Verzano, and Colin Muschette
Electrical and Mechanical Engineering
Faculty Advisor: Dr. Tom Holton

Abstract: The task of our project is to automatically dispense beer in to a 16 oz glass eliminating the need for a bartender. The user will place an empty 16 oz glass in to the machine, and it will tilt the glass to minimize foam and dispense beer. From our research, we have decided on an infra red sensor to detect the presence of glass and sense the level of beer in the glass.

Entry Number: 108 UP

CNG LAWNMOWER

By: Christopher Fernandez, Paul Stelter, and Yeygeuiy Shkelev
Mechanical Engineering
Faculty Advisors: Dr. Ahmad Ganji, Dr. A. S. (Ed) Cheng, and Dr. Kwok-Siong Teh

Abstract: It is our goal in this design project to modify a gasoline lawnmower to run on natural gas (CNG) in order to reduce emissions and take advantage of the benefits of using a lower cost, cleaner burning alternative fuel. We chose to use a low cost hand pushed craftsman mower for our conversion. Our alterations will include a fuel mixer, pressure regulator(s), carburetor adaptor, fuel tank, and various adapters/fittings and mounting hardware. Additionally in order to ensure the safety of our device the design will include some shielding for the fuel tank. CNG will be stored at high pressure (3000 psi) in order to minimize the size of the storage tank that will have a refueling fitting and a high-pressure regulator connected directly to it. The gas, now at a lower pressure, will be fed to the fuel regulator/zero governor and then to a carburetor adaptor with a venturi to properly mix the CNG with air for combustion. An idle plate to ensure smooth running will also be installed between the engine housing and the carburetor. Having finished our conversion (which through small modification can still run on gasoline), we will then conduct several comparison tests between the CNG conversion and the gasoline version for torque curves, running times, and emissions.

Entry Number: 109 UP

RAPID SYNTHESIS OF HIGH-ASPECT RATIO ZINC OXIDE NANOWIRES BY A CATALYST-FREE, LOW-POWER INDUCTIVE HEATING PROCESS

By: Joachim Pedersen
Mechanical Engineering
Faculty Advisor: Dr. Kwok-Siong Teh

Abstract: A method of rapidly synthesizing ZnO NW is presented. ZnO NW of diameters 20-300nm, and lengths up to 5μm are synthesized in 5-10 minutes without the use of catalysts. Highly localized heating of growth substrates to a process temperature of ~900ºC is achieved using an applied RF power of 65-120WRF.

Entry Number: 110 UP

HUMAN POWERED VEHICLE

By: Michael Diep, Ahmed Hassani, and Kevin Ng
Mechanical Engineering
Faculty Advisor: Dr. Kwok-Siong Teh

Abstract: Human Powered Vehicle that is used to reach speeds of up to 45 mph.

Entry Number: 111 UP

THE ELECTRIC MOTORCYCLE PROJECT

By: Oliver Burke and David Shirling
Mechanical Engineering
Faculty Advisors: Dr. A. S. (Ed) Cheng and Dr. Kwok-Siong Teh

Abstract: The Electric Motorcycle Project is an effort to decrease the environmental impact of transportation. It involves the conversion of a gasoline-powered motorcycle to battery-electric power. We have replaced all internal combustion devices (engine, gas tank, etc.) with an electric motor for propulsion, batteries to hold the energy, and other necessary parts for energy control. The intention is for this vehicle to be used on public roadways, achieve a top speed of 70 mph, a range of about 20 miles, and eventually be charged by solar power.

Entry Number: 112 UP

JET ENGINE

By: Patrick Moore, Nicholas Ng, and Nick Certo
Mechanical Engineering
Faculty Advisors: Dr. A. S. (Ed) Cheng and Dr. Kwok-Siong Teh

Abstract: By utilizing a turbo charger from an automotive engine as a turbine we have created a self sustaining jet engine.

Entry Number: 113 UP

PROGRESSIVE METAL STAMPING DIE

By: Richard Moore
Mechanical Engineering
Faculty Advisor: Dr. Kwok-Siong Teh

Abstract: Team SVS's senior design project scope was to design and build a unique metal stamping tool for a bay area manufacturer. The sponsor, Scandic Springs Inc., is a leading manufacturer located in the San Francisco bay area. It produces metal stamped components for a variety of industries which ships world wide. Faced with the challenges of overseas competition, Scandic was in need of a new method of producing a high precision metal stamping that required no addition manual operations to complete. The work produced by team SVS included the conception, design, and project guidance throughout the building process. In all, the conception and design took approximately 250 hrs of design and drawing to produce detailed manufacturing drawings. The building of the tool required approximately another 600 hrs to produce a working prototype of the progressive stamping die. The result of this collaborative effort proved to be very successful for team SVS and the sponsor. Scandic has since incorporated the approach developed by team SVS into two other projects. In addition, the sponsor has a new cost effective method of adding value to sheet metal stampings giving the company a competitive advantage.