Entry Number: 1 D
NON-VERBAL COMMUNICATION IN ONLINE INTERRACIAL INTERACTIONS
By: Ghislaine Atkins and Dr. Charlotte Tate
Social Psychology
Faculty Advisor: Dr. Charlotte Tate
Abstract: The aim of this project was to determine whether or not the anxiety typically experienced in a face-to-face interracial interaction setting can be attenuated if the interaction were to take place in a typically less threatening online communication medium: Skype (copyrighted) Participants chatted with an on out of state student who was of the same race as the participant or was of a different race. Finally, participants answered questions about what they experienced in the lab study.

Entry Number: 2 GB
THE MEANINGFULNESS OF PARENTHOOD AND ITS IMPACT ON DEPRESSION DURING INFERTILITY TREATMENT
By: Elizabeth Lauro and Dr. Sarah Holley
Clinical Psychology
Faculty Advisor: Dr. Sarah Holley
Abstract: Infertility can bring up feelings of uncertainty about the future and the loss of parenting potential. Not surprising, infertility is highly associated with depression (Williams & Zappert, 2006). Yet not everyone experiencing infertility becomes depressed. It may be that those who place the greatest meaning on a successful pregnancy outcome (i.e., becoming parents) are more susceptible to depression. 417 women participated in a study of infertility treatment and psychological outcomes. Measures of perceived stress, depression, and meaningfulness (e.g., "Without a child, I could not be truly happy") were obtained via self-report. After controlling for the effect of perceived stress, the meaningfulness of parenthood was significantly associated with levels of depression. Results further showed a significant interaction between the meaningfulness of parenthood and perceived stress, indicating that those who cared most about the outcome of pregnancy and who were experiencing higher levels of stress reported the greatest levels of depression.

Entry Number: 3 GB
DIVORCE, FAMILY CONTEXT, AND EATING HABITS: A FIVE-DAY DIARY STUDY OF PRE-ADOLESCENT OBESITY RISK
By: Allison K. O'Leary, Susan S. Mauskopf, Luke N. Remy, Luis A. Cornejo, and Dr. Jeffrey T. Cookston
Developmental Psychology
Faculty Advisor: Dr. Jeffrey T. Cookston
Abstract: Obesity rates have more than doubled in children and tripled in adolescents since the 1980s, and currently more than one-third of children and adolescents are overweight or obese (Ogden et al., 2012). Because little is known about the links between specific eating habits and divorce, the current study gathered a five-day eating diary from 40 children and their parents to explore whether marital status was linked to obesity risk and if family context mediated that link in a sample of pre-adolescents. Children in divorced families consumed more sugar-sweetened beverages than children in married families, and we observed a trend for less frequent breakfast consumption. Of the three family context variables, only family routines was a mediator. This study highlights the importance of family context (e.g., parental acceptance and family routines) in understanding the etiology and prevalence of child and adolescent obesity.

Entry Number: 4 GB
CLASSROOM MINDSET: A NEW MODEL OF STUDENT MOTIVATION IN CONTEXT
By: Danika Maddocks
Developmental Psychology

Faculty Advisor: Dr. Patricia Miller

Abstract: Student motivation is a key component of student success, and the classroom context is known to impact motivation. The current research introduces a new model of student motivation based on a novel concept, classroom mindset, or the implicit message communicated by a classroom environment that intelligence is either malleable or fixed. This study tested whether middle school students (n = 75) perceived a clear classroom mindset in their math classrooms, and whether this perception was related to their own motivation for math as well as their perceptions of their classroom's goal structures, autonomy support, and feedback about effort and ability. Results indicated that the majority of students perceived a clear classroom mindset, and that student mindset and classroom mindset were highly correlated. The perception of a growth-mindset classroom was linked to perceptions of stronger mastery goal structure, lower performance goal structure, and more autonomy support. Structural equation modeling confirmed that classroom mindset mediated the relationship between other elements of the classroom mindset and student mindset for math, and revealed that boys' and girls' sense of classroom mindset was related to different aspects of the classroom environment. Areas for future research and implications for classroom practice are discussed.

Entry Number: 5 GB

DESCRIBING AND PREDICTING CHANGES IN INTERPARENTAL CONFLICT ACROSS EARLY ADOLESCENCE: A LATENT CURVE MODEL ANALYSIS

By: Kaitlyn Fladeboe and Dr. Jeffrey T. Cookston

Developmental Psychology

Faculty Advisor: Dr. Jeffrey T. Cookston

Abstract: Interparental conflict affects adolescent adjustment by threatening the emotional security of the child as well as by hindering the child's ability to regulate emotions (Davies & Cummings, 1994) which places adolescents at risk for a number of adjustment problems (Davies & Cummings, 2010). However, less is known about whether interparental conflict changes over the course of adolescence. The present study examines this trajectory of interparent conflict within families with an adolescent child and explains such changes as a function of family type, ethnicity, gender of adolescent, and adolescent age. Due to previous findings that the familistic values commonly reported by Mexican-American families are associated with less conflict for both mothers and fathers (Taylor, Larsen-Rife, Rand, & Widaman, 2012), we predict that Mexican-American families will exhibit less initial conflict than European-American families. Similarly, we predict that stepfamilies will also exhibit increased initial conflict compared to intact families (Shelton, Waters, & Harold, 2008). The sample included 394 adolescents and their families who identified as either European-American or Mexican-American in ethnicity and where some fathers were stepparents. Participants were interviewed at equal intervals three times between 7th and 10th grade. Parent conflict was measured using the Children's Perception of Interparental Conflict Scale (Grych, Seid, & Fincham's, 1992) with Cronbach's Alphas for parental conflict of .82, .83, and .87 for waves 1, 2, and 3, respectively. First, we estimated an unconditional growth model for parent conflict without predictors. The model showed a good fit to the data (see Figure for all values). The estimated mean level of parental conflict at time 1 was significantly different from zero and families varied in their initial levels of conflict, and the estimated average rate of change over each year suggested a significant decline over time with significance variance between participants. Second, we estimated a growth model with predictors of family type, gender of adolescent, ethnicity of parent, and age of child to explain interparental conflict over time (see Figure for all values). The model had good fit. Initial mean levels of conflict were significantly higher for Mexican-American families compared to European American families as well as for stepfamilies compared to intact families. There was no difference in gender or age for initial levels of conflict. Concerning rate of change of parental conflict over time, there were no significant pathways for ethnic group, family type, or age on rate of decline. However, the average rate of decrease in family conflict was greater for the families of girls than boys. Our results provide new information about change in rates of interparental conflict in families with adolescents – they appear to decline on average suggesting that adolescence may be a time of relative marital stability for parents. Our prediction that stepfamilies would experience higher conflict was upheld while our prediction that Mexican-American families would report less conflict was not.

Implications are considered in light of current research about family context during adolescence and cultural family values.

Entry Number: 6 GB
COMPARISON OF TWO MEASUREMENTS OF ATTITUDES AND BELIEFS ABOUT PSYCHOLOGICAL SERVICES
By: Louis Cornejo and Dr. Jeffrey T. Cookston
Developmental Psychology
Faculty Advisor: Dr. Jeffrey T. Cookston
Abstract: The research project will compare two measurement scales of attitudes and beliefs about psychological services among a college sample. The reliability and validity of the two scales will be examined. Data will be analyzed based on how participants' attitudes and beliefs regarding mental health services and psychological services predict psychological distress using the Attitudes Towards Seeking Professional Psychological Help Scale (ATSPPHS) And the Beliefs About Psychological Services (BAPS) Scale.

Entry Number: 7 GB
WHY WE SPLIT: PREDICTING FAMILY CONTEXT FOLLOWING DIVORCE FROM THE REASON FOR SEPARATION
By: Luke Remy
Developmental Psychology
Faculty Advisor: Dr. Jeffrey T. Cookston
Abstract: The changes in the family context that precede divorce and continue after the separation explain many of the problems experienced by children of divorced families (Amato, 2000). Recently, there has been a push to identity factors that explain these potentially modifiable mediators of divorce effects (Braver et al., 2005). Amato & Previti (2003) identified the most common reasons given for divorce by American adults (i.e., infidelity, drinking or drug use, physical or mental abuse, incompatible, grew apart, personality problems, communication, immature, personal growth, no love, unhappy, not meeting obligations to family, work problems, financial problems, illness, and interference from others). Because most divorced parents can provide a reason for the divorce, it represents a starting place for intervening with divorcing families. This study examines the links between recently divorced adults' self-reported reasons for separation and modifiable mediators of child adjustment following divorce. The sample included 202 adults (73% female) who had recently divorced. Participants were recruited from the community by convenience and completed a survey battery that measured the following hypothetical constructs: coparenting, interparental conflict, parental alienation, conflict breadth, sharing problems with parent, divorce communication, parent-child communication, the Family Routines Inventory, parenting identity, the Brief Symptom Inventory (BSI)—Anxiety, BSI—Depression, child behavior problems, and demographic information . The survey also included an open-ended response where participants shared their reasons for the divorce, and responses were coded for the reasons for divorce given by Amato & Previti (2003). We then independently coded data for a random selection of 25% of the cases; Kappa scores ranged from .80 to .97with a mean value of .86.Greater interparent conflict occurred when the reason for divorce was abuse but occurred less when the reason was unhappiness; parental alienation was higher when the reason was more abuse and more personality problems but occurred less when the reason was that the couple grew apart; there were fewer topics of conflict when the reason was interference from others. Children shared less with their parent when the reason for divorce was substance abuse and when there was more interference from others; children communicated more about the divorce when the reason was abuse or personality problems with the other parent; more consistent family routines occurred when the other parent did not meet obligations to the family; and warm parenting occurred more often when parents grew apart and the other parent was immature. Finally, more behavior problems in children occurred when the reason was a lack of love in the family and more unhappiness. The present findings demonstrate abuse is linked to number of mediators and may provide an important starting place in clinical treatment and services for recently divorced

families. Given our knowledge of those changes in family processes and structure following divorce which affect child adjustment, we can now identify those families at greater risk for specific divorce outcomes, and more adequately prepare these families for an adaptive separation.

Entry Number: 8 GB
ARE UNPOPULAR CHILDREN MORE LIKELY TO BE IGNORED BY TEACHERS? LINKS BETWEEN SOCIAL BEHAVIOR & PEER RATINGS IN A PRESCHOOL SAMPLE
By: Susan S. Mauskopf and Dr. Jeffrey T. Cookston
Developmental Psychology
Faculty Advisor: Dr. Jeffrey T. Cookston
Abstract: The purpose of this study was to assess preschool children's perceptions of each other through sociometric ratings and patterns of social interactions in order to better understand social dynamics in the classroom. Subjects were 32 children in two cohorts ranging from 38 to 53 months of age. It was hypothesized that unpopular children would receive fewer social invitations from others and this was supported ($r = -.526$, $p = .002$). Unpopular children were also more likely to have their social initiations ignored by teachers ($r = .363$, $p = .041$). These results have significant implications for researchers and teachers. As social dynamics in children of this age are relatively fluid, it is important to be able to identify children in need of social skills help to best set them up for future positive outcomes.

Entry Number: 9 GB
THE INFLUENCE OF STEREOTYPES ON PERSON PERCEPTION
By: Eric Splan, Sierra Niblett, Willam Krenzer, Patrick Hibberd, Monica Mendoza, Dr. Mark W. Geisler, and Dr. Avi Ben-Zeev
Mind, Brain, and Behavior Psychology
Faculty Advisor: Dr. Mark W. Geisler and Dr. Avi Ben-Zeev
Abstract: The study examines whether stereotypes can influence how we perceive another person. To examine this question, behavioral and physiological measures will be used to examine the effect thatstereotypic versus counter stereotypic information has on basic perceptual and memory processes using a face recreation sketch program, categorization tasks, and the use of EEG measures.

Entry Number: 10 GB
ENJOYMENT AS A FUNCTION OF EFFORT IN SCHIZOPHRENIA: EVIDENCE USING ECOLOGICAL MOMENTARY ASSESSMENT
By: Kathryn Cooper, Heidi Iseman, Devyn Difilippo, Elma Caplin, Yasmin Campos, and Dr. David E. Gard
Mind, Brain, and Behavior Psychology
Faculty Advisor: Dr. David E. Gard
Abstract: Research has indicated that people with schizophrenia anticipate that activities will be less pleasurable than controls, but experience similar levels of pleasure in-the-moment (Gard et al., 2007). Additionally, patients appear to have difficulty assessing how effortful a task will be (Gold et al., 2013). Using EMA, we investigated whether enjoyment in current activities, and anticipated enjoyment of goals, differed as a function of how much effort was involved in the activities or goals. People with ($n = 43$) and without schizophrenia ($n = 34$) were given a cell phone and were called four times a day for one week. In contrast to previous research, we found people with schizophrenia reported higher levels of enjoyment in activities and in anticipatory enjoyment, perhaps due to methodological differences in the present study. Interestingly, control participants showed a quadratic response to enjoyment of activities and anticipated goals (high and low effort activities and goals were rated higher than moderately effortful activities and goals), while patients showed a decrease in enjoyment as activities became more complex, and no relationship of enjoyment by effort on anticipated goals. Implications

of these findings are that patients may be struggling to assess the anticipated enjoyment of effortful tasks, providing a possible treatment target.

Entry Number: 11 GB
REVISITING LIBET'S STUDIES: EFFECTS OF VOLITION ON TIME PERCEPTION AND RESPONSE INTERFERENCE
By: Lara Krisst, Maria Robinson, and Dr. Ezequiel Morsella
Mind, Brain, and Behavior Psychology
Faculty Advisor: Dr. Ezequiel Morsella
Abstract: In his seminal psychophysiological experiments, Libet (2004) instructed participants to report when they felt the intention to perform a "free-willed" action. Interestingly, psychophysiological measures revealed unconscious neural activity that predicted when participants would have these conscious inclinations. Research has since revealed that voluntary and non-voluntary actions may have distinct neural and subjective correlates (Brass & Haggard, 2007). Building on this work, we investigated how levels of volition (e.g., voluntary versus automatic actions) influence temporal perception and response interference. In Study 1, we measured participants' (n =10) time perception as they emitted an automatic or non-automatic response to a cue. The mean discrepancy between actual tone onset and the average perceived tone onset was 112.84 milliseconds (SD = 30.11). To examine the long-term consequences of having responded "freely" to a stimulus, Study 2 (n = 18) employed a variant of Ericksen's flanker task, where participants must respond to a target and disregard the influence of flanking 'distractors.' Psychophysiological research has revealed that distractors can activate motor programs that lead to response interference (DeSoto et al., 2001). We found interference from targets that had been associated with a free-choice response during training, $t(17) = 2.57$, $p < .02$. We also examined participants' subjective urges on a trial-by-trial basis. Combined with neuroimaging technologies, these paradigms can further reveal the unique properties of volitional processes in the brain (Fleming et al., 2009).

Entry Number: 12 GB
THE DIFFERENCE IN GENDER CATEGORIZATION USING EVENT RELATED POTENTIALS
By: William L. D. Krenzer, Eric D. Splan, Dr. Avi Ben-Zeev, and Dr. Mark W. Geisler
Mind, Brain, and Behavior Psychology
Faculty Advisors: Dr. Avi Ben-Zeev and Dr. Mark W. Geisler
Abstract: Gender categories are most highly associated with characteristics of natural groupings, with individuals being faster at categorizing a female face at the basic level (e.g. female), then at the subordinate level (e.g. Jane), when compared to categorizing a male face. Running a within-subjects design study, we are looking at the Event-Related Brain Potentials of individual's categorization of male and female celebrity faces. Our studying is currently still running participants, and analyzing data.

Entry Number: 13 GB
WORKING MEMORY BASED ACTION CONTROL: INCREASED REFRESHING RATE IN THE FACE OF INTERFERENCE
By: Christina Merrick, Shanna Cooper, Tiffany Jantz, and Dr. Ezequiel Morsella
Mind, Brian and Behavior Psychology
Faculty Advisor: Dr. Ezequiel Morsella
Abstract: Action control often involves delaying a to-be-performed action for a short span. During such delayed actions, action-related information can be held in working memory (WM), as when one holds a telephone number in mind until reaching a telephone. During the delay, representations are activated reiteratively ("rehearsal") through intentional, top-down processing. For reasons unexplained, each re-activation of the representation ("refreshing") brings the representation into consciousness. (Between refreshes,

there may be “imageless thought” influencing control.) Rehearsal somehow sustains the activation of action-related representations, which are susceptible to interference from task-irrelevant information. Accordingly, we found that rehearsal rate (and its associated conscious imagery) increases during delayed actions when “action-competing” distractors are presented during the delay. Specifically, participants (n = 37) button-pressed when presented with stimuli (letters) but only after a delay (14 sec). During the delay, 28 distractor letters appeared sequentially onscreen. Participants indicated whenever they experienced target-related imagery. In the Response Interference (RI) trials, some of the distractor letters were associated with incompatible responses. Higher imagery rates occurred for RI trials compared to Neutral trials (letters unassociated to incompatible responses), $t(35) = 2.33$, $p = .026$. We discuss the implications of this finding for the study of WM, action, and imageless thought.

Entry Number: 14 GB
GENDER CATEGORIZATION AND INDIVIDUATION IN PERSON PERCEPTION
By: Curtis Shelton, Dr. Mark W. Geisler, and Dr. Avi Ben-Zeev
Research Psychology
Faculty Advisors: Dr. Mark W. Geisler and Dr. Avi Ben-Zeev
Abstract: We sought to examine the role that gender may play in person perception and individuation. Though faces are generally fastest to be categorized at the level of identity (e.g. a person’s name), context has been shown to moderate this effect (D’Lauro, Tanaka, & Curran, 2008). We presented participants with homogeneous or heterogeneous sets of celebrity faces, along with label pairings for three levels of abstraction (following D’Lauro et al., 2008): the subordinate level (e.g. “Anne Hathaway”), the basic level (e.g. “female”), and the superordinate level (e.g. human). Participants completed a category-confirmation task in which they made true or false responses regarding the agreement of the category labels (e.g. “female”) and a subsequently presented photograph (e.g., a photo of Anne Hathaway). Reaction times were recorded for each response to the stimulus-label pairings. Findings were consistent with previous research (D’Lauro et. al, 2008), and revealed a subordinate-level shift in categorization, $F(2, 100) = 18.53$, $p < .001$, $\eta^2 = .270$, suggesting that participants responded faster to individuating information than they did to category information in a heterogeneous context. Given the results, current studies are investigating whether responses to stimulus -label pairings at each level of abstraction differ between homogeneous sets of male or female faces. Though data collection is ongoing, findings are expected to address questions about differences in individuation and categorization of males versus females for person perception.

Entry Number: 15 GB
CREATIVITY, INTELLIGENCE, AND BLACK IDENTITY: PRIVATE VERSUS. PUBLIC REGARD
By: Liz Scharnetzki, Akanksha Kalia, and Dr. Avi Ben-Zeev
Research Psychology
Faculty Advisor: Dr. Avi Ben-Zeev
Abstract: The current study was designed to examine the oft underemphasized link between how an academic task is framed and stigmatized individuals’ felt sense of racial identity. Specifically, we ask whether aspects of Black identity would be differentially affected by framing a test as diagnostic of a stereotypic negative trait (intelligence) versus a stereotypic positive trait (creativity) regarding African Americans. Twenty-eight Black identified participants completed the Multidimensional Inventory of Black Identity (MIBI) (Sellers, Smith, Shelton, Rowley, & Chavous, 1998) twice (a week before and during the experimental session). Participants were randomly assigned to solve a set of spatial logic puzzles, introduced as either diagnostic of intelligence (negative stereotypic) or of creativity (positive stereotypic). Whereas aspects of Black identity remained the same as baseline in the positive stereotypic condition, participants demonstrated a significant decrease in private regard (e.g., “I am happy about being Black”) ($M = -1.40$, $SD = 2.74$) but a significant increase in public regard (e.g., “Overall Blacks are considered good by others”) ($M = 2.50$, $SD = 3.59$) in the negative stereotypic

condition. These findings uncover an intimate link between how a task is framed and racial identification and are situated in a stereotype threat and identity bifurcation framework.

Entry Number: 16 GB
EDUCATION AND ATTITUDE CHANGE TOWARD LGBT TARGETS: MORE EFFECTIVE FOR THOSE HIGH IN SOCIAL DOMINANCE… AND ONLY FOR GAY AND LESBIAN TARGETS
By: Sara Michelle Mansoori-Rostam and Dr. Charlotte Tate
Social Psychology
Faculty Advisor: Dr. Charlotte Tate
Abstract: To probe the inconsistent link between education and attitude change, the present study focused on audience and communicator characteristics simultaneously. Participants were enrolled in either a sexuality or neurology course, which differed in education about lesbian, gay, bisexual, and transgender (LGBT) targets. Multiple regression analyses predicted the amount of attitude change toward LGBT targets using (a) the course type, (b) social dominance orientation (SDO), (c) right-wing authoritarianism (RWA), (d) ratings of professor's characteristics, (e) attractiveness, (f) SDO by course interaction, and (e) RWA by course interaction. No main effects emerged, but there was a significant SDO by course interaction, predicting positive attitude change toward gay men and lesbians, such that participants high in SDO in the sexuality course showed more positive attitude change. There was no difference between high and low SDO participants in the neurology course. These findings suggest that education may reduce prejudice for certain audience characteristics.

Entry Number: 17 D
THE DENITRIFICATION CAPACITY OF THERMOMICROBIUM HL1
By: Donne R. Estipona and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Thermomicrobium HL1 is thermophilic bacteria cultivated from a hot spring in Yellowstone National Park. T. HL1 notably grows in an enrichment culture intended for the model ammonia-oxidizing archaea, Nitrosocaldus yellowstonii, which grows on ammonia as a substrate and produces nitrite as a byproduct. Because these two organisms are affected by the same culture conditions, namely the availability of key nitrogenous substrates, I am interested to know if and how T. HL1 may also be contributing to nitrogen metabolism. From analyzing the sequenced genome of T. HL1 I have found several genes of interest in the dissimilatory pathway of nitrogen. Using KEGG, I have found a nitrous oxide reductase, a gene that converts nitrous oxide to nitrogen, as well as genes for the terminal acceptor complex NADH oxidoreductase. Further analyses confirm their identities. Other members of the dentrification pathway in bacteria, such as nitrite oxide reductase and nitric oxide reductase, have not been found. The presence of these genes suggests T. HL1 is capable of reducing nitrous oxide. This offers a possibility that nitrous oxide may be produced in the culture, contributing to the growth of T. HL1.

Entry Number: 18 GL
DRAFT-GENOME SEQUENCING AND ANALYSIS OF THREE NOVEL STRAINS OF THERMOPHILIC AMMONIA-OXIDIZING ARCHAEA
By: Amy Jo A. Johnson and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Ammonia oxidizing archaea (AOA) - known to thrive in a wide variety of environments - are significant contributors to essential nitrification processes that drive the global nitrogen cycle. AOA are part of the now described archaeal phylum Thaumarchaeota of which there are a growing number of fully sequenced species. Yet, much is still unknown about AOA physiology and evolution. At this time, the completed genome of only one representative from high temperature fresh-water sediments exists: Nitrosocaldus yellowstonii (N.

yellowstonii). The purpose of this project is to broaden our knowledge of archaeal ammonia-oxidation at high temperature. Our approach was to sequence and assemble draft genomes of additional representatives of thermophilic AOA for analysis through comparative genomics. Ammonia-oxidizing enrichment cultures were inoculated with sediments from hot springs in Yellowstone National Park (HL4 and ISA2) and Nevada (GBS). Following two years of enrichment, total genomic DNA was extracted from these cultures, and the genomes of the constituent microorganisms were determined by paired-end sequencing on an Illumina HiSeq 2000 platform. Each culture was found to contain a single archaeal strain closely related to N. yellowstonii. The resulting draft genomes of each new strain are equivalent in size to N. yellowstonii, approximately 1.4Mb. The average nucleotide identity (ANI) when comparing the genomes of HL4, ISA2, and GBS to N. yellowstonii is 98.8%, 98.4% and 95.2%, respectively. As hypothesized, strain sequence similarity decreases with geographic distance, possibly reflecting divergence influenced by allopatry. This biogeographic pattern is also apparent in 16S rRNA gene and other protein-coding gene comparisons; for example, relative to N.yellowstonii, the HL4 16S rRNA gene shows 99.71% nucleotide identity, ISA2 is 99.79%, and GBS 92.03%. When analyzed phylogenetically, the strains are positioned within the Thaumarchaeota and cluster together with N.yellowstonii as an exclusively thermophilic clade. All four genomes in this thermophilic cluster share 513 core functional orthologs conserved among all other AOA. These core orthologs include genes essential for ammonia oxidation-based metabolism like those encoding the proposed subunits of the archaeal ammonia monoxygenase. But, not surprisingly, 58% of protein-coding genes in the thermophiles are exclusive: 967 orthologs not found in any other AOA. We propose that these unique orthologs are implicated in adaptation to high temperature environments or are the result of horizontal gene transfer (HGT) events more likely to occur among faster-evolving, accessory genes.

Entry Number: 19 GL
UNCOVERING THE PROTEINS BEHIND THE ARCHAEAL AMMONIA OXIDATION PATHWAY
By: Donne R. Estipona and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Ammonia-oxidizing archaea (AOA) are key players in the global nitrogen cycle, catalyzing the oxidation of ammonia to nitrite in numerous aquatic and terrestrial environments. However, the biochemical mechanism by which AOA oxidize ammonia remains unknown despite nearly ten years of research. Genomic comparisons between AOA and better-studied ammonia-oxidizing bacteria (AOB) indicate that many of the key genes responsible for bacterial ammonia oxidation are missing in the genomes of known AOA. In order to identify potentially novel archaeal genes involved in ammonia oxidation, previous work in our lab compared the genome of a thermophilic AOA, Nitrosocaldus yellowstonii, with the genomes of all other archaea in the Integrated Microbial Genomes (IMG) database, including other sequenced AOA. 72 core AOA genes were found in all and only in AOA genomes. However, the majority of these genes (>65%) cannot be assigned a function based on sequence analysis alone. In order to identify candidate genes likely involved in archaeal ammonia oxidation, we have used proteomic analysis to compare N. yellowstonii from different conditions. SDS-PAGE on cell lysates reveals several bands specific to exponentially growing cells, suggesting certain proteins are upregulated during exponential growth of N. yellowstonii. In addition, LC-MS/MS analysis has identified three core AOA genes present in the stationary phase. These preliminary results show a promising approach in comparing gene expression between exponential and stationary growth phases in uncovering the proteins behind archaeal ammonia oxidation. Further experimental directions will also be discussed.

Entry Number: 20 GL
INVESTIGATION OF THE DND GENE CLUSTER IN SALMONELLA CLINICAL ISOLATES
By: Jennifer Griswold and Dr. Lily Chen
Microbiology

Faculty Advisor: Dr. Lily Chen

Abstract: Salmonella is one of the leading causes of foodborne illness every year. This microbe is a serious public health threat because of its ability to easily spread and acquire antibiotic resistance. Previous studies have determined that many bacteria, including Salmonella, can contain a set of genes responsible for sulfur modification of the DNA backbone known as phosphorothioation. These genes, known as the dnd gene cluster, replace a non-bridging oxygen with a sulfur molecule and results in a smear pattern (Dnd phenotype) during gel electrophoresis. While previous studies have shown that the dnd gene cluster is responsible for the DNA backbone modification, it has been unclear if these genes play a role in pathogenesis. This study further develops the understanding of the dnd gene cluster role in Salmonella clinical isolates obtained from an outbreak in a Monterey County jail by using Pulsed field gel electrophoresis (PFGE), PCR, gentamicin protection assays, and scanning electron microscopy (SEM). PFGE and PCR were used to screen Salmonella clinical isolates for the Dnd phenotype and dnd gene cluster, respectively. It was found that 100% of the isolates that display the Dnd phenotype also contain the dnd gene cluster. SEM was used to evaluate the surface morphology of the clinical isolates and it was determined that there were no apparent differences between the isolates. Cell invasion assays were used to infect RAW 264.7 macrophage cells with Salmonella in order to determine the potential contribution of dnd gene cluster to invasion activity. Strains with the dnd gene cluster had higher rates of invasion compared to strains lacking the dnd gene cluster, but further investigation is necessary to determine if the dnd gene cluster is playing a role in causing the increased invasion. Future experiments will also include intracellular replication and survival assays. SEM evaluation of invasion and intracellular replication process will further investigate the potential role of the dnd gene cluster in pathogenesis.

Entry Number: 21 GL

DOES FISSION YEAST CDC24 PLAY A ROLE IN STABILIZING REPLICATION FORKS DURING REPLICATION STRESS?

By: Anthony Xavier Lopez and Dr. Sally G. Pasion

Cell and Molecular Biology

Faculty Advisor: Dr. Sally G. Pasion

Abstract: Maintenance of genome integrity depends highly on proteins to work properly during both DNA replication and repair. Loss of function of DNA replication proteins may cause genome instability, which is a well-known hallmark of cancer. Fission yeast cells with mutations in the cdc24+ gene arrest in S-phase of the cell cycle and exhibit chromosome breaks. Although the precise role of cdc24+ is unknown, the chromosome breakage phenotype has also been reported in cells harboring mutations in other DNA replication genes. During S-phase of the cell cycle, DNA replication checkpoints detects and deals with perturbations that may halt replication fork progression. DNA replication stress is characterized as inefficient DNA replication caused by slowly progressing or stalled replication forks. Cds1, the human homolog of CHK2, protects the genome by stabilizing the replication fork and allows proteins involved in DNA replication to remain associated with chromatin until conditions are restored. Mechanistically, how the checkpoint stably stalls arrested replication forks and allows replication proteins to remain associated with chromatin remain unclear. My main goal is to determine if Cdc24 is chromatin associated in both unperturbed and perturbed cells by performing a chromatin fractionation assay. Hydroxyurea (HU) is a commonly used drug that is used to induce an S-phase arrest by depleting cellular dNTPs, resulting in stalled DNA replication forks. Cells treated with HU experience DNA replication stress, and therefore allows the investigation of the stability of proteins at arrested replication forks. Here we report the chromatin association of Cdc24 in both unperturbed (-HU) and perturbed (+HU) cells using a cdc24+-myc tagged strain. Flow cytometry analysis is used to determine DNA content for HU treated cells arrested at S-phase. Whole cell extracts for both samples are prepared by glass bead lysis and processed for the chromatin fractionation assay. A Western Blot approach is used to determine if Cdc24 is chromatin associated in both unperturbed and perturbed fission yeast cells. Results from these experimental data provide further insights into how Cdc24 may function to maintain genome stability during S-phase of the cell cycle.

Entry Number: 22 GL
INHIBITION OF ECTODERM NITRIC OXIDE SIGNAL DELAYS THE RATE OF MYOGENESIS IN CHICKEN EMBRYO
By: Farzad Ghamsari, Elliot Lozano, Eric Arreola, and Dr. Wilfred Denetclaw
Cell and Molecular Biology
Faculty Advisor: Dr. Wilfred Denetclaw
Abstract: Early embryonic skeletal muscle (myotome) formation depends on external signaling factors that include morphogens and other signals. We have identified nitric oxide (NO), a messenger gas molecule operating through a protein kinase activated by cGMP as an important regulator of myotome formation. However, it is not known if the earliest start of myotome formation depends on NO signaling in the embryo. Our investigation utilizing HH10-15 chicken embryos under inhibitors to NO synthase (NOS) demonstrates significant delays in the start of the first myotome formed. We conclude that NO produced by NOS, originating from the ectoderm layer represent an important signaling event that mediates the earliest embryonic myogenesis.

Entry Number: 23 GL
THE ROLE OF SPERM SPECIFIC PP1 PHOSPHATASES IN KINETOCHORE LOCALIZATION DURING SPERMATOGENESIS
By: Joseph Beyene
Cell and Molecular Biology
Faculty Advisor: Dr. Diana Chu
Abstract: Male infertility affects millions of couples within the US. Male fertility and sperm function depend upon proper chromosome segregation during meiosis. However, little is known about the molecular components required for chromosome segregation during sperm meiosis. Our lab examines the role that PP1 phosphatases, GSP-3 and GSP-4 (GSP-3/4), have in C. elegans sperm meiosis. GSP-3/4 are sperm associated protein phosphatases that are 98% identical. While gsp-3/4 mutants are infertile and gsp-3/4 mutant sperm chromosomes fail to segregate properly during meiosis, the specific role of GSP-3/4 in chromosome segregation remains unknown. During meiosis, microtubules attach to kinetochores to pull chromosomes apart. We have found that GSP-3/4 colocalize with kinetochore components. Thus, we hypothesize that GSP-3/4 are required for the correct localization and function of kinetochore components during spermatogenesis. Gsp-3/4 also regulate kinetochore and microtubule dynamics. Consistent with this, we have found that a kinetochore component called HCP-2 mislocalizes in gsp-3/4 male mutants, suggesting a dependency upon GSP-3/4 for kinetochore localization. We are using cytology to visualize if GSP-3/4 regulate additional kinetochore components. These results will elucidate the extent to which GSP-3/4 regulate kinetochore localization during spermatogenesis. Furthermore, we aim to visualize kinetochore and microtubule interactions in gsp-3/4 male mutants. This will allow us to observe how changes in kinetochore components influence microtubule attachment to sperm chromosomes. In gsp-3/4 mutants, we anticipate that there will be aberrant kinetochore localization along with abnormal attachment of microtubules to chromosomes. Our work will demonstrate sperm-specific aspects of kinetochore components and their dependency upon GSP-3/4 for proper localization.

Entry Number: 24 GL
ROLE OF REACTIVE OXYGEN SPECIES IN RUS1-MEDIATED UV-B RESPONSES AND ARABIDOPSIS DEVELOPMENT
By: Pierpont Dutcher and Dr. Zheng-Hui He
Cell and Molecular Biology
Faculty Advisor: Dr. Zheng-Hui He

Abstract: Ultraviolet B (UV-B, 280-320 nm) can be harmful or beneficial to biological organisms. Little is known about the molecular mechanism of how cells sense low-level UV-B as developmental signals. We have been working with the ROOT UV-B SENSITIVE1 (RUS1) gene that plays an important role in Arabidopsis early seedling development. The rus1 mutant displays severe developmental arrest when low UV-B is present. The rus1 phenotypes can be suppressed by specific mutations in ASPARTATE AMINOTRANSFERASE2 (ASP2) protein or by endogenously adding vitamin B6 in the growth media. RNAseq experiments have identified peroxidases that were differentially expressed as a result of the rus1 mutation. Reactive oxygen species (ROS) staining experiments showed different patterns between the wild type and the rus1 mutant. Diamino benzadine (DAB) staining was used to detect the presence of hydrogen peroxide in WT and rus1 roots. Different from the patterns observed in WT roots, rus1 roots display a strikingly clear region in the cell differentiation zone, suggesting there is a region with strong H2O2 scavenging activities. This clear zone also transiently appears in WT roots at very early stage (around 1 day old) but disappears beyond 1 day after germination. The rus1 mutant, however, maintains this clear zone throughout a long period of time (9 day period). The transient appearance of the clear zone is restored in the rus1 asp2 double mutant or when rus1 seedlings are treated endogenously with vitamin B6. Our findings suggest ROS may play critical roles in RUS1-mediated early Arabidopsis seedling development.

Entry Number: 25 GL

THE ROLE OF THE PP1 PHOSPHATASES, GSP-3 AND GSP-4, IN SPERM MEIOSIS OF C. ELEGANS

By: Thais Godoy Cintra and Dr. Diana Chu
Cell and Molecular Biology
Faculty Advisor: Dr. Diana Chu

Abstract: Proper meiotic chromosome segregation is crucial to maintaining the integrity of chromosomes and avoiding the inheritance of genetic disorders. Previous work in mammals has shown that sperm-specific PP1 phosphatases are required for male fertility and normal chromosome disjunction by playing a crucial role in motility and meiotic divisions of spermatids. However, studying PP1 phosphatases exact functions in sperm meiosis has been a challenge and it is presently unknown. In our work, we plan to use immunohistochemistry and live-imaging analysis to show the exact role of PP1 phosphatases GSP-3 and GSP-4 (GSP-3/4) in chromosome segregation during C.elegans sperm meiosis. To determine GSP-3/4 exact roles in chromosome segregation, we will test the dependence on GSP-3/4 of three key players in meiosis: 1) microtubules, which aid in chromosome orientation and separation, 2) kinetochores, the key link between chromosomes and microtubules, and 3) cohesions complexes that hold sister chromatids together to prevent premature segregation. By analyzing these players we will test our hypothesis that GSP-3/4 regulate microtubules, kinetochores, and cohesins, during meiotic divisions in C.elegans. Once we are able to identify the exact role of PP1 phosphatases, we will have contributed to advancements that will be crucial for treating male infertility and male specific aneuploidy in humans.

Entry Number: 26 GL

MANY DIFFERENT SOLUTIONS TO THE SAME PROBLEM: SUBCELLULAR TARGETING OF MDH GENES IN FUNGI

By: Oliver Oliverio, Cameron Soulette, Nicolas Cole, and Dr. Scott Roy
Cell and Molecular Biology and Physiology
Faculty Advisor: Dr. Scott Roy

Abstract: The central goal of molecular biology is to understand how molecules give rise to phenotypes. A tremendous diversity of molecular functions is accomplished by only a few thousand genes per organism, often requiring multiple functions to be performed by a single gene. A common strategy involves production of multiple proteins from the same gene by alternative splicing (AS). Nearly all known functional cases of alternative splicing are restricted to animals and land plants, however an exception was recently reported in the yeast Yarrowia lipolytica. Y. lipolytica produces Malate Dehydrogenase (MDH) proteins targeted to both the

peroxisome and cytosol by AS leading to presence/absence of a canonical C-terminal peroxisomal target sequence (PTS1). We examined the evolutionary history of AS and MDH targeting across dozens of Ascomycetes fungi. Our results are surprising: Different organisms use several different AS mechanisms to produce the same dual-targeting function. AS mechanisms are highly convergent, with different AS mechanisms scattered across the evolutionary tree. Functional redundancy among MDH isoforms is common, with multiple mechanisms to produce identical or likely functional identical proteins by AS in the same gene. In several instances, paralogs 'swap' subcellular targeting roles, including two cases of swapping among ancient paralogs diverged at least one billion years ago

Entry Number: 27 GL
STRUCTURAL CHARACTERIZATION OF HEAVY METAL TOXICITY IN A HUMAN DNA REPAIR GLYCOSYLASE
By: Trevor Gokey and Dr. Anton B. Guliaev
Computing for Life Science
Faculty Advisor: Dr. Anton B. Guliaev
Abstract: The DNA base excision repair pathway consists of several enzymes, some of which require metal cations for catalysis. UDG, a protein responsible for the initial detection and removal of carcinogenic lesions from DNA, is a non-metal requiring enzyme. Here we show Cd, Zn, Pb, and Ni metal cations, in order, inhibit UDG activity in the micromolar range. Molecular Dynamics simulations using AMBER showed Cd entering the catalytic pocket, interacting with the catalytic Asp 64 residue. Subsequent simulation at the PM3 semi-empirical quantum level of theory showed that Cd additionally interacts with His 67 and the peptide oxygen of Pro 65. This position effectively replaces the catalytic water necessary for lesion removal from DNA. Further quantum calculations using ONIOM of Gaussian 09 on structures obtained from the PM3 simulations indicate a tetrahedral coordination with Cd. We conclude that metal inhibition of UDG is due to replacement of the catalytic water, where a stable metal complex forms and prevents catalysis. Following the trends of our biochemical data, we predict that inhibition of UDG is mediated by the heavy metal's preference for tetrahedral coordination at the active site.

Entry Number: 28 GL
INVESTIGATING THE SUBSTRATE SPECIFICITY OF SECRETED PROTEASES FROM CANDIDA BIOFILMS
By: Desiree Tax, Clarissa Noble, Anthony O'Donoghue, and Dr. Alegra Eroy-Reveles
Chemistry
Faculty Advisor: Dr. Alegra Eroy-Reveles
Abstract: Candidiasis is the most common hospital-acquired fungal infection by Candida albicans. These infections are difficult to treat, especially when the fungal cells group together to form a biofilm. Proteases, degradative enzymes secreted by fungi, provide an essential source of nutrients to the organism in both the free-floating (planktonic) and biofilm stages. Secreted aspartyl proteases (Saps) have the ability to degrade structural proteins and little is known about the substrate specificity of these enzymes. Furthermore, it is unknown if there is a difference in protease secretion during the planktonic and biofilm stages. In this project, we will identify and compare the substrate specificity of secreted proteases from C. albicans in the planktonic and biofilm stages. This will indicate if these enzymes should be investigated further with targeted inhibitors.

Entry Number: 29 GL
PHYSIOLOGICAL RESPONSES OF PORCELAIN CRABS TO CLIMATE CHANGE
By: Adam Paganini
Marine Biology
Faculty Advisor: Dr. Jonathon Stillman

Abstract: F. Organisms that inhabit the intertidal zone experience large daily fluctuations in temperature, immersion and pH. Future climate scenarios indicate that the intensity and frequency of low pH and high temperature events will increase. Intertidal invertebrates may respond to these abiotic factors in ways that could alter their physiological performance. Due to their large abundance and diverse habitat distributions in the intertidal zone, Porcelain crabs play an important role in intertidal ecosystems. We investigated the Porcelain crab Petrolisthes cinctipes' performance under future ocean conditions that included the synergistic effects of temperature, increased CO2 (low pH), and emersion.

Entry Number: 30 GL

THE ROLE OF OXYGEN IN DETERMINING UPPER TEMPERATURE TOLERANCE IN THE FINGERED LIMPET UNDER EMERSION AND IMMERSION

By: Brittany E. Bjelde, Nate A. Miller, Dr. Jonathon H. Stillman, and Dr. Anne E. Todgham
Marine Biology
Faculty Advisor: Dr. Anne E. Todgham

Abstract: Predicting an organism's vulnerability to future increases in temperature requires an understanding of the factors that set their upper temperature tolerance. Previous investigations of cardiac performance and thermal tolerance limits in the fingered limpet, Lottia digitalis, have shown that limpets exposed to a thermal ramp under emersed conditions maintained heart function to a higher temperature than limpets exposed to the same heating while immersed. Here we examined whether differences in O2 concentration in air and water could explain reduced cardiac thermal tolerance under immersed conditions. Limpets were heated at a rate of 6°C/h under hyperoxic (35%), normoxic (21%), or hypoxic (5%) O2 conditions in both emersed and immersed conditions. Thermal limits of heart function were calculated as break point temperatures (BPT). Similar to previous work, emersed limpets were significantly more thermally tolerant than immersed limpets under all O2 exposures. BPTs of emersed limpets were roughly 2-3°C higher than immersed limpets under normoxic and hyperoxic conditions and almost 5°C higher under hypoxic conditions. Thermal tolerance was not increased in either immersed or emersed limpets exposed to 35% O2 suggesting that in both air and water the ability to supply O2 to tissues at high temperatures is already maximized under normoxia. However, under hypoxic conditions both groups of limpets exhibited significantly reduced thermal tolerance providing evidence of O2 limited thermal tolerance at low environmental PO2s. Given the consistent differences in thermal tolerance in emersed and immersed limpets across all O2 concentrations, reduced O2 availability in water is not sufficient to explain air/water thermal tolerance differences.

Entry Number: 31 GL

EFFECTS OF REPEATED HEAT STRESS AND RECOVERY ON THERMAL TOLERANCE OF THE FINGERED LIMPET, LOTTIA DIGITALIS

By: Christina Pasparakis, Brittany Bjelde, and Dr. Anne E. Todgham
Marine Biology
Faculty Advisor: Dr. Anne E. Todgham

Abstract: The ability of a species to respond to both increases in mean temperature as well as the increased frequency of extreme high temperature exposures will affect its survival in a changing environment. The rocky intertidal zone is among one of the most highly variable environments on Earth, with rapidly shifting conditions dependent on the tidal cycle. Therefore, intertidal organisms must be able to tolerate extreme and stochastic changes in temperature on a daily basis. Although there have been numerous studies investigating the thermal physiology of intertidal animals, few have focused on an organism's physiological capacity to withstand repeated heat stress and how previous exposure to sublethal heat stress may shift an organism's upper temperature tolerance. Lottia digitalis, a species of limpet ubiquitous along the coast of California in the upper middle intertidal zone, were collected from Fort Ross California in early June 2012 and brought back to the lab to acclimate to ambient ocean conditions for two weeks. To investigate the effect of a preliminary mild heat shock of differing magnitudes on upper thermal tolerance, limpets were aerially exposed to 15°, 20° 25°, 30°,

32° and 35°C on Day 1. The following day, in sync with the start of the midday low tide period, electrodes were placed into the limpets to record heart rate as temperatures were increased at a rate of 6°C/h to 48°C, a severe, lethal heat shock. Previous exposure to a mild heat shock of 32°C the day before a severe heat shock, increases L.digitalis upper thermal tolerance as determined by break of heart function. Next steps include examining Hsp70 protein levels following the preliminary mild heat shock and repeating this experiment using higher preliminary heat stress temperatures.

Entry Number: 32 GL
INVESTIGATING UNDERGRADUATE SCIENCE STUDENTS' CONCEPTIONS AND MISCONCEPTIONS OF OCEAN ACIDIFICATION
By: Kathryn I. Danielson and Dr. Kimberly D. Tanner
Marine Biology
Faculty Advisor: Dr. Kimberly D. Tanner
Abstract: Scientific research exploring the impact of climate change on the ocean, specifically ocean acidification, has grown substantially in the last two decades. Yet, little science education research has investigated the extent to which these ideas are understood by college graduates, especially by undergraduate science students, who will constitute the next generation of experts in a range of scientific fields. Considering the multi-disciplinary science curriculum taken by an undergraduate science student, one would predict these students would be best able to understand ocean acidification among undergraduates more generally. What conceptions and misconceptions of ocean acidification do these students hold, and how do they compare across scientific disciplines? Open-ended written assessments were collected from undergraduate Biology, Chemistry/Biochemistry, and Environmental Studies students, as well as science faculty for comparison, and follow-up interviews were conducted with a subset of students. Results revealed that while many students demonstrated knowledge of climate change and greenhouse gases, awareness and understanding of ocean acidification was remarkably low. Significantly more Environmental Studies students demonstrated awareness of ocean acidification and identified the key role of carbon dioxide, compared to Biology or Chemistry/Biochemistry students. Lastly, multiple novel misconceptions about ocean acidification were discovered among these emerging scientific experts. These findings raise the question of whether current undergraduate science curriculum sufficiently prepares students to use their conceptual expertise in understanding issues of climate change, specifically ocean acidification.

Entry Number: 33 D
POTENTIAL DRIVERS OF AGGREGATION BEHAVIOR IN THE LEPTASTERIAS SEA STAR
By: Kathryn Nuessly
Marine Biology
Faculty Advisor: Dr. C. Sarah Cohen
Abstract: Aggregations of organisms are often formed in response to conspecifics, predators, or abiotic stress. Aggregations of sea stars in the genus Leptasterias have been reported to occur in Washington state only during fertilization events; however, aggregations have been observed year---round in populations on the coast of central California. We investigated Leptasterias aggregation behavior at Muir Beach, Marin County, CA to quantify the occurrence of this behavior and test association with potential drivers, such as the proximity of predators and prey, shelter found in microhabitats, and physical protection from wave exposure. Six fixed plots were surveyed during low tides from October 2012 to March 2013. Microhabitats were divided into three categories for this study: crevice, overhang, and no protection. Total number of adults present in aggregations, associated flora and fauna, and the microhabitat the aggregations occur on were recorded for each plot. Additional boulders were surveyed from January to March 2013 to determine wave impact effects on aggregation occurrence. Preliminary results suggest that the ratio of aggregated to total Leptasterias varies among plots. Microhabitat analyses suggest aggregation ratios do not vary significantly among the three categories. Additional fieldwork and analyses are being conducted to examine the significance of different sizes of aggregations in different microhabitats and wave exposed surfaces. Continued study of Leptasterias will

focus on the role of aggregation behavior in determining dispersal and connectivity between populations, as well as individual and population---level fitness.

Entry Number: 34 GL
PATTERNS OF CO-SPECIATION AND HOST SWITCHING IN AVIAN MALARIA PARASITES OF AFRICAN SUNBIRDS (FAMILY NECTARINIIDAE)
By: Elvin James Lauron
Cell and Molecular Biology
Faculty Advisor: Dr. Ravinder Sehgal
Abstract: The malaria parasite Plasmodium falciparum is one of the world's most devastating and widespread parasites, killing more people than any other parasitic infection. Parasites of this genus can also exploit multiple vertebrate hosts including reptiles, mammals, and birds. Furthermore, malaria parasites of birds are found on all continents of the world except Antarctica. The potential for these widely spread avian plasmodium parasites to leap into new hosts has conservation implications, as was seen in the endemic bird populations of Hawaii. The host-specificity, pathogenenicity, and geographical distribution of avian plasmodium are influenced by the life history of the host-parasite relationships. However, understanding these processes requires an extensive sampling of parasite distributions across hosts. We thus sought to understand the history of avian plasmodium and the widespread bird family, Nectariniidae. These birds spread from Asia to Africa; after arriving to Africa, they rapidly diversified. To determine whether Nectariniidae speciation led to congruent parasite speciation in Africa, we generated a Nectariniidae phylogeny and a three-genome phylogeny of avian plasmodium found in Nectariniidae. These phylogenies were used to perform co-phylogenetic analysis. Our co-phylogenetic analysis indicates the extent of avian plasmodium parasite co-speciation, host switching, sorting, and duplication events that occurred in the African sunbirds.

Entry Number: 35 GL
RESPONSE OF MAMMALIAN PREDATORS TO CORRIDOR RESTORATION ALONG THE MIDDLE SACRAMENTO RIVER
By: Vasilissa Derugin, Dr. Gretchen LeBuhn, Joseph G. Silveira, Dr. Gregory H. Golet, and Dr. Edward F. Connor
Conservation Biology
Faculty Advisors: Dr. Gretchen LeBuhn, Joseph G. Silveira, Dr. Gregory H. Golet, and Dr. Edward Connor
Abstract: Growing awareness of the ecological implications of habitat fragmentation has sparked efforts to restore connectivity between isolated habitat patches. For this purpose, habitat conservation initiatives increasingly focus on the restoration of "corridors," parcels of land that promote the connectivity necessary for organisms' movement. Most studies of organisms' responses to corridor restoration focus on species at the lower trophic levels; top predators (often, keystone species) have received less attention. Riparian corridor restoration in the Sacramento River National Wildlife Refuge provides an opportune setting to investigate the use of a corridor by large mammalian predators. In Colusa, Glenn, and Tehama Counties, we investigated mammalian predator use of 16 riparian corridor sites that varied in age since restoration. We used remote cameras to document predators' habitat preference, assessed by species richness and detection frequency. Top predators and the predator community at large tended to favor restored forests over remnant forests, and young restored forests over old restored forests. This trend persisted even when data from variable seasons and climatic conditions were pooled, although habitat selection was more often significant in our wet sampling year than in our dry sampling year, and in the cold seasons than in the warm seasons. Our study suggests that restoration age affects predator community diversity and activity levels. Incorporating earlier successional vegetation in corridor restoration strategies and maintaining river processes that promote early successional vegetation growth may prompt predators' return to restored locations.

Entry Number: 36 GL
FUNCTIONAL LEAF TRAITS OF ARCTOSTAPHYLOS (ERICACEAE) IN RELATION TO FOG
By: Lois McCubbin
Ecology and Conservation Biology
Faculty Advisor: Dr. V. Tom Parker
Abstract: Functional leaf traits are morphological and physiological characteristics that impact a species' fitness for a given set of environmental conditions and have been widely used in ecological research due to their predictive power. Ecological water resource strategies of plants, for example, can be predicted using functional leaf traits such as specific leaf area, stomatal pore area per leaf area index, and venation characteristics. Large scale projects have been suggestive, but more smaller-scale research is needed in order to determine how plants will respond to climate change. Coastal California is an ideal study area because climate change will be rapid due to the strong climatic gradient associated with fog and the mountainous terrain. Fog plays an important role in the water systems of many endemic plants in California and likely dictates a plant's water resource strategy which can be represented using functional leaf traits. I have chosen Arctostaphylos (Ericaceae) as a model genus because there are many local endemic species in central California and physiological differences along this environmental gradient have already been established. Coastal Arctostaphylos species appear to be fog dependent and, because of their endemism and rarity, predicting their responses to potential shifts in climate and breakdown of fog is of critical conservation concern. Only kilometers away from fog influences, closely related species are subject to summer drought and high temperatures. Do Arctostaphylos functional leaf traits correlate with local climatic conditions in a manner that would permit modeling with future climatic changes? I hypothesize that Functional leaf traits associated with water resource strategies are highly correlated with local climatic conditions. Functional leaf traits, if useful for modeling ecological water resource strategies, will be important tools for species character comparisons. Our knowledge of fog, and its dependent organisms, is still developing and further research is needed at a smaller scale to enable prediction of future range shifts of California's endemic species for the purpose of conservation.

Entry Number: 37 GL
INCIDENCE OF CHYTRIDIOMYCOSIS IN THREE AREAS OF HIGH AMPHIBIAN ENDEMISM IN GUATEMALA
By: Angel Jacobo Conde, Gustavo Ruano, Carlos Vasquez, Liza Garcia, and Alejandra Zamora
Ecology and Systematic Biology
Faculty Advisor: Dr. Vance T. Vredenburg
Abstract: Amphibian populations are declining worldwide due in part to a fungal infection called chytridiomycosis, caused by the fungus Batrachochytrium dendrobatidis (Bd). Infecting more than 350 species of amphibians worldwide, Bd is found in all continents that inhabit amphibians. Guatemala is not an exemption to this case and some species were detected with chytridiomycosis (Mendelson, et.al, 2004; Rovito et.al., 2009, Cheng et.al., 2011). The high diversity and endemism of amphibians in cloud forests of Guatemala and the lack of information about chytridiomycosis in that country brings into focus the study of health status and current amphibian conservation in these regions. In this study we surveyed three cloud forests of Guatemala in order to know and determine the dynamics of the disease in the area. We found a total of 477 individuals distributed in 14 species and 5 families. 135 of those individuals were found positive for chytridiomycosis, being this an alarming 28% of prevalence in the cloud forests of Guatemala. Quick conservation efforts are required in this area in order to prevent bigger amphibian declines.

Entry Number: 38 GL
EFFECT OF FOOD AVAILABILITY ON THERMAL TOLERANCE ON JUVENILE DUNGENESS CRABS IN THE SAN FRANCISCO ESTUARY
By: Katherine McLean and Dr. Anne E. Todgham

Ecology and Systematic Biology
Faculty Advisor: Dr. Anne E. Todgham
Abstract: Understanding the consequences of anthropogenic environmental change to Dungeness crabs, Metacarcinus magister, is crucial for the successful management of this species. By 2100 the San Francisco Estuary (SFE) will experience a 1.5-4.5°C increase in average temperature as well as more frequent extreme thermal events. Within the estuary, 0+ age group juvenile crabs prefer eelgrass beds and oyster beds because they provide refuge from predators and elevated nutrient availability. Little is known about whether this increased nutrient availability enables juvenile Dungeness crabs to better tolerate extreme thermal events by providing them with more energy to grow and allocate to other physiological processes like stress tolerance. We investigated the effect of different food rations on the upper thermal tolerance of juvenile Dungeness crabs. 0+ Dungeness crabs (26mm) were collected from the SFE and were held in outdoor tanks for four weeks under two feeding levels: high (300mg squid tissue/48hrs) and low (50mg squid tissue/week). Crabs in the low food group weighed significantly less and had significantly smaller carapace widths than crabs in the high food group. When crabs were separated by whether they recently molted, the weight differences between feeding groups were apparent in both molted and non-molted crabs. Heart rate was then monitored in crabs as temperatures were increased from 12°C (current Bay temperature) to 36°C (representing a thermal extreme) over a 4h period. Upper thermal tolerance was determined by a break in heart function. To assess the metabolic response to elevated temperature, crabs were placed in respirometers held at constant temperature (15, 20, 25 and 30°C) and oxygen consumption was measured until oxygen levels decreased to 80% air saturation.

Entry Number: 39 GL
EXPLORING THE BOUNDARIES OF GENETIC DIVERSITY: A POPULATION SURVEY OF LIZARDS AT THE CIMA VOLCANIC FIELD
By: Michael Hague
Ecology and Systematic Biology
Faculty Advisor: Dr. Eric Routman
Abstract: Genetic variation among individual organisms lies at the core of biodiversity. Such diversity is a fundamental requirement for evolution and adaptation. We examined how levels of population genetic diversity vary among different lizard species at the Cima Volcanic Field in the Mojave Desert. A previous study of side-blotched lizards at this site discovered an unusually high level of both mitochondrial and autosomal genetic diversity. Despite the small size of the 150 sq. km. volcanic field, the lizards' diversity statistics were near the upper observed limits of vertebrates. The goal of this study was to investigate the cause of the side-blotched lizards high diversity along with why levels of genetic diversity vary among species. We conducted a population genetic survey of four other lizard species at the site, which all vary in their demography and habitat use. In the mitochondrial gene cytb, we found that small lizard species with high population densities and short lifespans had significantly higher levels of population genetic diversity than large species with low densities and long lifespans. We continue to analyze two autosomal genes, Mc1r and Rag1, to further clarify how and why diversity varies among species. These preliminary results provide researchers with a spectrum of empirical population diversity levels in desert lizards. They also shed light on how factors like population density and longevity can contribute to high diversity levels in certain lizard species.

Entry Number: 40 GL
TEMPORAL AND SPATIAL VARIATION OF CHYTRIDIOMYCOSIS ACROSS BATRACHOSEPS ATTENUATUS POPULATIONS
By: Carla M. Sette, Dr. Vance T. Vredenburg, and Dr. Andrew G. Zink
Physiology and Behavioral Biology
Faculty Advisor: Dr. Vance T. Vredenburg and Dr. Andrew G. Zink

Abstract: Batrachochytrium dendrobatidis (Bd) is a highly virulent fungal pathogen which causes chytridiomycosis in amphibians. This rapidly-spreading disease is implicated in the decline and extirpation of amphibian populations throughout the world. Because the fungus' flagellated zoospores spread by swimming through water or along amphibians' moist skin, it is considered an aquatic disease. However, it has recently been detected in completely terrestrial salamanders, such as the California slender salamander, Batrachoseps attenuatus. We used quantitative PCR to detect the presence of Bd in up to 20 randomly-selected individuals from seven decades and across twelve counties within B. attenuatus' range. Results from these 1300 samples reveal temporal and spatial variation in the presence and infection intensity of Bd across populations. Because B. attenuatus is highly gregarious in its nesting behavior, we propose that social behavior may provide an opportunity for transmission of Bd.

Entry Number: 41 GL

THE EFFECTS OF ERRORS, MULTIMODAL SIGNALS, AND COGNITIVE RULES ON COMMUNICATION EVOLUTION

By: Ryan Tate and Dr. Andrew G. Zink
Physiology and Behavioral Biology
Faculty Advisor: Dr. Andrew G. Zink

Abstract: Mathematical models of animal communication that look at how errors in communication effect communication. Looking specifically at how different types of cognitive rules, multiple signals, and multimodal signals affect the benefits of communicating. Also looking at how signal error affects senders and receivers differently leading to possible conflict over which signals to drop from a repertoire.

Entry Number: 42 GL

THE PHYSIOLOGICAL RESPONSE TO MULTIPLE STRESSORS: EFFECTS OF SALINITY AND TEMPERATURE ON OLYMPIA OYSTERS

By: Sara E. Boles and Dr. Anne E. Todgham
Physiology and Behavioral Biology
Faculty Advisor: Dr. Anne E. Todgham

Abstract: Rising global temperature and changes in seawater chemistry are projected to alter species abundance and distribution. To better understand the effect of multiple stressors (temperature and salinity), we assessed the physiological response in adult Olympia oysters (Ostrea lurida),a foundation species, to current and projected conditions in the San Francisco Bay during late winter and early spring. After one week of acclimation to the lab, oysters were split into 4 different treatment groups in a fully factorial design of two temperatures (12˚C, and 16˚C) and two different salinities (25 and 18) in triplicate (n=3 containers/ treatment, 12 containers total , n=48 oysters/container): 12˚C/Salinity 25; 12˚C/Salinity 18; 16˚C/Salinity 25; 16˚C/Salinity18 for 4 weeks of acclimation. Temperatures were chosen to represent the mean for San Francisco Bay (12°C) and a +4 ˚C increase (16°C) as outlined by the IPCC A1FI scenario. Salinities were chosen to represent the mean high salinity (Salinity 25) and the mean low salinity (Salinity 18) during late winter and early spring in the San Francisco Bay. Following 4 weeks of acclimation, all oysters were exposed to a common-garden salinity challenge (12 ˚C and Salinity 12, representing a low salinity event in bay during periods of heavy rain) for two weeks. To evaluate the physiological response of O. lurida over the course of the experiment under these treatments, we assessed survival and RNA:DNA ratios (a proxy for protein synthetic capacity and over all nutritional condition). Oysters held under future conditions may allocate more energy to dealing with stressors rather than reproduction and survival. With global climate change, a number of environmental factors are projected to undergo relatively rapid changes; therefore, if we are to predict how contemporary organisms will fair under future ocean conditions, it is pertinent to understand the impacts of climate change from a multi-stressor perspective.

Entry Number: 43 GP
MOLECULAR DYNAMIC MODELING OF OROTIDINE 5'-PHOSPHATE DECARBOXYLASE
By: Thomas Olson and Dr. Anton B. Guliaev
Computing for Life Science
Faculty Advisor: Dr. Anton B. Guliaev
Abstract: The field of Molecular Dynamics is increasingly used as an extension of experimental data and to test theories concerning the interaction of biological molecules. By extending experimental data and with molecular dynamic simulations, which uses classical mechanics and a defined force field parameters , it is possible to use molecular dynamic simulations to test theories from the experimental data, opening the possibility of running experiments that would otherwise be too difficult or impractical to carry out in a physical laboratory. The goal of this study was to get a better understanding of Orotidine 5' – phosphate decarboxylase (ODCase). ODCase is responsible for the synthesis of uridine 5'-phosphate, which is a precursor of RNA and DNA . In a neutral solution, uridine 5' phosphate is produced via the decarboxylation of uridine 5'phosphate at a rate with a half life of 78 million years. However, in the presence of ODCase, which operates with no co metals or cofactors, the rate of reaction for the decarboxylation will increase by a factor of 1017 , to a half life of approximately 18 msec. To analyze and attempt to better understand how ODCase operates at such efficiency without any cofactors, we ran MD simulations of ODCase using AMBER 12. ODCase is a dimer and each monomer of the dimer contains 2 subunits, both of which contain active sites and both of which influence the active site of its adjacent subunit. This study focused on the loops that make up these active sites, which contain residues 151 - 165 and 207 – 218 of each subunit and loop 95 – 103 of the adjacent subunit. The data generated from this study will serve as the basis for further study of the protein.

Entry Number: 44 GP
DISSOLVED INORGANIC CARBON DYNAMICS IN ANOXIC MARINE SEDIMENT
By: Huan Lei Li, Abraham King Cada, and Adrian Gerretson
Chemistry
Faculty Advisor: Dr. Tomoko Komada
Abstract: Study of dissolved inorganic carbon (DIC) dynamic yields important clues to understand local microbial activity and carbon transformation processes in interested zone such as subsurface anoxic marine sediment. This research project evaluates the role of DIC as the terminal anaerobic food chain in carbon remineralization process. In anoxic marine sediment where concentration of available oxidant is low and limited, determination of DIC distribution in upper 0.5 meter in Santa Monica and Santa Barbara Basin along with their depth profile of carbon isotopic composition and signatures would allow understanding key parameters such as reactivity rate and dominated sources of DIC within the zone. In addition, a selective DIC reactivity model would be employed to better explain experimental measurement for the same purpose.

Entry Number: 45 GP
CHARACTERIZATION OF [001] ORIENTED THIN FILMS OF ANATASE (TITANIUM DIOXIDE) AS A FUNCTION OF ANNEALING TEMPERATURE
By: Devin Nelson
Chemistry
Faculty Advisor: Dr. Andrew S. Ichimura
Abstract: The anatase phase of titanium phase has been shown to be a novel broadband semiconducting material for uses as a photocatalyst and electrode. Current understanding suggests that the minor exposed (001) facet has higher photoreactivity than the major exposed (101) facet. Using hydrothermal synthesis methods with TiF4, polycrystalline thin films of [001] oriented and (001) exposed anatase can be grown on various substrates at 120-135°C. A temperature analysis was done to probe the thermal properties of this new material to show that

the altered crystal habit causes higher stability at elevated temperatures, both in film and powder form, and resists the phase transformation to rutile up to 900°C.

Entry Number: 46 GP
THE EFFECT OF PEGYLATION ON HEME HYDRATION AND LIGAND BINDING DYNAMICS IN MYOGLOBIN
By: April Lynn Toledo and Irina Volosko
Chemistry and Biochemistry
Faculty Advisor: Dr. Raymond M. Esquerra
Abstract: Polyethylene glycol (PEG) has been used for the covalent modification of drugs, proteins, and other biological macromolecules for pharmacology and biotechnology applications. PEGs have been found to increase solubility, half-life, and hydration radius of many proteins, while reducing the likelihood of antigenicity. The covalent attachment of PEGs (PEGylation) often changes functional properties in an unpredictable fashion. To better understand the physical mechanisms by which function is perturbed, we examine the effect of PEGylation on the ligand binding dynamics of wild-type and mutant myoglobin (H64L and H64A). The binding ability of myoglobin is facilitated through the distal histidine and the presence of a water molecule located in the apolar heme cavity. We hypothesize that PEGylation affects the internal non-coordinated water occupancy in the distal pocket of myoglobin through the alteration of the heme environment. We will also determine if PEGylation alters ligand binding kinetics by altering ligand diffusion or heme reactivity. We will measure the ligand binding dynamics and the distal pocket water occupancy of carbon monoxide following ligand photolysis using multichannel time-resolved absorption spectroscopy. Wild-type and mutant myoglobins samples modified with a variety of N-hydroxysuccinimide ester (NHS-PEG) and aldehyde PEGylating agents will be compared. We also use magnetic circular dichroism (MCD) spectroscopy to determine how PEGlyation alters the electronic structure around the heme moiety. Preliminary results show PEGylation alters the ligand binding dynamics and distal pocket water occupancy suggesting structural changes of the heme environment. This result will help establish a physical understanding of how PEGylation surface modifications can result in alteration of active sites within proteins.

Entry Number: 47 GP
SYNTHESIS AND CHARACTERIZATION OF A LIBRARY OF PEPTIDOMIMETICS AS POTENTIAL INHIBITORS OF HIV-GP41
By: Michael D. Pun
Chemistry
Faculty Advisor: Dr. Marc O. Anderson
Abstract: A library of alpha helical peptidomimetic inhibitors has been synthesized based on the structure of g41 complex hydrophobic pocket. These inhibitors were produced by first synthesizing an amino acid t-butyl ester followed by coupling of this amino acid to a n-Boc-tryptophol scaffold. The final step in the synthesis is the simultaneous deprotection of n-Boc and t-butyl groups located on the tryptophol indole and amino acid respectively. The yields for amino acid t-butyl ester formation ranged from 62-95%, and coupling yields ranged from 60-78%.

Entry Number: 48 GP
PHOTOCATALYTIC PROPERTIES OF ANATASE FILMS WITH {001} FACETS
By: Serkan Kabak and Dr. Andrew S. Ichimura
Chemistry
Faculty Advisor: Dr. Andrew S. Ichimura
Abstract: Titanium dioxide (TiO_2) is a wide bandgap (3.2 eV) semiconductor that has important environmental and commercial applications in water remediation, photooxidation, and dye-sensitized solar cells [1, 2]. In this study, the photocatalytic ability of two types of TiO_2 films were investigated. One set of films consisted of

anatase films with a high fraction of {001} facets and the other utilized Degussa P-25 (a mixed phase of 80% anatase and 20% rutile). Anatase films with exposed {001} facets are of particular interest due to the apparent high reactivity of this facet compared to the {101} facet [3]. Recently, a method to prepare ~100% exposed {001} faceted anatase films was reported [4]. Thus, the primary objective of this work is to compare the photooxidative ability of {001} faceted anatase films to the P-25 films. Anatase films were hydrothermally synthesized on the gold-coated silicon wafers from a solution of TiF4 and HF [4]. Annealing at 600 °C removes surface and bulk fluorine and improves the crystallinity of the film. P-25 films were prepared by spin-coating a P-25-ethanol slurry onto Pyrex substrates, which were then sintered at 450 °C. The films were positioned vertically in quartz cuvettes containing dilute, aqueous solutions of the compounds of interest, which included phenolic derivatives and colored dyes such as phenol, 4-nitrophenol, methylene blue (MB), and rhodamine B (RB). The solutions were photolyzed with 365 nm light and the concentrations were monitored by UV-vis spectroscopy to quantify the rate of photodegradation. It was found that sintered P-25 and (001) faceted anatase films showed comparable photocatalytic efficiencies when normalized for surface area, but not the enhancement expected for reactive (001) facets. A second set of experiments sought to extend the absorption of TiO2 into the visible region. In this work, TiO2 films were hydrogen-implanted using a low energy ~1 keV proton beam. The films absorbed visible light and both P-25 and {001} faceted anatase produced hydroxyl (ŸOH) radicals upon irradiation as indicated by terephthalic acid (TA) fluorescence assay. Our preliminary results on the effects of H+ implantation on photo-oxidation efficiency will be reported.

Entry Number: 49 GP

HYDROTHERMAL SYNTHESIS OF PYRITE FILMS ON GOLD SUBSTRATES

By: Diana Mars
Chemistry
Faculty Advisor: Dr. Andrew S. Ichimura

Abstract: Iron (II) disulfide is a semiconductor that has considerable promise as the absorbing component of solar conversion modules. Pyrite is an attractive photovoltaic material (0.95 eV) because of the high abundance, low cost, and environmental compatibility of its constituent elements. With a large absorption coefficient in the visible region (6.5x105 cm-1), very thin films may be used reducing materials cost1. In this work, we explore low temperature hydrothermal synthesis conditions for the growth of polycrystalline pyrite thin films. Our strategy employed gold on silicon as the substrate for film growth. In principle, the strong affinity of sulfur or sulfide for gold would promote strong adhesion between pyrite and the substrate. To prepare the wafers, gold (50 nm) is deposited onto a wetting layer of chromium (5 nm) by thermal evaporation onto single crystal silicon (100). The resulting polycrystalline gold surface has a dominant {111} texture. Synthesis of iron (II) disulfide follows the methods of Wu et al2 and Wadia et al3, which were designed for nanoparticle synthesis. In the first method, the substrate is placed in a Teflon lined autoclave and immersed in an aqueous solution of FeSO4, Na2S2O3, and sulfur. The Parr reactor is sealed and held at temperature (150-230 oC) for 16 hours2. The effects of temperature and initial pH on the final phase composition and film morphology were investigated. In the second method, the substrate is placed in a Teflon lined autoclave and immersed in an aqueous solution of FeCl3Ÿ6H2O and (C2H5O)2P(S)SNH4 with and without the surfactant (C16H33)N(CH3)3Br, CTAB. The Parr reactor is sealed and held at 230 oC for 4 hours3. The effects of reactant concentration and presence of surfactant were investigated. Iron (II) disulfide films on gold from the first method range from primarily marcasite at low temperatures to a dominant pyrite phase at high temperatures. Films from the second method yeild a dominant pyrite phase with the surfactant affecting particle morphology. Scanning electron microscopy (SEM) imaging shows that the polycrystalline films are continuous, uniform over a majority of the 1” wafer, and composed of densely packed ~micron sized particles with well-formed facets. Film thickness depends on preparation and was found to lie within 1-10 microns. Powder x-ray diffraction was measured by grazing angle and Bragg-Brentano configurations showing evidence of preferred orientation for marcasite and pyrite with the first and second methods, respectively. While the pyrite phase was randomly oriented within films from the first method, marcasite had a dominant (101) or (020) texture. Films from the second method are predominately

pyrite phase and showed the surfactant affecting surface roughness, defect concentration and amount present of the (100) facet. A detailed summary of the SEM, XRD, and optical spectra results will be presented.

Entry Number: 50 GP
MINIATURIZING RFID ANTENNA FOR BIOMEDICAL IMPLANTS
By: Shad Kish
Electrical Engineering
Faculty Advisors: Dr. Hao Jiang and Dr. Michael Harrison
Abstract: Anastomosis is a common surgical procedure using staples or sutures in an open or laparoscopic surgery. A more effective and less invasive alternative is developed by using the attractive force between two permanent magnets. To ensure the two magnets are perfectly aligned during the surgery, a batteryless Radio Frequency IDentification (RFID) tag is developed to wirelessly telemeter the status of a pressure sensitive mechanical switch. The batteryless RFID technology has a huge potential to realize wireless telemetry in implantable biomedical devices. The technology promises continuous wireless sensing without hazardous battery. However, the critical challenge to employ RFID technology in an implant for wireless telemetry is its antenna size. Often, a large coil is needed for a RFID tag to harvest enough RF power to power up its circuit. In this project, we propose and experiment various methods to reduce the coil size while avoiding the reduction in read-range and power-harvesting energy, by (1) using powerful transponders, (2) designing multi-turn spiral printed circuit board, and (3) designing multi-layer board. The overall size of the RFID tag is shrunk to a 19 mm diameter coil with 22 cm reading distance from the center of the reader's antenna. In addition, when the RFID tag was in salt-water and parallel orientation to the reader's antenna, the read-range reported was about 21 cm. Same read-range was reported for when the tag was attached to the magnet. Also, different orientations of the tag in regards to tag-readers antenna were tested. When tag was perpendicular to reader's antenna, we saw a decrease in read-range but parallel orientation gave the highest read-range. Furthermore, we noticed the read-range was reduced when we moved the tag away from the center of the reader's antenna to the corners and edges. The device is ready to be used in the medical research in UCSF.

Entry Number: 51 GP
SPIN TRANSFER TORQUE LOGIC DESIGN
By: Sridevi Lakshmipuram and Dr. Hamid Mahmoodi
Embedded Electrical and Computer Systems Engineering
Faculty Advisor: Dr. Hamid Mahmoodi
Abstract: Magnetic Tunnel Junction(MTJ) is a spintronic device that offers non volatile memory capable of fast read/write operation and high stability. Though these features look promising, the existing read-only MTJ based circuits with Sense Amplifiers may not be competitive in terms of performance and power as compared to Static CMOS circuits. The goal of this research is to analyze the effectiveness of the existing read-only MTJ based look-up tables(LUTs) for realizing fixed logic circuits.

Entry Number: 52 GP
PROBABILISTIC SEISMIC DUCTILITY DEMAND OF SDOF SYSTEMS WITH BOUC-WEN HYSTERETIC BEHAVIOR
By: Sunyoung Park
Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: This research aims to evaluate existing methods for estimating maximum nonlinear displacement of single-degree-of-freedom (SDOF) systems under earthquakes. The hysteretic behavior of SDOF is represented by the Bouc-Wen model for various hysteretic curves. The methods are derived from probabilistic characteristics of peak ductility demand. The methods are then applied to variety earthquakes with different

scale factor and natural period for investigating of ductility demand. The maximum displacement will be compared with non-linear time history analysis from MATLAB programing using a number of selected ground motion.

Entry Number: 53 GP
SEISMIC ANALYSIS AND DESIGN OF STEEL PLATE SHEAR WALLS CONSIDERING PLATE AND FRAME INTERACTION
By: Jennifer Ton and Dr. Cheng Chen
Structural/Earthquake Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: The California Bay Area is in a high seismic zone, so buildings need to be designed to resist earthquakes. Steel plate shear wall (also abbreviated as SPSW) is a structural system able to resist gravity and lateral forces (such as seismic forces). Further analysis of the plate and frame interaction may result in a more economic design, making the SPSW system a more viable structural system option. Thirty-six earthquake simulations were applied to a SPSW prototype using an open source structural earthquake engineering program called OpenSees. Select story drift ratio responses due to far field and near field earthquake records are presented on this poster. Story drift ratio is defined as the lateral displacement between the floor above and floor below over the height of the floor. Furthermore, each open source program has the potential for future application since the program's framework for structural modeling can be adjusted to fit unique site and building parameters for analysis accuracy.

Entry Number: 54 GP
AN EXPERIMENTAL TEST BED FOR HYBRID SIMULATION TOWARDS SEISMIC HAZARD MITIGATION
By: Justin Brodowski and Dr. Cheng Chen
Structural/Earthquake Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: The NSF-funded MTS state-of-the-art servo hydraulic system is used to establish an experimental test bed for hybrid simulation at San Francisco State University. The actuator combined with control software can replicate structural response under desired displacement. A self-reacting steel reaction frame was designed and fabricated to mount the actuator in the structural laboratory at the School of Engineering. The specially designed clevis hinge allows researchers to replicate hysteretic behavior of structures under earthquakes economically. The OpenSees and OpenFresco software further enables researchers at SFSU to simulate complex structural behavior under earthquakes.

Entry Number: 55 GP
EVALUATION OF CRITICAL ANGLES FOR DESIGN BASED EARTHQUAKE ENGINEERING
By: Vincent Diep
Structural/Earthquake Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: This project focuses on evaluating critical angles and responses of a structure using response spectrum and response history analysis. Response spectrum analysis to determine the critical angles and corresponding responses of a structure are only estimations while response history analysis is considered the more accurate approach. However, RSA is a much faster procedure compared to RHA so finding a RSA approach that will give adequate results will help provide an efficient estimation of a structures critical angles and responses.

Entry Number: 56 GP
UAV HEXACOPTER: A LOW-COST AERIAL DATA COLLECTION PLATFORM
By: Peter Christian, Dr. Jerry Davis, and Dr. Leonhard Blesius
Geographic Information Science
Faculty Advisors: Dr. Jerry Davis and Dr. Leonhard Blesius
Abstract: Aerial survey has long been an important tool in environmental research. Recently, availability and use of aerial photography have increased with the introduction of internet applications such that high resolution images can be found and displayed within minutes and at no cost. For the majority of research projects the spatial (~1m) and temporal scale (~1-2 years) of these images is adequate. However, for many applications, higher resolution and more timely data are required. In these cases either renting a plane for aerial surveys or conducting terrestrial surveys must be done, but this is extremely time-consuming and costly. Therefore, for projects with small areas of interest or the need for images taken at frequent intervals these methods are typically not feasible. The emerging technology of unmanned aerial vehicles (UAV), or drones, has the potential to fill this gap. The purpose of this project is to determine the feasibility of a low altitude image gathering platform that fills this niche between aerial and terrestrial data gathering methods. It will test the suitability of a low-cost small UAV program for use by students and faculty at SFSU to acquire data for these types of research purposes. Initial tests with such a UAV in a montane meadow in the Sierra Nevada have shown the great potential of this technology to provide critical data that cannot be gathered by existing methods.

Entry Number: 57 GP
MEASURING RIVER GEOMETRY FOR DISCHARGE ESTIMATION USING GEOGRAPHIC OBJECT-BASED IMAGE ANALYSIS (GEOBIA)
By: Damon Burgett
Geography
Faculty Advisors: Dr. Leonhard Blesius and Dr. Jerry Davis
Abstract: Rivers are complex, dynamic, and open systems whose forms reflect processes operating at multiple spatial and temporal scales. High resolution satellite and aerial imagery of fluvial systems contain much information about planform river channel features. However, not much is known about how these forms quantitatively relate to channel process, specifically, discharge at time of image acquisition. This research explores methods for remote image-based river discharge estimation through Geographic Object-Based Image Analysis (GEOBIA) and GIS techniques. Previous efforts in image-based discharge estimation have relied primarily on manual delineation of river features and the input of reach-averaged values of these geometries into statistically based models for estimation. In addition to analyzing GEOBIA techniques for channel feature delineation, this approach explores automated techniques for measurement of river geometry for discharge estimation, including disaggregation of channel widths into a continuum of intervals throughout a reach.

Entry Number: 58 GP
PUBLIC PERCEPTIONS OF LEVEES AND RISK: A NATOMAS, SACRAMENTO, CALIFORNIA CASE STUDY
By: Rachel L. Cunningham
Resource Management and Environmental Planning
Faculty Advisors: Dr. Nancy Wilkinson and Dr. Courtney Donovan
Abstract: The Natomas area of Sacramento, California is a floodplain surrounded by levees that now has large residential and commercial developments (Campbell 1999). Developments in such an area that are dependent on levees for flood control raise the issues of safety, emergency preparedness, and risk communication. This research sought to answer the following questions: 1) How do the residents of the South Natomas neighborhood of Sacramento, California, understand the function of the levees surrounding their community? 2) What are residents' levels of awareness of the risk associated with living behind levees? 3) What have residents done to prepare for an emergency situation, and do they feel prepared? Overall, participants had a high understanding of

the function of the levees in their community, had a perception of a high level of risk from a levee failure, and had completed a mid-level amount of emergency preparations, but felt that they were prepared.

Entry Number: 59 GP
MATHEMATICAL MODELING OF FOG WATER DEPOSITION, SAN FRANCISCO, CALIFORNIA
By: Ryan Corbett and Dr. Jason Gurdak
Geosciences
Faculty Advisors: Dr. Jason Gurdak and Dr. John Monteverdi
Abstract: Fog droplets that blow over the surfaces of plants, and coalesce into drops large enough to fall to the ground are known as fog drip. The Mediterranean climate of San Francisco, with intense diurnal fog that dominates the summer months, may play an integral role in the hydrologic cycle and have a significant effect on the groundwater in local aquifers. The majority of precipitation falls between November and April, whereas May through October is dominated by coastal fog and stratus regimes. Advection fog is most frequent along the coast occurring between May and October when there is a 30% chance of daily fog. The highest fog frequency occurs in August when there is a 50% chance that marine-formed stratus will be present. My primary research objectives are to build on previous fog collection work, and characterize how temperature, dew point, wind speed, and wind direction control stratus development along the Bay Area coastline. Additionally, this study will provide insight into how fog water can be used to more accurately estimate groundwater recharge, and how fog water collection can reduce the volume of potable water used for non-potable applications during summer months when rain is scarce.

Entry Number: 60 GP
RECHARGE BENEATH LAND USE AND CLIMATE GRADIENTS, NORTHERN HIGH PLAINS AQUIFER, USA
By: Zachary Lauffenburger
Geosciences
Faculty Advisor: Dr. Jason Gurdak
Abstract: Understanding the controls of land use/land cover and climate change on diffuse recharge rates is critically important to develop appropriate management and sustainability plans for groundwater resources, particularly those in semiarid and arid regions. Much of the High Plains has transitioned from natural rangeland to irrigated cropland over the last 60 years. Field-based recharge rate estimates were implemented to quantify the differences in recharge rates beneath two rangeland and two irrigated corn sites along an east-west transect in the Platte River Basin in central Nebraska. Historical climate data and the field-based estimates were used to calibrate HYDRUS-1D computer models. The modeled historical annual averages of precipitation, recharge rate, evapotranspiration (ET) and irrigation were used as the baseline for a 1990 climate. A total of 16 different global climate models (GCMs) and two global warming scenarios were used to project a 2050 climate relative to the baseline 1990 climate. The low global warming scenario (+1.0 oC) projected no statistical differences between any future variables compared to the baseline variables. The high global warming scenario (+2.4 oC) projected up to a 77% decrease in average annual recharge rate, a 24% and 14% increase in average annual ET and irrigation, respectively. The high global warming scenario projections result in a bidirectional shift of climate gradients, where future northern High Plains temperatures will resemble current central High Plains temperatures and future recharge rates at the eastern study sites will resemble current recharge rates at the western study sites.

Entry Number: 61 GP
THE TROPICAL LAPLACIAN OF VERTEX-BALANCED POLYTOPES
By: Alyssa Palfreyman
Mathematics
Faculty Advisor: Dr. Federico Ardila
Abstract: This research project involves an investigation of the tropical Laplacian matrix. The tropical Laplacian is a symmetric square matrix associated to polytopes that satisfy a special balanced condition at each vertex. I call these polytopes vertex-balanced. I show that there is exactly one negative eigenvalue for this matrix for several families of polytopes.

Entry Number: 62 GP
STOCHASTIC SIMULATIONS OF DNA PACKAGING IN BACTERIOPHAGES
By: Brian Cruz
Mathematics
Faculty Advisors: Dr. Mariel Vazquez and Dr. Javier Arsuaga
Abstract: We present a model for DNA packaging simulations in bacteriophages that includes the effect of the molecular motor responsible for pumping viral DNA into a newly-formed capsid. We simulate the motor using a kinetic Monte Carlo algorithm that mimics the discrete conversion of ATP molecules into mechanical energy to feed the DNA into the virus while twisting it. We couple the motor simulation with a Brownian Dynamics simulation of the DNA based on a worm-like chain polymer model that accounts for torsional strain. We then show how the DNA moves and writhes to fill the space in the capsid while being pumped and twisted at the motor site. The simulations were written in-house and implemented on the parallel computing platform OpenCL. In our results, we show that the DNA may form several coiling domains instead of one spooled structure; we also show that the direction that the DNA is twisted at the motor determines the chirality of the coils formed inside the capsid.

Entry Number: 63 GP
FUSION FRAME RECONSTRUCTION OF AN AUDIO SIGNAL
By: Christopher Nagel
Mathematics
Faculty Advisor: Dr. Shidong Li
Abstract: Current microphone design entails the use of potentially high-quality components, many of which can be quite costly. In the market today, high-quality microphones carry with it an equally high price. Recent developments in frame theory provide a new method of capturing high-quality digital audio by using multiple low-cost parts. This project is a proof of concept for a frame theory based high-quality microphone design.

Entry Number: 64 GP
A SCREEN FOR PREDICTIVE BIOMARKERS IN BREAST CANCER
By: Dian Li, Dr. Alexandra Piryatinska, Dr. Leslie Timpe, Dr. Robert Yen, and Dr. Bruce A. Macher
Mathematics
Faculty Advisors: Dr. Alexandra Piryatinska, Dr. Leslie Timpe, Dr. Robert Yen, and Dr. Bruce A. Macher
Abstract: Biomarkers that can predict the response to chemotherapy are important in breast cancer, but although twenty drugs are approved for use in this disease, there are only two predictive markers. The goal of our study is to find protein biomarkers that can predict a patient's response to chemotherapy drugs for which no markers are currently known. Here, we work on breast cancer cell lines, using drug response data from Heiser, et al [1] as observations and shotgun proteomics data from Macher lab at SFSU as explanatory variables. Since this is a large p problem such that the number of predictor variables is much greater than the number of observations, we use Lasso regression to select a set of predictors, then use regular linear regression to obtain a final model. By

testing 74 drugs, for 7 of them we failed to identify significant predictors, and we built linear models for the other 67 drugs. Among the 67 drugs, 20 of them have statistically significant models with 2 to 4 variables and high R^2 scores. A well-known biomarker HER2 that predicts a good response by Lapatinib was successfully identified in our model of Lapatinib. The predictor variables identified in the regression models are candidates for further development on patient samples.

Entry Number: 65 GP
COMPUTER SIMULATION OF TYPE II TOPOISOMERASES ACTION ON CIRCULAR DNA DESCRIBED AS WORM-LIKE CHAIN
By: Hong Guo
Mathematics
Faculty Advisor: Dr. Mariel Vazquez
Abstract: Studies have shown that DNA is highly knotted in extremely tight spaces, such as bacteriophage capsids. Knotting interferes with the normal functioning of the DNA. The cell uses enzymes, such as type II topoisomerases, to remove DNA knotting in the cellular environment. We are interested in modeling unknotting by type II topoisomerases. In the past our group has used self-avoiding polygons(SAPs) in the simple cubic lattice to represent circular DNA, and to simulate the strand-passage action of these enzymes. This model allows us to investigate the transition probabilities between different knot types. In the current study we aim to model circular DNA as a worm-like chain in R3, which provides realistic characteristics such as volume exclusion, bending energy, and torsional energy. Therefore, our goal is to study DNA knotting due to different states of the DNA, for example, effective diameter and superhelical density. Also, we want to simulate the unknotting action of type II topoisomerases on theses different types of DNA, and we want to compare our simulation results to experimental data. In addition, we want to investigate unknotting of a bacteriophage mix

Entry Number: 66 GP
HOW TO ORDER CHICKEN NUGGETS
By: Jessica Delgado
Mathematics
Faculty Advisors: Dr. Matthias Beck and Dr. Joseph Gubeladze
Abstract: McDonalds sells chicken nuggets in packs of 6, 9 and 20, what is the largest amount of nuggets you cannot order? This research explores this one-dimensional problem and then explains how the problem looks in a higher dimension. We abstract the chicken nugget problem into multi-dimensions and involve the use of algebraic geometry and polytopes.

Entry Number: 67 GP
DYNAMICS OF PIECEWISE ROTATION $PI/9$
By: Kelley Walker
Mathematics
Faculty Advisor: Dr. Arek Goetz
Abstract: The purpose of study is to identify a family of maps from C to C which are piecewise continuous. Specifically, it is the aim of this research to determine the self-similar structure a map with rotation commensurate with pi/9. The dynamics of U will be investigated through cataloging the itineraries. When the components of U are mapped to U, then we can explicitly state the first return map. We use the first return map to determine a linear conjugacy among the original map and the first return map which will allow for calculation of the Hausdorff dimension of the set with aperiodic orbits. At the time of this project, there is no literature on the self-similar structure of maps with rotations commensurate with pi/9. Thus, any successful research will contribute to the study of piecewise isometries by providing a class of examples which are

understood in great detail. Further, the Math 898 student will be advancing her knowledge of dynamical systems while establishing effective research methods for use in a PhD program.

Entry Number: 68 GP
MULTISCALING PROPERTIES OF INTEGER AND FRACTIONAL MOMENTS FOR ASYMMETRIC TEMPERED STABLE DISTRIBUTIONS
By: Maria Coca and Dr. Alexandra Piryatinska
Mathematics
Faculty Advisor: Dr. Alexandra Piryatinska
Abstract: I study the behavior of fractional and integer order moments for the asymmetric Tempered Stable distributions. In my research, I demonstrate calculations of integer moments as well as the observations derived from the study of the behavior of fractional moments. The latest of which cannot be calculated explicitly. Further, I will demonstrate that if a scaling parameter a goes to zero, then their behavior is close to that of the heavy tail distributions. If scaling parameter a goes to infinity the behavior is similar to that of the Gaussian distribution. I will present these results by pictures of simulations of random numbers from the Tempered Stable distributions, which will estimate moments and observations of their behavior. The significance of this presentation is to contribute to the theory of Tempered Stable distributions from a probabilistic side. Due to the vast and advantageous applications, Tempered Stable distributions have attracted the interest of mathematicians and statisticians alike. In addition, my simulations serve as a way to test my hypothesis and generalization of the problem itself.

Entry Number: 69 GP
BUILDING A 3D YEAST GENOME MAP USING 4C AND LP METHODS
By: Matthew Simms
Mathematics
Faculty Advisor: Dr. Javier Arsuaga
Abstract: The National Human Genome Research Institute reflects that, “over time, the most effective way to improve human health is to understand normal biology (in this case, genome biology) as a basis for understanding disease biology.”1 An important example is the understanding of how human chromatin is organized within the cell nucleus. However the immense size of the human genome makes Saccharomyces Cerevisiae (S. Cerevisiae) a better organism for developing novel experimental techniques such as Circularized Chromosome Conformation Capture (4C) which uses sequencing data to estimate genomic distances between chromatin regions. Nevertheless drawing global three dimensional (3D) reconstructions is not immediate and new mathematical approaches are needed. Z. Duan and colleagues created a 3D model for an entire S. Cerevisiae genome using optimization of a non-linear objective function with non-convex constraints. This approach produced a 3D model of the S. Cerevisiae genome, but it proved to be computationally expensive and unstable. To address these issues we propose to develop a new algorithm that transforms the non-linear problem into a linear programming problem by substituting the Euclidean (L2) norm with the L1 norm. 1Eric D. Green, Mark S. Guyer & National Human Genome Research Institute, Charting a Course for Genomic Medicine From Base Pairs to Bedside, Nature 470, 204-213(2011)

Entry Number: 70 GP
HOPF RANDOM WALK ON GENERALIZED PERMUTOHEDRA
By: Servando Pineda Carranza and Dr. Federico Ardila
Mathematics
Faculty Advisor: Dr. Federico Ardila

Abstract: Recently, Diaconis, Pang, and Ram defined a random walk on the elements of a Hopf algebra. Aguiar and Ardila defined a Hopf algebra of certain polytopes called generalized permutahedra. This gives rise to a random walk on the faces of such a polytope. We study this walk by finding the probability of absorption at a vertex and the average expected time of absorption. Having already proven the probability of absorption for generalized permutohedra, my current focus is finding the average expected time of absorption by visualizing our walk through binary trees. In the process we have found connections this walk has with other random models used in computer science, statistics, and algebraic combinatorics. For instance, we proved that once we reach an n-cube face, then the random walk reaches a vertex after approximately log(n) steps.

Entry Number: 71 GP
ENUMERATION OF COMBINATORIAL DESIGNS
By: Steven Collazos
Mathematics
Faculty Advisor: Dr. Matthias Beck
Abstract: Combinatorial designs have applications in a variety of fields, such as networks and cryptography. Once a combinatorial design has been found, we can ask whether there is a different one. In order to answer such questions, mathematicians have tried to develop techniques to enumerate designs. In our research project, we are interested in taking the counting function for combinatorial designs and derive a combinatorial reciprocity theorem. A reciprocity theorem is a result linking data about the combinatorial structure under consideration and evaluations at negative integers of a counting function. We present an overview of this area of research and progress we have made towards deriving a combinatorial reciprocity theorem for designs.

Entry Number: 72 GP
SINGLE-SCORE QUANTIFICATION OF PROTEIN-PROTEIN INTERACTION DATA VIA INDEPENDENT COMPONENT ANALYSIS
By: Nino L. Yosinao, Andrew Peterman, and Dr. Rahul Singh
Mathematics and Computing for Life Science
Faculty Advisor: Dr. Rahul Singh
Abstract: Being able to grade an interaction between two proteins and capture the most relevant information about this interaction into a single score is a topic of critical importance. It is a complex computational challenge given the multifarious, multi-dimensional nature of the data, which is often taken from experimental observations. There are various methods at the state of the art that combine the data into a single score, such as Bayes' rule and principal component analysis. We propose a single-score quantitative method that is based on the method of independent component analysis (ICA) to combine proteomic data from a HIV-human PPI dataset into a single score.

Entry Number: 73 D
STOP HATIN': COMBATTING INTRAETHNIC MICROAGGRESSIONS TO STRENGTHEN COMMUNITY ORGANIZING
By: Jessica Petalio, Dr. Allyson Tintiangco-Cubales, and Dr. Tracy Lachica Buenavista
Psychology
Faculty Advisor: Dr. Allyson Tintiangco-Cubales
Abstract:

Entry Number: 74 UB
MOTIVATING EXPERIENCES AND SUCCESS: A LOOK INTO FORMERLY INCARCERATED YOUTH AND COURT ORDERED PLACEMENTS

By: Christopher Gueco
Psychology
Faculty Advisor: Dr. Amy Smith
Abstract: High recidivism rates plague the juvenile justice system at rates similar to those of adults. One major issue appears to be juveniles who fail to complete, or remain in court ordered placements ("AWOL"). In this study, we look at the effects of motivating experiences. Motivating Experiences is refers to experiences that lead to internal or personal decision to complete a program or succeed to benefit yourself or another person. Using the four main categorize of motivational experiences (Bonds, Financial Support, Nurture, and Serious Crime) we find a noticeable pattern exist between motivational experiences and success. Success is defined as completing a court ordered placement.

Entry Number: 75 UB
STILL SEARCHING FOR THE PHONOLOGICAL STORE: EEG CORRELATES IMPLICATING MOTOR AND PERCEPTUAL REGIONS
By: Jason M. Samaha, Margaret T. Lynn, Tiffany K. Jantz, Dr. Ezequiel Morsella, and Dr. Mark W. Geisler
Psychology
Faculty Advisors: Dr. Ezequiel Morsella and Dr. Mark W. Geisler
Abstract: Isolating the neural correlates of the phonological store (i.e., the imagery-related component of verbal working memory [WM]) has proven to be more challenging than originally anticipated (Buchsbaum & D'Esposito, 2008). Contrary to classic models of WM (e.g., Baddeley, 1986), in which the phonological store is well circumscribed and modularized, studies examining the neural underpinnings of this component have implicated both perceptual and what have historically been classified as motor regions, along with frontal regions employed in cognitive control (Koenigs et al., 2011; McNorgan, 2012). Building on these findings, we examined the degree of involvement of motor and perceptual processing in verbal WM. In Study 1, subvocalizing a word (traditionally associated with articulatory rehearsal) or holding verbal auditory imagery in mind (traditionally associated with perceptual processing) led to comparable behavioral effects (e.g., priming), $t(45) < 1$, $p > .30$. This equivalence is, consistent with the hypothesis that auditory imagery and subvocalization may recruit the same neural network, and echoes 'common-code' proposals (e.g., Hommel, 2009) in which motor-related and perceptual-related processes are inextricably linked. Study 2 provides additional evidence for this hypothesis using electroencephalography coherence (sites F3, F7, and TP3). While participants ($n = 20$) experienced auditory imagery of words, we measured co-activation of motor-speech areas (F7, TP3) and prefrontal areas (F3) involved in foregrounding representations in WM (Johnson & Johnson, 2009). Taken together, these data provide evidence that the phonological store may rely on both perceptual and motor processes.

Entry Number: 76 UB
SHOPPING STIGMA: THE SOCIAL CONSEQUENCES OF BEING MATERIALISTIC
By: Jessica A. Lam, Nicholas K. Harsch, Darwin A. Guevarra, Jia Wei Zhang, and Dr. Ryan T. Howell
Psychology
Faculty Advisor: Dr. Ryan T. Howell
Abstract: Research suggests materialistic individuals are stigmatized when compared to experiential buyers. We examined if individuals display greater rejection toward materialistic, relative to experiential, individuals. Study 1 demonstrated that participants who read a description of a materialistic target (e.g., "in my free time I love to shop for new clothes, shoes, or sunglasses") chose to sit farther away than those who read a description of an experiential target (e.g, "in my free time I like to hike, go to the movies, or go to any local gigs"). In study 2, participants read the same vignette and were told that they will participate in a laboratory interaction with this person. After they read the vignette, they completed a word completion task (e.g., abandonment) that contained 10 rejection words and 10 neutral words. Participants that expected to interact with the materialistic person

completed more rejection words than participants that expected to interact with an experiential person. In sum, the results demonstrate that materialistic individuals are rejected and excluded more than experiential buyers.

Entry Number: 77 UB
COMPASSION FATIGUE, BURNOUT AND SELF-CARE AMONG MULTIDISCIPLINARY PROVIDERS AT TWO VA CLINICS
By: Jose D. Monroy, Christopher Koenig, and Karen H. Seal
Psychology
Faculty Advisor: Dr. Amy Smith
Abstract: Background: Compassion fatigue and burnout is a significant mental health problem for health care providers (Figley, 1995). Self-care is a broad concept that encompasses self-monitoring and self-management (Richard & Shea, 2011) and may be an important resource for multidisciplinary providers to prevent compassion fatigue and burnout. This study examines self-care strategies among multidisciplinary providers caring for returning military veterans. Methods: Qualitative, semi-structured interviews conducted with 31 primary care, mental health, and social work care providers in two VA clinics who saw at least two veterans of Iraq and Afghanistan within six months. Interviews entered into Atlas.ti software for qualitative data management. All self-care segments were coded using thematic analysis (Braun & Clarke, 2006). Results: Preliminary analysis shows that providers were variously aware of risk of compassion fatigue and burnout associated with regular contact with returning military veterans. However, different provider types described different self-care strategies. Primary care providers actively ignored compassion fatigue and made conscious efforts to leave negative feelings at work, while mental health and social work providers were more likely to share their feelings with colleagues while at work. Conclusion: Primary care providers may ignore compassion fatigue while mental health and social workers routinely debrief with colleagues as a form of self-care. Primary care training culture may emphasize independence while other provider types may emphasize interdependence when faced with compassion fatigue and burnout. Primary care providers can learn from other disciplines to improve their self-care strategies, which may contribute to overall quality of veteran care.

Entry Number: 78 UB
THREE-DIMENSIONAL MENTAL ROTATION TASKS: GENDER DIFFERENCES IN COLOR AND GRAYSCALE
By: Kevin Ryan, Lyle Truscott, and Kristy Wisnia
Psychology
Faculty Advisor: Dr. Margaret F. Lynch
Abstract: Mental rotation of three-dimensional objects has been applied in a broad range of studies but few studies have focused on the interaction between the variables of gender and color. This study analyzed how the previously mentioned variables affect the objective measure of the participants visuospatial working memory system. Mental rotation is one of the few measures to show cognitive differences between men and women (Collins and Kimra, 1997). Our sample consisted of 79 psychology students between the ages of 18- 38 (17 males, 61 females and 1 undeclared) from San Francisco State University participated in this study. Testing methods were inspired by the standard Vandenberg and Kuse (1978) mental rotation test. Contrary to our hypothesis, females significantly outperformed the males overall ($p < .05$). The hypothesis that participants will perform better on colored objects was not supported by the data ($p > .05$). There was no statistically significant interaction between the variables of color and gender ($p > .05$).

Entry Number: 79 UB
DEVELOPMENT OF THE GENERAL CASUALITY ORIENTATIONS SCALE FOR USE WITH CLINICAL POPULATIONS
By: Lindsey M. Lavaysse, Shanna Cooper, Elma Caplin, Jessica Starr, and Dr. David E. Gard

Psychology
Faculty Advisor: Dr. David E. Gard
Abstract: The General Causality Orientations Scale (GCOS) was designed to assess trait elements of motivation based on Self-Determination Theory (Deci & Ryan, 1985) focusing on autonomy, control, and impersonal styles. This measure may be particularly helpful for assessing motivation in psychopathology. However, the existing measure assumes a fairly high functioning population (e.g., one vignette begins, "You are the CEO of a large corporation…."), so we created an adapted version more applicable for clinical populations (GCOS-CP). Participants from a college sample from San Francisco State University completed the GCOS and GCOS-CP, as well as free responses to questions about participants' future life goals. We hypothesized that the two scales will be strongly correlated and will equally predict participants' stated future goals (i.e., those higher in autonomy will report more autonomous goals). Thus far we have collected a large number of participant responses to both questionnaires (n = 651), the findings indicate that the subscales are very similar (autonomy r = 0.73; control r = 0.63; impersonal r = 0.66). In addition to the GCOS and GCOS-CP data, the free-response data will be coded for motivation orientations through word use, length of response, and content. This questionnaire may be useful in both clinical and research contexts

Entry Number: 80 UB
WHAT IS HEDONISM? EXPLORING THE PURSUIT OF PLEASURE AS A LIFE VALUE
By: Masha Ksendzova, Graham Hill, and Dr. Ryan T. Howell
Psychology
Faculty Advisor: Dr. Ryan T. Howell
Abstract: Three popular value scales (Schwartz Values Scale, List of Values Scale, and Kasser Aspiration Index) include a measure of hedonism - an emphasis on the pursuit of pleasure as a stable life goal, but no scale exists in the literature to gauge the value of hedonism on its own. Further, the current measures of hedonism may vary conceptually in their relation to the experience of pleasure. To better understand the construct of hedonism, correlates of three different measures of hedonism (n1 = 177, n2 = 538, n3 = 135) were explored using data from BeyondThePurchase.org. Significant, though weak, Pearson correlations between the three hedonism scores (ranging from 0.27 to 0.48) confirmed important conceptual differences. In further exploration, pleasure-seeking from List of Values (LOV), conceptualized as an interpersonal value correlated positively with emotional contagion (r = .25) and dispositional compassion (r = .30); however, the other two measures of hedonism, which construe hedonism as a self-interest value, did not. Also, hedonism as measured by the LOV and Kasser's Aspiration Index, correlated positively with trait amusement (r = .29; r = .38) while Schwartz hedonism did not. This demonstrates that the Schwartz Values Scale conceptualizes hedonism as a value less associated with pleasure and, possibly, more with subtle contentment. Additionally, we found significant Pearson correlations between the three measures of hedonistic values and the belief that well-being means experiencing pleasure (ranging from .39 to .55), as well as with a time perspective focused on present pleasure (ranging from .38 to .49). These correlations confirm an overlap between generally valuing pleasure and believing it is important for well-being, as well as focusing on present time to enjoy oneself, but suggest that a stable life value of hedonism requires further exploration as its own construct.

Entry Number: 81 UB
ONLY ROBOTS DON'T WANT KIDS: DEHUMANIZATION OF THE CHILDLESS BY CHOICE
By: Monica Mendoza, Lann Chan, Eric Splan, and Dr. Avi Ben-Zeev
Research Psychology
Faculty Advisor: Dr. Avi Ben-Zeev
Abstract: We ask whether women who choose to not have children would be subjected to a particular form of gender stereotyping, causing them to be perceived as more machine-like; a type of dehumanization (see Haslam, 2006; Haslam, Bastian, Laham & Loughnan, 2012). We base this reasoning, in part, on the findings that whereas wanting children is an intensified prescription for women, it is a relaxed one for men (Prentice &

Carranza, 2002). In the current study, 203 participants were given a vignette depicting John or Jane, who were described as mentally and physically healthy, as well as financially successful. John/Jane were furthermore described as either wanting or not wanting to have children. We found a moderated mediation such that for Jane only, being voluntarily childless caused her to be rated lower on humanness (e.g., friendly, curious, impatient). This relationship was fully mediated by the perception of Jane as more gender atypical, using the Adult Gender Typicality Scale. These findings suggest that women who are childless by choice might be susceptible to stigma because they are perceived as gender deviants.

Entry Number: 82 UB
MIRROR, MIRROR, ON THE WALL: AN OBSERVATION PIECE ON THE VANITY DISPLAYS OF YOUNG WOMEN
By: Sarah Martin
Psychology
Faculty Advisor: Dr. Margaret F. Lynch
Abstract: Young women today are inundated with pressures to be immaculate on an almost daily basis. It is because of this reason that it is no wonder they feel the need to perfect themselves whenever they get the chance. However, these kinds of pressures can lead to self-destructive tendencies. Problems can range from lowered self-esteem when the individual experiences dissatisfaction with their appearance, to utter narcissism. This project takes a look at the vanity displays of young women and attempts to delve into the problems that arise from it.

Entry Number: 83 UB
SUBSTANCE USE FOR COPING: THE ROLES OF EXECUTIVE FUNCTIONING AND EMOTION DYSREGULATION
By: Scott Ewing and Dr. Sarah Holley
Psychology
Faculty Advisor: Dr. Sarah Holley
Abstract: The tendency to use drugs and alcohol as a mechanism for coping with distress has been shown to be an important predictor of the development of substance use disorders (Cooper, 1994). Similarly, having deficits in executive cognitive functioning (ECF), particularly one's ability to inhibit impulsive responses to stimuli, has also been shown to be significant in the etiology of these disorders (Dolan, Bechara & Nathan, 2008). A common correlate of these two patterns is a lack adaptive emotion regulation strategies, but the joint contributions of ECF and emotion dysregulation on substance use for coping is unclear (Verdejo-Garcia, Bechara, Recknor & Perez-Garcia, 2006). The present study attempted to explore these relationships. It was hypothesized that cognitive inhibition abilities may moderate the relationship between emotion dysregulation and the tendency to use substances for coping, as those who are less able to inhibit impulsive responses may be more at risk to turn to maladaptive strategies, such as substance use, to cope with emotional distress when more adaptive strategies are unavailable. A sample of 106 college students who endorsed substance use in the past year participated in the study. Deficits in emotion regulation were examined using the Difficulties in Emotion Regulation Scale (Gratz & Roemer, 2004), and cognitive inhibition abilities were assessed using the Color-Word Interference subtest of the Delis-Kaplan Executive Function System (Delis, Kaplan, & Kramer, 2001). The use of substances for coping was assessed with a modified version of the Drinking Motives Questionnaire-Short Form (Kuntsche & Kuntsche, 2009). The hypothesis was evaluated using a multiple regression model. Results showed a main effect of emotion regulation deficits on substance use for coping, $B = 0.404$, $p < .001$, but not for cognitive inhibition, $B = -0.068$, $p = .493$. Results further demonstrated a significant interaction effect, $B = -0.229$, $p = .019$, such that participants with deficits in both emotion regulation and cognitive inhibition were much more likely to use chemical substances to cope than participants with no deficits, or with deficits in one area alone. These results may suggest that cognitive training, which has been shown to improve abilities in some domains of executive functioning, may be beneficial in the prevention and treatment of substance use disorders.

Entry Number: 84 UB

GENDER DIFFERENCES IN RECOGNIZING FACIAL EXPRESSION OF EMOTION

By: Severin Walston and Johanna Pellissier
Psychology
Faculty Advisor: Dr. Margaret F. Lynch

Abstract: Studies have examined the effects of demographical factors such as race, gender and mental status on the ability to correctly interpret facial expressions of emotions. One such study focused on gender differences in facial expression recognition, defined the issue of gender bias as the tendency to recognize individual expressions within one's own gender group (Nutt, 2010). In addition to gender bias, the literature discusses the impact that prejudice and foreknowledge of societal roles can have on an individual's ability to recognize facial expressions of emotion. In this study, researchers looked at a sample of fifty psychology students at San Francisco State University to assess if there is a difference in reaction time across sex boundaries. The results concluded there was no statistically significant difference in reaction time for recognition of facial expression of emotion across sex boundaries. The results trended towards both sexes recognizing female expressions quicker than male expressions; however, a larger sample size of male participants is necessary to draw conclusive results.

Entry Number: 85 D

HOW TO MAKE A LIVING IN A HOT SPRING: CARBON FIXATION PATHWAYS IN THERMOMICROBIUM SP. HL1

By: Diego Rivera Gelsinger and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre

Abstract: Carbon is one of the essential elements for life. It is the main building block in all living organisms and attributes to the majority of biomass on Earth. Thus, many organisms have evolved ways to use Carbon as an energy source through metabolic pathways. Carbon fixation is the ability to assimilate inorganic carbon compounds, such as CO2, into an organic molecule such as glucose. There are six known carbon fixation pathways. The microorganism I am researching is a Gram-negative bacterium, Thermomicrobium sp. HL1, that was cultivated from a hot spring in Yellowstone National Park. The main goal of the research is to determine through bioinformatics: what are the possible carbon fixation pathways in Thermomicrobium sp. HL1 and which genes are present in the genome that encode for them? Using KEGG pathways it has been determined that there a genes that encode for the Calvin Benson Bassham (CBB) cycle and the reductive acetyl-CoA pathway (Wood-Ljungdhal). Thermomicrobium sp. HL1 contains many genes that encode for enzymes found in the Calvin cycle, but not all of them. The gene for the small subunit of the key enzyme Rubsico, which carries out the first step of carbon fixation in the Calvin cycle, is missing but there is a gene for the Rubisco large subunit. Phylogenetic analysis shows that the large subunit has a different function altogether (being a type V Rubisco). The reductive acetyl-CoA pathway is missing many more genes, but does encode for enzymes required for downstream reactions of the pathway. Surprisingly, it appears that Thermomicrobium sp. HL1 encodes growth on an alternative C1 compound, formate (CHOO-). Ultimately, the microorganism seems to use CO2 heterotrophically and may be able to use other small carbon molecules such as formate, giving it a mixtotrophic advantage in a low nutrient environment.

Entry Number: 86 UL
WHERE IS IT? WHERE IS IT FROM?: THE HORIZONTAL GENE TRANSFER OF THERMOMICROBIUM HL1'S FLAGELLAR GENES
By: Abigail Mandac and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Horizontal gene transfer, a phenomenon in which genetic material is transferred between bacteria rather than from descendants, is an important factor in the evolution of many organisms. Thermomicrobium HL1 contains various genes corresponding to flagella synthesis and chemotaxis. But because T. HL1's closest relative Thermomicrobium roseum also has these genes, but is not a motile bacteria, it draws speculations to whether T. HL1 is also non-motile. In addition, these genes are only common in three species within the Chloroflexi phylum, indicating the possibility of these genes being acquired through horizontal gene transfer. To determine whether T. HL1 is motile, I used the IMG Database to compare and examine genes to determine if T. HL1 had the appropriate cell wall and outer membrane to support a flagella for motility. I also used the IMG and NCBI database as well as a phylogenetic examination to determine where the flagellar genes may have originated. It was determined that like T. roseum, T. HL1 did not have the proper cell wall or outer membrane to support a flagellar structure, indicating it was non-motile. It was also determined Thermomicrobium's flagellar genes probably originated as a result of horizontal gene transfer.

Entry Number: 87 UL
CARBON FIXATION IN THERMOMICROBIUM SP. HL1
By: Ivan T. Gao and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Thermomicrobium sp. HL1 is a thermophilic bacterium of the division Chloroflexi cultured from a hot spring in Yellowstone National Park, currently having its genome sequenced at SFSU. Other members of the Chloroflexi are known to be able to fix inorganic carbon into biomass, so to better understand Thermomicrobium sp. HL1, we investigate the possible pathways for carbon fixation. The closest known relative of Thermomicrobium sp. HL1 is Thermomicrobium roseum DSM 5159, so we used this organism as a comparison to look for genes encoding for carbon fixation. Using bioinformatics tools (KEGG, MetaCyc and IMG), we determine if Thermomicrobium sp. HL1 utilizes the Calvin-Benson-Bassham cycle, reductive tricarboxylic acid (rTCA) cycle, reductive acetyl-CoA (Wood-Ljungdahl pathway), or 3-hydropropionate cycle for carbon fixation. We found that Thermomicrobium sp. HL1 does not have the genes that encode for the essential enzymes of the Calvin cycle and reductive TCA cycle. Thermomicrobium sp. HL1 does have genes that encode for part of the reductive acetyl-CoA and 3-hydropropionate cycle. These pathways are unlikely to stop in the middle which suggests that there are other genes encoding for the necessary enzymes (ie. hypothetical proteins) which complete these cycles for carbon fixation.

Entry Number: 88 UL
HYDROGEN FUNCTION IN T. HL1
By: Janel Anastacio and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Thermomicrobium HL1 is a Gram-negative rod-shaped thermophilic bacteria found in Heart Lake, a hot spring in Yellowstone National Park. Thermomicrobium roseum, its closest known relative found in another hot spring in the same park, is known to have hox genes that encode for molecular hydrogen uptake by Ni-Fe hydrogenase and a series of hyp genes that encode for hydrogenase assembly, maturation and Nickel insertion. If present and functional, these would allow bacteria to use H2 as an additional energy source. Although orthologous hydrogenase-coding genes were found in T. HL1, they were for Fe-S hydrogenase which are not membrane-bound as predicted by TMHMM and Phobius and no hox genes were found. In this form, Fe

hydrogenases generally favors the reverse reaction that forms molecular hydrogen. The genes were surrounded by formate hydrogen lyase and formate-dependent nitrite reductase genes which allow the bacteria to use formamide as nitrogen source to form ammonia, a metabolism pathway found on KEGG. This suggests that in contrast to T. roseum, the Fe hydrogenase in T. HL1 is not used in hydrogen uptake and oxidation but may be related to nitrogen metabolism, a pathway that T. HL 1 shares closely to T. roseum as described above.

Entry Number: 89 UL
DENITRIFICATION OF NITROGEN IN THEMOMICROBIUM HL1
By: Janice-Marie Buenavides and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: In multiple organisms dentrification is a process that reduces nitrate to nitrogen gas. This concept is important in the nitrogen cycle. Thermomicrobium HL1 is gram negative bacteria found in a hot spring located in Yellowstone National Park, WY. Using KEGG results shown that HL1 is positive for nitrous oxide reductase but no other dentrification genes were present. However, comparing with Sphaerobacter it has nitrite reductase that is only found in dentrification. Using BLASTp compare the homolog of HL1 and Sphaerobacter nitrate reductase but found a small about of sequence similarity. Since there is no presence of nitric oxide reductase maybe its encoded by another unknown enzyme. Based on these findings I hypothesize that HL1 is capable of Dentrification.

Entry Number: 90 UL
A CRISPR SITUATION
By: John Mateo and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: The CRISPR region, an acquired immunity for many bacteria, provides “memory scars” of past viral infections. These Clustered Regularly Interspaced Short Palindromic Repeats are used to recognize and silence the foreign invaders from infecting again. Perhaps some of the CRISPR’s oldest conserved regions will provide us with an idea of which viruses came first and are conserved between different species of thermomicrobiums. Through Bio-Informatic analysis, my experiment has been aimed to analyze the CRISPR region of Thermomicrobium_HL1 and compare the viral proteins found in the CRISPR regions of other similar organisms but found in different ecological niches. The results of this experiment should conclude that Thermomicrobium_HL1 have evolutionarily conserved secondary structures similar to organisms located elsewhere.

Entry Number: 91 UL
A PHYLOGENETIC ANALYSIS OF THERMOMICROBIUM HL1 FLAGELLAR GENES
By: Jourdan McPhetridge and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Cell motility is a critical property of many bacteria as it allows them to move towards a food source or away from a toxin or threat. This chemotactic process requires an intricate system of signal transduction proteins and a complete flagellar structure. Interestingly Thermomicrobium HL1, a novel species of the Chloroflexi, contains the genes for the complete assembly and structure of the flagellar apparatus on its megaplasmid, yet remains non-motile. A phylogenetic analysis of several key flagellar and chemotactic components encoded on the megaplasmid show that the genes were likely horizontally transferred to Thermomicrobium HL1 from an unknown Firmicute. Further analysis of the 16S ribosomal subunits of the

Chloroflexi show a long branch length, indicating that Thermomicrobium HL1 diverged from the Chloroflexi early on, explaining many of its novel features. Future phylogenetic analysis of the Thermomicrobium HL1 megaplasmid may point to the currently unknown Firmicute species from which these genes were horizontally transferred.

Entry Number: 92 UL
EVIDENCE FOR GENE TRANSFER OF AEROBIC CARBON MONOXIDE DEHYDROGENASES
By: Kadie-Ann Williams and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Carbon monoxide dehydrogenases (CODH) are key components of various energy-yielding pathways in aerobic and anaerobic microbes from the Bacteria and Archaea domains. Aerobic microbes use CODH to oxidize CO in respiratory pathways. Thermomicrobium HL1, a bacterium found in hot springs at Yellowstone National Park, uses carbon monoxide (CO) as an electron source based on the presence of molybdopterin containing carbon monoxide dehydrogenase (Mo-CODH). Mo-CODH allows HL1 to oxidize carbon monoxide aerobically, which is a unique function of Chloroflexi. Aerobic CO oxidation is found only in a few groups of bacteria; Actinobacteria, Proteobacteria, and Firmcutes. Phylogenetic analysis will determine gene transfer of Mo-CODH in Thermomicrobium HL1. Search IMG protein database to identify which species among the four phylum that have the Mo-CODH gene. Create and analyze phylogenetic relationship using phylogenetic comparative database. Phylogenetic analysis will show evidence of horizontal gene transfer of Mo-CODH in Thermomicrobium HL1. Carbon monoxide dehydrogenase (EC 1.2.99.2) catalyzed the oxidation of carbon monoxide according to the following equation CO + H2O + A --> CO2 + AH2.

Entry Number: 93 UL
THERMOMICROBIUM HL1 MAY END GLOBAL WARMING FOREVER
By: Karl Russell Deloso-Kennedy Alicando and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: The purpose of this experiment is to figure out whether or not Thermomicrobium HL1 is able to perform carbon fixation. As we all know carbon fixation is highly important in limiting the excess CO2 that is negatively affecting our planet. Therefore, almost every matter that takes the CO2 in the environment and converts it into biomass is highly important. With that said, if Thermomicrobium HL1 shows that it can perform carbon fixation, we can say that it is a promising organism that may be used in experiments that relates to biomass production and ending global warming. Many carbon fixation pathways were observed, though, the Wood-Ljungdahl pathway was in focus as it contained a promising amount of present genes that are necessary to perform a complete round of carbon fixation. According to the KEGG map, most of the enzymes are present, however, it lacks the enzymes Carbon Monoxide Dehydrogenase and Formate Dehydrogenase, which means that it is unable to produce Acetyl-Coa, Acetyl Phosphate, Acetate, and formate as organic compounds. However, considering that some of the genes are present such as Formyl-THF, for instance, there must be something in THL1 that is taking in CO2 to produce the enzymes needed to make the genes that are present in THL1. Thus, it is not completely impossible that THL1 cannot perform carbon fixation.

Entry Number: 94 UL
GENERATION NOVEL ARYL THIAZOLE BASED INHIBITORS OF TMEM-16A
By: Kashif Javed and Dr. Marc O. Anderson
Microbiology
Faculty Advisor: Dr. Marc O. Anderson

Abstract: Development of TMEM16a modulators is useful to probe the basic biochemical and biophysical characteristics and physiological functions of this relatively new class of chloride channels. TMEM16a inhibitors decrease CaCC function in vascular smooth muscle cells, relaxing murine and human blood vessels, providing support for TMEM16a as an anti-hypertensive drug target. TMEM16a inhibitors have recently been shown to inhibit proliferation of pancreatic cancer cells, demonstrating new potential for anti-cancer applications. It has also been shown that TMEM16a mRNA and protein are highly expressed in LNCaP and PC-3 cells, implicating the possibility that TMEM16a is involved in prostate cancer. Since the molecular identity and structure of these proteins is still unclear, a group of scientists at UCSF, led by Prof. Alan Verkman screened roughly 110,000 compounds and discovered that there were four main classes of molecules that fully inhibited TMEM16a and had an IC50<10μM. We are working on optimizing one class of these molecules, substituted aryl thiazoles, to potentially give us an IC50 value less than 1μM. The central hypothesis of this project is to explore the chemical structure of the aryl thiazole lead inhibitor scaffold, to generate new inhibitors with improved potency. Doing this will allow us to learn more about CaCC's and allow for sufficient disease cures relating to it.

Entry Number: 95 UL
NITROGEN: THE BUILDING BLOCK FOR MACROMOLECULES
By: Kathy Le and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Nitrogen assimilation is a fundamental biological process given the role of nitrogen being an essential component for proteins and nucleic acids. In Thermomicrobium sp. HL1, bacteria found in Yellowstone National Park, the mechanism for this pathway has remained unclear. To have a better understanding of how this process occurs, comparative genomic analysis was performed using IMG, Blast, KEGG and Phylogeny. IMG revealed that T. sp HL1 has ABC-type nitrate transport system with an ATPase and a permease component as well as having Nitrate/nitrite transporters. These transporters are necessary for the uptake of the oxidized form of nitrogen. In addition to the uptake of the nitrate, it was found that T. sp HL1 can also take in the inorganic form of nitrogen through the ammonium transporter and ammonia permease. Generally, ammonium assimilation is the preferred source of nitrogen rather than nitrate, the oxidized form. The KEGG pathway and IMG showed that both T. sp HL1 and T. roseum, its closest relative, have glutamate dehydrogenase and glutamine synthetase. Both are key enzymes for the regulation of nitrogen assimilation.

Entry Number: 96 UL
INHIBITION OF AMMONIA OXIDATION IN THE THERMOPHILIC AMMONIA-OXIDIZING ARCHAEON NITROSOCALDUS YELLOWSTONII
By: Madeline Cassani, Diego Rivera Gelsinger, and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Molecular data suggests ammonia-oxidizing archaea (AOA) play an important role in nitrogen cycling. To better understand their contribution to geochemical processes such as nitrogen cycling, we need tools to manipulate metabolic activity of AOA. Metabolic inhibitors have been used to examine the contribution of ammonia-oxidizers to nitrification rates in low temperature (mesophilic) environments. Nitrosocaldus yellowstonii HL72 is a thermophilic AOA cultivated from a hot spring in Yellowstone National Park (Wyoming, USA). To understand how N. yellowstonii contributes to nitrogen cycling in hot springs, we must first characterize the effect of nitrification inhibitors on its metabolic function. In this study, we have focused on allylthiourea (ATU), a commonly-used inhibitor of nitrification. Previous work in our laboratory has shown this compound is stable at 72˚C, the growth temperature of N. yellowstonii. We find that ammonia oxidation in N. yellowstonii is completely inhibited by ATU concentrations of 1 mM or greater, concentrations that are approximately 100 times higher than those required to inhibit ammonia oxidation in bacteria. In our

experiments, addition of 1 mM ATU decreased the rate of nitrite production of N. yellowstonii from 0.039 ± 0.001 mM/h-1 prior to addition, to 0.001 ± 0.001 mM/h-1. The amoA gene is present as a single copy in the genome of N. yellowstonii and can be used as a proxy for calculating cell numbers. Quantitative Polymerase Chain Reaction (QPCR) measurements of amoA copies in N. yellowstonii cultures treated with 1 mM ATU corresponded to nitrite production rates, confirming an ATU-dependent reduction in growth. With this there is sufficient evidence that ATU is an effective inhibitor of cell growth and a usable tool to manipulate metabolic activity of AOA.

Entry Number: 97 UL
HEAT SHOCK PROTEIN IN THERMOMICROBIUM HL1
By: Megan Lauzon and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Thermomicrobium HL1, a microbe native to a hot spring in Yellowstone National Park contains heat shock proteins that are responsible for RNA degradation; the folding and unfolding of proteins due to stress. HSP70 (heat shock protein 70) plays an essential role in the cell's machinery for protein folding, and even protects the cell from stress. The bacterial homologue of HSP70 is DnaK. My research is to see if our organism has the gene HSP70, what its paralogs and orthologs are and how it may have been acquired. We see that Thermomicrobium HL1 does indeed have the protein DnaK as does with close relatives Thermomicrobium Roseum and Sphaerobacter Thermophilus DSM. All three organisms participate in RNA degredation as indicated in Kegg. Doing a phylogenetic analysis, we see that the DnaK protein from our own organism and the DnaK protein from the Thermomicrobium Roseum seem to be considered the same gene and is also an ortholog to the DnaK gene found in Sphaerobacter Thermophilus. The gene DnaK in THL1 is found to be transferred laterally- as determined by GC content.

Entry Number: 98 UL
PATHWAYS USING CARBON MONOXIDE DEHYDROGENASE IN THERMOMICROBIUM ROSEUM
By: Michael Guadamuz and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: The ability to aerobically oxidize carbon monoxide is a trait seen in few groups of bacteria. Wu et al.'s analysis of the Thermomicrobium roseum genome indicated the presence of genes that encode for subunits of a molybdopterin-containing carbon monoxide dehydrogenase (CODH), suggesting that the species is capable of oxidizing carbon monoxide. This suggestion was supported by experimental tests conducted by Wu et al. in which T. roseum was able to grow in the presence of CO and produce CO2 in an aerobic environment. The pathways used in this pathway were investigated with KEGG, and a phylogenetic tree was constructed to find whether any other strains go through similar pathways.

Entry Number: 99 UL
PHYLOGENETIC ANALYSIS OF THE FLAGELLAR ASSEMBLY PROTEINS IN THERMOMICROBIUM SP. HL1
By: Michael Tran and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: The use of a flagellum in bacterial cell motility allows for the cell to migrate towards attractants such as a food source and away from repellents such as toxins. Thermomicrobium sp. HL1, a thermophilic member of the Chloroflexi phylum, contains a number of genes encoding for a complete flagellar system used in chemotaxis and motility. Interestingly, although these genes are present on its megaplasmid, Thermomicrobium

sp. HL1 does not express them, and is a well-known non-motile organism. Three gene clusters located on the megaplasmid encode for a complete flagellar assembly, as well as a two component signaling system used in chemotaxic signal transduction, which enables HL1 to sense, respond, and adapt to changes in their environment. With a repertoire of genes encoding for chemotaxis and flagellar assembly, HL1 has the potential of gaining a flagellum in the future. Through phylogenetic analysis using Phylogeny fr, Img, NCBI, and other bioinformatic databases, it was determined that Thermo HL1 acquired the genes through lateral transfer from an unknown member of the Firmicute phylum.

Entry Number: 100 UL
INCORPORATION OF ACETATE USING THE ABC-TRANSPORT SYSTEM INTO THE CARBON FIXATION PATHWAY
By: Miguel Karlo Jabagat and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Thermomicrobium sp. HL1 is a relatively new thermophilic bacterium that was cultured from a hot spring in Yellow Stone National Park and is currently undergoing sequencing in San Francisco State University. It is classified under the phylum Chloroflexi because of the high ribosomal RNA sequence similarities found in other similar organisms in the phylum such as Thermomicrobium roseum DSM 5159. T. roseum is known to have the ability to fix inorganic carbon through the Wood-Ljungdahl pathway (reductive acetyl-CoA. Other suggested pathways, such as reductive TCA cycle and the 3-hydropropionate cycle were also investigated. We present the idea that the ABC transport system (ATP Binding Cassettes), which has a complete cluster encoded in the HL1 genome, is used as an alternative route during the carbon fixation phase by the incorporation of acetate to make acetyl-CoA. By using different bioinformatic tools such as KEGG, IMG, NCBI, and MetaCyc, we determined that the ABC transport system is conserved throughout all the organisms used in this presentation and that the genome does encode for enzymes that are present in the reductive acetyl-CoA pathway, suggesting that the organism may be using the ABC transporters as a means to incorporate external nutrients, such as acetate, to complete carbon fixation.

Entry Number: 101 UL
GLOBAL WARMING SAVIOR?
By: Pages Liu and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: Global warming is undoubtedly one of the biggest issues to the human kind today. Global warming is a “green house effect” that is caused by the Earth’s rising temperature due to gases in the atmosphere, such as carbon dioxide and methane, trapping the heat energy from the sun. These gases, known as greenhouse gases, can be emitted in different ways. For instance, the production of plastics, the burning of coal or the natural processes of human respiration can cause carbon dioxide and methane emissions. These gases are causing the Earth’s climate to change every day, and scientists are trying to find ways to reduce these gases in our atmosphere. Methane gas is thought be the second most damaging greenhouse gas after carbon dioxide. However, methane emission has approximately 25 times the impact on global warming than carbon dioxide emission. While the emissions of methane gas is relatively low compared to carbon dioxide, methane gas still poses a threat and should not be overlooked. There is a large amount of natural methane gas trapped in soil that has been frozen. As the climate increases due to global warming, these hidden methane gas will be release back into the atmosphere again. Researchers have been showing interest in the study of methanotrophs because they can prevent greenhouse gases like methane to be released into the atmosphere. In this research, bacteria thermoHL1 is being investigated to see if the bacteria are closely related to the methanotroph. Database such as IMG and BLAST were used to identify similar genomic sequences to understand the origin and functions of the bacteria. A phylogenetic tree is built to understand the relationship between thermoHL1 and known

methanotrophs. Current research did not show a definite relationship between thermoHL1 and methanotrophs and further investigation is required.

Entry Number: 102 UL
WHO IS PATIENT ZERO? THERMOMICROBIUM HL1'S CRISPR-CAS SYSTEM PROVIDES US WITH THE MEDICAL HISTORY OF ITS PAST VIRAL INFECTIONS
By: Virginia Russell and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: The CRISPR-Cas system is a recently discovered RNA-based adaptive immune system in bacteria and archaea that helps fight invasions of viruses and plasmids. CRISPRs are short direct repeated sequences, usually 30 to 40 nucleotides long that have unique spacers in the middle. The spacers are sequences of DNA that are derived from viruses or plasmids that have previously invaded the cell. CRISPRs are aided by Cas proteins, which include nucleases, helicases and RNA binding proteins. The CRISPR-Cas system is obtained through horizontal gene transfer and shows the adaptive history of past infection. Thermomicrobium HL1, a bacterium cultivated from the hot springs at Yellowstone National, has Cas proteins 1, 2, 3, 5, 6, 7, 10, A and B as well as several spacers at the CRISPR loci. Determining if other organisms that are infected with the same viruses have the same Cas proteins as Thermomicrobium HL1 can be accomplished by examining its Cas proteins and spacers. IMG and BLAST will be used to identify the Cas proteins of Thermomicrobium HL1 and a database called CRISPR finder will be used to identify the CRISPR loci as well as the spacers. Then these sequences will be BLASTed to identify other organisms that have the same spacers, which will mean they were infected by the same invader. Finally, the different organisms that have the same spacers will be compared with the organisms that have the same Cas proteins and to see if there is a correlation between where Thermomicrobium HL1 acquired its Cas proteins and where it obtained the spacers. The CRISPR-Cas system is an essential method for bacteria and archaea to overcome viral infections and getting a better understanding of the relationship between the Cas proteins and the spacers will help us better understand the system as a whole.

Entry Number: 103 UL
ASSIMILATING NITROGEN AS AN EXTRAORDINARY EXTREMOPHILE
By: Zoe Dion and Dr. José de la Torre
Microbiology
Faculty Advisor: Dr. José de la Torre
Abstract: All organisms play a distinct role in the nitrogen cycle, and utilize different nitrogenous compounds to build biomass. For example, some organisms fix molecular nitrogen from the atmosphere into ammonia, whereas others obtain nitrogen solely by ingesting amino acids. Thermomicrobium HL1, a bacterium found in hot springs at Yellowstone National Park, is an organism with unclear methods of acquiring and utilizing nitrogen. To challenge this mystery, data will be collected by article research, IMG genome and protein analysis, as well as BLAST and KEGG pathway comparative analyses. Based on evident protein coding regions such as for Glutamate Synthase, it is theorized that Thermomicrobium HL1 uses ammonia as a primary nitrogen source to build its amino acids. Nitrogen assimilation is an essential pathway for building biomass from compounds in the immediate environment, and Thermomicrobium HL1 has developed to utilize nitrogen by comparable mechanisms seen in other organisms.

Entry Number: 104 UL
FLAGELLAR PROTEINS IN A NOVEL MEMBER OF THE CHLOROFLEXI
By: Nassim F. Karbasi and Dr. José de la Torre
Microbiology

Faculty Advisor: Dr. José de la Torre
Abstract: Flagella (generally consisting of an ion driven motor, a hook, and a filament) serve as a useful means for movement and signal transduction by the cell through a liquid medium. The sequencing of the novel genome of Thermicrobium sp. HL1, a thermophilic member of the phylum Chloroflexi that may live symbiotically with an archaeal counterpart, has been undertaken at SFSU. Motility via flagella is rare in the Chloroflexi; however, HL1 has acquired genes that enable the synthesis, assembly, and regulation of a flagellum. These genes are largely shared with its closest relative, Thermomicrobium roseum DSM 5159, in addition to with Sphaerobacter thermophilus, both members of the Chloroflexi. However, despite coding for known flagellar components within their genomes, HL1, T. roseum, and S. thermophilus are not known to be motile, and these genes may be defunct vestiges from a recent common ancestor, or novel genes from a plasmid circulating within a shared environment via an unknown organism. BLAST and Phylogeny.fr were used determine that HL1, T. roseum, and S. thermophilus most likely gained these genes via lateral transfer from a member or several members of the Firmicutes.

Entry Number: 105 UL
ROLE OF ROOT UV-B SENSITIVE1 AND VITAMIN B IN AUXIN TRANSPORT AND ARABIDOPSIS DEVELOPMENT
By: Danielle Black, Marisol Pantovich, Hongyun Tong, and Dr. Zheng-Hui He
Cell and Molecular Biology
Faculty Advisor: Dr. Zheng-Hui He
Abstract: Mutations in the RUS1 (ROOT UV-B SENSITIVE 1) gene of Arabidopsis thaliana result in UV-B hypersensitivity and severe developmental arrest. Specific mutations of ASPARTATE AMINOTRANSFERASE 2 (ASP2) or exogenously adding its cofactor, vitamin B6, to growth media have been found to partially rescue rus1 phenotypes. How exactly RUS1 and ASP2 work together to regulate Arabidopsis development is not well understood. Auxin is an important phytohormone that is known to regulate many aspects of plant development and RUS2 (ROOT UV-B SENSITIVE 2) was implicated to play a role in auxin transport. The DR5::GUS construct was used to examine the accumulation and distribution of auxin in rus1-2 and its suppressor mutants. Two to seven day-old seedlings were grown in light and dark conditions as well as in the absence or presence of vitamin B6. These seedlings were assayed for GUS activities. Etiolated seedlings of all tested genotypes and ages showed no distinguishable differences in auxin distribution. At seven days old, auxin distribution in the light-grown rus1-2 plants appeared to extend farther up into the maturation zone of the root compared to the wild type in both the presence and absence of vitamin B6. Confocal analysis using PIN1::PIN1-GFP and PIN2::PIN2-GFP also shows that levels of these auxin transport proteins were greatly reduced in the rus1-2mutant. The reduced PIN1-GFP and PIN2-GFP are significantly restored in rus1-2 asp2 double mutants or when rus1-2seedlings were grown on growth media with vitamin B6 exogenously added. Our data suggests that RUS1 is required for the normal auxin distribution required for early seedling development in the light. Our ongoing experiments are analyzing how RUS1 and vitamin B6 affect auxin distribution and regulate root development.

Entry Number: 106 UL
DETECTING DIFFERENCES IN THE STRUCTURE OF CANCER GENOMES: APPLICATIONS TO CHRONIC MYELOID LEUKEMIA
By: Reyka Jayasinghe, Heaven Mesfun, and Dr. Javier Arsuaga
Cell and Molecular Biology and Applied Mathematics
Faculty Advisor: Dr. Javier Arsuaga
Abstract: Determining the three dimensional organization of chromatin is key to understanding a number of biological processes including long-range chromatin interactions, gene regulation and chromosome aberration formation. In Lieberman-Aiden et. al. 2009, the Hi-C method was published to quantitatively analyze the nuclear chromatin architecture by computing spatial proximity measurements. In this project we investigate the

variations in spatial proximities between regions of an erythroleukemia cell line (k562) and a lymphoblastoid cell line (gm06690). Our results suggest the spatial proximities of specific regions, or loci, on a chromosome change between normal and cancer cell lines. Loci with statistically significant modifications correlate to regions containing genes that can be attributed to the survival and proliferation of cancer. By applying principal component analysis (PCA) on the Hi-C data, we show fluctuations of genes between transcriptionally active and inactive regions. We employed Significance Analysis of Microarrays (SAM), to verify the fluctuations between active and inactive regions is correlated to gene expression alterations between the erythroleukemia and lymphoblastoid cell lines.

Entry Number: 107 UL
ENDOPLASMIC RETICULUM REORGANIZATION DURING MITOSIS IN DROSOPHILA MELANOGASTER
By: Dzu Nguyen
Cell and Molecular Biology
Faculty Advisor: Dr. Blake Riggs
Abstract: Intra-cellular organelles experience a dramatic remodeling during mitosis; however the mechanism governing this process has not been identified. The microtubule cytoskeleton is instrumental in many mitotic events: there is preliminary evidence suggesting that the microtubule network is required for these dramatic rearrangements of intracellular organelles. The Endoplasmic Reticulum (ER) is an essential membrane organelle that displays this dramatic rearrangement during mitosis. Specifically, the ER experiences dramatic structural changes that align it with the microtubule-based bipolar spindle. Our objective is to identify mitotic specific, microtubule associated factors involved in ER rearrangement. Possible candidates for this study are the microtubule motor proteins Kinesin and Dynein, which have been shown to be instrumental in many mitotic events. The Kinesin family of motor proteins are plus-end directed, moving along the microtubules, and facilitate many essential mitotic events, including mitotic spindle assembly, chromosome alignment, and chromosome segregation. Dynein is minus-end directed motor protein and has been suggested to be involved in membrane movement during mitosis, specifically at the centrosomes. Our hypothesis is that cytoplasmic Dynein or a mitotic kinesin are involved in mitotic ER rearrangement. We will examine the role of mitotic motor proteins in ER rearrangements in dividing neuroblast in Drosophila melanogaster. We have created a transgenic line that expresses GFP-Protein Disulfide Isomerase (PDI), an ER specific marker which is expressed in dividing neuroblast. In addition, we will use tissue specific RNA interference (RNAi), to inhibit cytoplasmic Dynein heavy chain (DHC) and the conventional kinesin, Kin1 and examine the effects on ER organization and partitioning during mitosis. Early results show that the Kin1 knockdown produced a ~0% survival rate while the DHC knockdown flies showed a ~13% survival rate. These results confirm the necessity of both motors in proper development: particularly that loss of Kinesin knockdown, even localized only to the brain, would in effect halt development all together. Furthermore, it appears that the DHC knockdown does not fully affect mitosis but does appear to affect ER localization to the membrane. Further steps would be to observe mitosis specific kinesins Klp61f similarly to the DHC knockdown as well as observe neuroblast development during embryonic development.

Entry Number: 108 UL
PUTATIVE PROTAMINES, SPCH-1/2/3, LOCALIZE TO MATURE SPERM CHROMATIN AND MAY PLAY A ROLE IN FERTILITY
By: Jennifer Gilbert, Dr. Dana Byrd, Jordan Berry, and Dr. Diana Chu
Cell and Molecular Biology
Faculty Advisor: Dr. Diana Chu
Abstract: During spermatogenesis, chromatin becomes highly compacted to ensure the efficient delivery of DNA to the oocyte. Compaction of sperm chromatin in most animals is facilitated by deposition of small nuclear basic proteins (SNBPs) called protamines, which bind in the major groove of DNA to allow bending of the DNA. While protamine incorporation to compact chromatin is well conserved, the high variability of

protamine gene and protein sequences across phyla has complicated the identification of these proteins across species. We hypothesize that C. elegans have SNBPs that share similar molecular features and functions as protamines. As such, we expect them to be small, highly basic proteins enriched in sperm chromatin, and localize to DNA during late stages of spermatogenesis. To identify such proteins, a proteomic approach was taken. We identified three nearly-identical proteins, SPCH-1/2/3 that were abundant in sperm chromatin samples and not found in embryo chromatin. SPCH-1/2/3 are only 22kD and they have a predicted isoelectric point of ~13.7. Also consistent with the amino acid content of SNBPs, SPCH-1/2/3 consist of a high percent of arginine (28%) and serine (29%) residues. Immunostaining using an antibody that recognizes all three SPCH proteins shows that SPCH-1/2/3 localize to DNA in late stages of spermatogenesis and around mature sperm. Immediately after fertilization, SPCH-1/2/3 mark the paternal pronuclei and then are removed as the sperm pronucleus decondenses. Using proteomic analysis of acid solubilized sperm chromatin, we find that SPCH-1/2/3 are highly phosphorylated. Interestingly, major sites of phosphorylation are found on amino acids that differentiate SPCH-1 from SPCH-2 and SPCH-3. Due to the importance of protamines in sperm DNA compaction, we anticipate that loss of SPCH function could lead to fertility defects. In fact, progeny counts of single spch mutants suggest elimination of SPCH function reduces fertility, in some cases up to 1/3 the amount of wild-type. Thus, SPCH-1/2/3 appear to function as protamines and may play an important role in male fertility.

Entry Number: 109 UL

THE ROLE OF C. ELEGANS HISTONE H2A VARIANTS IN TRANSCRIPTION DURING SPERMATOGENESIS

By: Londen Johnson
Cell and Molecular Biology
Faculty Advisor: Dr. Diana Chu

Abstract: One key contributor to male fertility is the proper packaging of DNA in sperm. This packaging is facilitated by histones, which compact DNA and manage the accessibility of DNA for transcription. Histone variants are specialized in function and replace canonical histones. For example, the histone H2A variant HTZ-1 is 54% identical to H2A, expressed in all cell types, and present at 23% of all C. elegans promoters, which suggests a role in transcription1. HTAS-1 is 48% identical to H2A and incorporated into sperm chromatin during a period of global transcriptional silencing. Because both variants are expressed during spermatogenesis, our goal is to understand how the incorporation of HTZ-1 and HTAS-1 may influence gene transcription during sperm formation. We hypothesize that while HTZ-1 will be incorporated at active chromatin in the male germ line, HTAS-1 may be incorporated at repressed chromatin. To test this, we have conducted immunlocalization of HTZ-1 and HTAS-1 during spermatogenesis. First, we found that HTAS-1 and HTZ-1 co-localize during later stages of spermatogenesis and both are under-represented on the X transcriptionally-silent chromosome. This suggests, counter to our original hypothesis, that HTZ-1 and HTAS-1 may both be incorporated in transcriptionally active chromatin. To further assess this, we will test whether HTZ-1 and HTAS-1 are located on active or inactive extrachromosomal arrays in males. Preliminary data has shown that HTZ-1 is localized on active arrays in the hermaphrodite germ line; thus we anticipate that HTZ-1 will also colocalize to transcriptionally active arrays in males. Immunolocalization of HTAS-1 to active and inactive arrays is also currently underway. Further, because HTAS-1 and HTZ-1 differ from H2A in their N- and C-termini, we will create chimeras by swapping these domains onto canonical H2A and analyze their localization to transcriptionally active or inactive sites. We expect that this research will correlate HTZ-1 and HTAS-1 incorporation with transcription and define important features of H2A variant structure required for their potential roles in transcriptional regulation.

Entry Number: 110 UL

SERINE LIPID MODIFICATION OF WNT1 IS REQUIRED FOR CELL PROLIFERATION AND SPECIFICATION IN THE CHICK SPINAL CORD

By: Matilde Miranda, Lisa M. Galli, Michael Enriquez, Linda Szabo, and Dr. Laura W. Burrus
Cell and Molecular Biology
Faculty Advisor: Dr. Laura W. Burrus

Abstract: Spinal cord development and patterning is heavily regulated by Wnts. Wnts are a family of lipid modified signaling proteins that play crucial roles in embryonic development and adult homeostasis, in processes such as cell migration, cell proliferation, and cell fate. In the developing spinal cord, Wnts form a dorsal to ventral concentration gradient, controlling cell proliferation and inducing different neuronal types. Wnt1 is lipid-modified on two conserved amino acids, C93 and S224. Porcupine (Porcn) is an acyl transferase that modifies S224 with palmitate and is essential for Wnt gradient formation during spinal cord development. Mutations in human Porcn cause defects in a number of tissues, including the spinal cord. Porcn is a member of a large family of acyl transferases; some modify cysteine residues while others modify serines. It is not known whether a single family member can promote the modification of both residues. We hypothesize that 1) lipid modification of S224 is required for Wnt1 activity and 2) Porcn specifically modifies serine residues. To test this hypothesis, we performed biological and biochemical assays with wild-type and mutant (S224A, S224C) Wnt1. First, we measured Wnt signaling in HEK293T cells using a reporter assay. Second, we analyzed Wnt signaling in the developing chick spinal cord by immunostaining for markers of proliferation and neuron specification. Lastly, we performed biochemical experiments to directly assess the ability of Porcn to promote the incorporation of radiolabeled palmitate into GFP-tagged Wnt1 peptide fusion proteins that span S224. Our studies show that Wnt1 S224A and S224C are biologically inactive in cells and in vivo. Hence, we conclude that 1) S224 is absolutely necessary for Wnt1 activity in amniotes and 2) Porcn can modify serine, but not cysteine, residues. Biochemical studies further show that S224A mutants do not incorporate radiolabeled palmitate. Parallel experiments with the S224C mutation are underway and are expected to add mechanistic insight into our biological results in testing enzyme specificity for Porcn.

Entry Number: 111 UL

CHARACTERIZATION OF ROOT UV-B SENSETIVE2 PROMOTER IN ARABIDOPSIS THALIANA

By: Michelle Wallace, Dr. Hong-Yun Tong, and Dr. Zeng-Hui He
Cell and Molecular Biology
Faculty Advisor: Dr. Hong-Yun Tong and Dr. Zeng-Hui He

Abstract: Ultraviolet B light (UV-B, 280-320 nm) can either harm or help organisms depending on its fluence level. Low-fluence levels serve as signals for plant morphogenesis and development, while high-fluence levels can increase mutation rate and damage macromolecules such as DNA, RNA, and protein. While much is known regarding the effects of high-fluence UV-B exposure, little is known about the mechanisms of how low-fluence UV-B regulates plant growth and development. Our lab has discovered an Arabidopsis mutant, called rus2 (root uv-b sensitive2), that is hypersensitive to very low-fluence (VLF) UV-B. Under a light a condition with VLF UV-B, rus2 is stunted and does not progress past the cotyledon stage. This UV-B hypersensitive mutant has been used as a powerful genetic platform to deduce the UV-B signaling pathway in plants. Our analysis suggested RUS2 plays important roles in early seedling UV-B response. To understand how RUS2 functions in early seedling UV-B responses, we set up to study RUS2 promoter activities at various developmental stages and under different environmental conditions. RUS2 promoter region was PCR amplified from Arabidopsis genomic DNA. The amplified fragment was cloned in a pGEM vector and confirmed by sequencing. This fragment was then fused to the reporter gene beta-glucoronidase (GUS) to create a RUS2::GUS construct. The RUS2::GUS construct was ligated in pBI101 transformation vector and the final pBI101-RUS2::GUS plasmid was identified and sequenced for confirmation. We are placing the confirmed plasmid into Agrobacterium tumerfacien that will be used to transform WT Arabidopsis. Transgenic plants carrying RUS2::GUS will be selected by plating transformed seeds on growth media containing kanamycin. RUS2 promoter activities will be analyzed by incubating transgenic plants with X-Gluc, a colorless substrate that can be converted by GUS to a blue product. The amount of GUS activities found in an Arabidopsis seedling is a direct reflection of the RUS2

promoter activity. RUS2::GUS transgenic seedlings of various ages (3-day-old, 5-day-old and 7-day-old) will be subjected to various treatments (with or without stresses related to UV-B, osmotic, drought, temperature, etc.) and RUS2:GUS activities will be assayed. We are expecting to obtain a detailed RUS2 expression profile at various developmental stages and under various growth conditions, and to provide important insights in how RUS2 functions in early seedling UV-B responses.

Entry Number: 112 UL
CONSTRUCTION OF TWO CDC24+-MYC STRAINS WITH EITHER THE RAD2D or CDC17ts BACKGROUND TO DETERMINE LOCALIZATION OF CDC24 IN SCHIZOSACCHAROMYCES POMBE
By: Ngoc 'Nikki' Hoang and Dr. Sally G. Pasion
Cell and Molecular Biology
Faculty Advisor: Dr. Sally G. Pasion
Abstract: Proper genomic replication ensures correct genetic information is passed down to future generation. cdc24 mutants arrest at S phase with a replicated genome but with broken chromosomes. The exact function of cdc24 is unknown, but it is suggested to have a role in lagging strand synthesis due to its genetic and physical interactions with conserved replication proteins, such as Cdc17 (DNA ligase), Pcn1 (PCNA), and Rad2 (flap endonuclease). Both Cdc17 and Pcn1 are known to be multicopy suppressors of the temperature sensitive phenotype of Cdc24 in a Rad2 dependent matter, suggesting that Cdc24, a possibly forms a complex with Cdc17 and Pcn1 in the presence of Rad2 in the nucleus. According to unpublished data from a graduate student in the lab, Cdc24 exhibit chromatin association. It is unknown whether Cdc24 will remain in the nucleus in the absence of one of the components of the complex. We hypothesize that Cdc24 will not be able to form stable complex with Pcn1 and Cdc17 in the absence of Rad2, leading to a change in the localization of Cdc24 to be loosely associated with the chromatin, completely dissociation from the chromatin but remain in the nucleus, or to be export out of the nucleus. In the absence of Cdc17, Cdc24 could still form a complex with Rad2 and Pcn1, but the complex might not be functional without Cdc17. In order to determine the localization of Cdc24 in absence of either Rad2 or Cdc17, we constructed two cdc24-myc strains with either the rad2Δ background or the nonfunctional cdc17 background using Random Spore Analysis: cdc24+-myc rad2Δ and cdc24+-myc cdc17ts. The spores were selected for the ura4+ marker in the rad2Δ background, and temperature sensitivity for the cdc17ts background. The cdc24-myc strains were verified via PCR and gel electrophoresis. The construction of these two strains will help into understanding the localization of Cdc24.

Entry Number: 113 UL
ELUCIDATING THE CATALYTIC MECHANISMS OF THE NOVEL STYRENE DETOXIFICATION SYSTEM IN PSEUDOMONAS BACTERIA
By: Nonye N. Okonkwo and Dr. George T. Gassner
Cell and Molecular Biology
Faculty Advisor: Dr. George T. Gassner
Abstract: As the world becomes more polluted with styrene-based polymers, it is essential to consider how the 28 million tons of Styrofoam and commercial plastics produced in the United States impact human health. Styrene and its metabolites act as biological membrane disrupters and intracellularly where they are transformed by cytochrome p450 isofroms to styrene oxide and vinylphenol, which have biological activity as pulmonary and hepatic poisons.
This toxic vinyl benzene is a danger to living systems and for this reason we focused our research on the styrene detoxification pathway in Pseudomonas bacteria. The first enzyme, styrene monooxygenase (SMO), a two component flavoenzyme with an NADH specific reductase, SMOB, and a FAD specific epoxidase, SMOA, catalyzes the epoxidation of styrene to yield styrene oxide. Here, SMOB binds NADH and oxidized FAD as substrates and catalyzes the reduction of FAD by a hydride-transfer mechanism. Many details of the SMOB catalyzed flavin reduction and transfer still need to be explained.
This research evaluates the catalytic mechanism of N-terminally histidine-tagged styrene monooxygenase reductase (N-SMOB) from Pseudomonas putida S12 bacteria. Over expression of N-SMOB in E.coli BL21

(DE3) cells produces high amounts of the enzyme, which we purified using nickel affinity chromatography. A Spectromax190 microplate reader was used to measure the rate at which the hydride ion is transferred from NADH to FAD at 340nm. Previous data showed the native SMOB enzyme follows a sequential mechanism under identical conditions. However, preliminary data of N-SMOB at 10 °C suggests that a double displacement reaction with NADH as the leading substrate could be prevalent mechanism.
These studies of N-SMOB at 10°C provided estimates of the Km of NADH, Km of FAD and Vmax of N-SMOB at 5.0 uM, 3.7 uM, and 38.0 uMs-1, respectively. Through the use of high resolution kinetic analysis at 30°C, we confirm that the double displacement mechanism is the preferred reaction for N-SMOB and these findings will be used to elucidate the flavin-transfer reaction.

Entry Number: 114 UL
HORIZONTAL GENE TRANSFER OF CHAPERONIN AND HEAT SHOCK RESPONSE PROTEIN GROEL IN THERMOMICROBIUM
By: Scott Gablenz and Dr. José de la Torre
Cell and Molecular Biology
Faculty Advisor: Dr. José de la Torre
Abstract: Microbial heat shock response typically involves the up regulation of chaperone type proteins. These molecular chaperones are highly conserved and are critical in helping new or denatured proteins fold into their correct 3-dimensional shape. GroEL, also known as heat shock protein 60 (hsp60), is a molecular chaperone that is found in the mitochondria. During heat shock, it helps refold and transport proteins from the cytoplasm into the mitochondria and also aids in the degradation of RNA. In this study, we found that Thermomicrobium, a thermophilic bacterium found in several Yellowstone hot springs and member of the Chloroflexi, contains two copies of hsp60; one of which is evolutionarily derived, and the other is the product of horizontal gene transfer - the process by which an organism acquires DNA from another microbe. To do this, several browser based tools such as blast and phylogeny.fr were employed. We found that the gene is unrelated to a genes present in other members of Chloroflexi, and was likely transferred to Thermomicrobium from a relative of Spirochaeta.

Entry Number: 115 UL
CHARACTERIZATION OF A TAURINE-REGULATED PROMOTER IN CAULOBACTER CRESCENTUS
By: Tanisha Saini and Dr. Joseph Chen
Cell and Molecular Biology
Faculty Advisor: Dr. Joseph Chen
Abstract: Members of the Alpha-proteobacteria class occupy diverse ecological niches: they include pathogens that infect humans and animals, marine plankton that perform photosynthesis, and agriculturally significant rhizobia that fix nitrogen while in symbiosis with appropriate plant hosts. The availability of genetic tools and, in particular, promoters that allow regulatable gene expression would greatly facilitate the study of this important group of bacteria. Previous research identified a promoter (Ptau) that is induced by taurine in the alpha-proteobacterium Sinorhizobium meliloti, and it appears to have a useful range of expression. Thus, we investigated whether the Ptau promoter and its associated regulator (TauR) are functional in another alpha-proteobacterium, Caulobacter crescentus. To determine whether tauR is required for reporter gene expression from the Ptau promoter in C. crescentus, we used different plasmids with transcriptional fusions to examine how each functioned in the presence or absence of taurine. Specifically, uidA, which encodes the reporter enzyme beta-glucuronidase (GUS), was fused to the Ptau promoter and placed on a plasmid with or without tauR. We then performed assays that measured GUS activity at different inducer concentrations. We found that in the absence of TauR, there was no expression from the Ptau promoter. In contrast, in the presence of the TauR activator, increasing concentrations of taurine led to higher levels of gene expression. Therefore, our results indicate that the Ptau promoter is functional in C. crescentus and requires TauR for expression.

Entry Number: 116 UL

ANTI-MITOTIC DRUG EFFECT ON BUB1/BUBR1 MUTATED CLONES USING TWIN-SPOT ANALYSES IN THE DROSOPHILA COMPOUND EYE

By: Torey Jacques
Cell and Molecular Biology
Faculty Advisor: Dr. Blake Riggs

Abstract: Understanding cancer drug dynamics and function can lead to anti-mitotic drugs efficiently targeting cancerous cells. Microtubules key role in cell division include chromosome separation and movement of the cell's organelles. During mitosis microtubules form mitotic spindles that drive chromosome separation to newly formed daughter cells. Errors activate the spindle assembly checkpoint (SAC) which repair defects or initiates apoptosis. Several cancers have SAC mutations in which mitotic spindle proteins are improperly regulated. We try to identify anti-mitotic drugs effective against SAC mutated cells. BUB1 and BUBR1; are protein kinases with major roles in SAC function by localizing to the kinetochores and recruiting other SAC proteins. We examine BUB1 and BUBR1 mutated cells using twin-spot analyses. Using the FLP/FRT technique we induce homozygous bub1 and bubr1- mutant red spot clones in the Drosophila melanogaster compound eye allowing for anti-mitotic drug effect observation. These clones serve as tumor growth models that test the effectiveness of anti-mitotic drugs. Several anti-mitotic drugs target the SAC of cancerous cells e.g., taxol and colchicine. Our early whole organism tests show colchicine to be more toxic than taxol to WT Drosophila melanogaster. To understand and optimize their effectiveness we will measure their ability to affect clone size on bub1 and bubr1- mutants. The aforementioned drugs will be scored according to clone size reduction. We can then be more effective in targeting cancerous cells by preventing microtubule assembly, disassembly, or both.

Entry Number: 117 UL

ENHANCING THE EFFICIENCY OF PHOTODYNAMIC THERAPY USING CONTROLLED EXPOSURE TO NITRIC OXIDE

By: Mele Latai, Marco Monroy, Sylvia Wojdyla, Pooncharas Tipgunlakant, Dr. Raymond M. Esquerra, and Dr. Ursula Simonis
Cell and Molecular Biology and Chemistry
Faculty Advisors: Dr. Raymond M. Esquerra and Dr. Ursula Simonis

Abstract: Photodynamic therapy (PDT) is a non-invasive method for cancer treatment that involves administering a tumor-specific photosensitizing agent, light source, and molecular oxygen. These three factors combined cause cancer cells to undergo oxidative stress due to an accumulation of intracellular reactive oxygen species (ROS) leading cells to undergo programmed cell death; however, the reaction that causes this mechanism to occur remain poorly understood. Recent studies are now making it clear that nitric oxide (NO) a powerful vasodilator involved in a variety of biological processes that enhances the effects of PDT in cancer cells. In this study, we hypothesize that nitric oxide enhances the cancer cell killing efficiency of ¬PDT agent pheophorbide a when nitric oxide exposure occurs concurrently with PDT initiation. Sodium nitroprusside was used as our NO releasing agent because it releases nitric oxide when illuminated with light at 318 nm. This method can simultaneously generate NO and initiate PDT using light exposure. LNCαP prostate cells were used for in vitro cell activity and mortality assays. We tested and quantified the photogeneration of NO by nitroprusside under experimental conditions using the oxyhemoglobin detection assay, which monitors the oxidation of hemoglobin by nitric oxide. Using these data, we designed an experiment that combined the photoproduction of NO by nitroprusside with our existing microplate photosensitizing reaction and MTT (3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide) cellular activity assay. Clarifying the role NO plays in affecting the efficiency of PDT will provide further insight in improving the clinical use of PDT.

Reference

1. Yoo, J., & Ha, K. (2012). New insights into the mechanisms for photodynamic therapy-induced cancer cell death. International review of cell and molecular biology, 295, 139-174.

Photodynamic therapy (PDT) is a non-invasive method for cancer treatment that involves administering a tumor-specific photosensitizing agent, light source, and molecular oxygen. These three factors combined cause cancer cells to undergo oxidative stress due to an accumulation of intracellular reactive oxygen species (ROS) leading cells to undergo programmed cell death; however, the reaction that causes this mechanism to occur remain poorly understood. Recent studies are now making it clear that nitric oxide (NO) a powerful vasodilator involved in a variety of biological processes that enhances the effects of PDT in cancer cells. In this study, we hypothesize that nitric oxide enhances the cancer cell killing efficiency of ¬PDT agent pheophorbide a when nitric oxide exposure occurs concurrently with PDT initiation. Sodium nitroprusside was used as our NO releasing agent because it releases nitric oxide when illuminated with light at 318 nm. This method can simultaneously generate NO and initiate PDT using light exposure. LNCαP prostate cells were used for in vitro cell activity and mortality assays. We tested and quantified the photogeneration of NO by nitroprusside under experimental conditions using the oxyhemoglobin detection assay, which monitors the oxidation of hemoglobin by nitric oxide. Using these data, we designed an experiment that combined the photoproduction of NO by nitroprusside with our existing microplate photosensitizing reaction and MTT (3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide) cellular activity assay. Clarifying the role NO plays in affecting the efficiency of PDT will provide further insight in improving the clinical use of PDT.

Reference

1. Yoo, J., & Ha, K. (2012). New insights into the mechanisms for photodynamic therapy-induced cancer cell death. International review of cell and molecular biology, 295, 139-174.

Entry Number: 118 UL

A ROLE OF TATA BINDING PROTEIN ASSOCIATED FACTOR 3 IN HUMAN ERYTHROPOIESIS

By: Shawntel Okonkwo and Dr. Daniel Hart

Physiology

Faculty Advisor: Dr. Daniel Hart

Abstract: Erythrocytes account for a large portion of blood volume and primarily function in the transport of oxygen and carbon dioxide throughout the circulatory system. Though heritability for red blood cell traits is high, their genetic determinants remain largely unknown. Several Single Nucleotide Polymorphisms (SNPs) are known to be associated with high Mean Corpuscular Hemoglobin Concentration (MCHC), a red blood cell trait indicating abnormal erythropoiesis in which red blood cells display a spherocytic morphology instead of the normal bi-concave disk morphology. Recent data collected from a Genome-Wide Association Study (GWAS) showed that a SNP located in an intron of the TATA-Binding Protein Associated Factor 3 (TAF3) was found to have a particularly strong statistical correlation (r2=0.88) to the SNPs linked to high MCHC. Interestingly, it has also been shown that TAF3 is specifically required for proper erythropoiesis in zebrafish and mice but the same requirement in human erythropoiesis has, to date, not been demonstrated. Therefore, our goal is to determine if there was a relationship between TAF3 and high MCHC in human erythropoiesis. We hypothesized that TAF3 is a key transcriptional regulator of the genes encoding major proteins of the erythrocyte cytoskeleton—namely Ankyrin and α-Spectrin. We performed Chromatin Immunoprecipitation (ChIP) experiments to determine the occupancy of TAF3 in the promoter regions of these genes and found recruitment of TAF3 to be relatively high. We then knocked down TAF3 in human leukemic K562 cells (pro-erythrocytes) using shRNAs, and determined the effect on the gene expression of Ankyrin and α-Spectrin using qPCR. Our results indicated that TAF3 knockdown down-regulates α-Spectrin, but not Ankyrin gene expression. In future studies, we aim to elucidate the mechanisms underlying this phenomenon by investigating epigenetic mechanisms such as histone modifications and chromatin cross talk which may be responsible for the strong correlation between high MCHC and TAF3 as observed in the GWAS. We hope that these experiments will further our understanding of the genetic determinants underlying human red blood cell traits and membrane diseases.

Entry Number: 119 UL
INVESTIGATING THE EFFECTS OF NITRIC OXIDE ON PHOTODYNAMIC THERAPY
By: Sylvia Wojdyla, Marco Monroy, Mele Latai, Pooncharas Tipgunlakant, Dr. Raymond M. Esquerra, and Dr. Ursula Simonis
Biochemistry
Faculty Advisor: Dr. Raymond M. Esquerra and Dr. Ursula Simonis
Abstract: Photodynamic therapy (PDT) is a currently used, novel anti cancer treatment that is based on the irradiation of a photosensitizer. Upon irradiation of visible light the activated photosensitizer, pheophorbide a (pba), transfers its energy to nearby oxygen molecules to produce toxic, reactive singlet oxygen species. In addition to destroying nucleic acids, proteins, and lipids, it diffuses into the mitochondria and interferes with the growth properties of the cancer LnCAP cells, inducing apoptosis. The cancer cells produce low levels of nitric oxide (NO) via inducible nitric oxide synthase (iNOS) by way of conversion of L-Arginine into nitric oxide and L-citrulline. Under endogenous concentrations, nitric oxide has cytoprotective properties as it vasodilates, prevents epithelial platelet aggregation, and increases vascular permeability invivo. Without an adequate vascular system tumors would remain miniscule and would not be able to reach a greater size. Under micromolar concentrations nitric oxide, which is also produced by macrophages as an inflammatory response, is cytotoxic because of its conversion into peroxy nitrite (ONOO-) after reacting with itself. Its hydrophobic nature allows it to freely move across cell membranes and thus is quickly consumed once it's in cell solution. Excess concentrations of nitric oxide have shown to enhance the efficacy of PDT, which varies depending on the type of tumors and size. Our study focuses on the relative quantification of viable LnCAP cells invitro by way of the MTT assay after induction of Pba and NO to show that PDT is enhanced by NO.

Entry Number: 120 UL
DETECTION OF ENDOTOXIN
By: Amanda Chamsi
Biochemistry
Faculty Advisor: Dr. Teaster Baird Jr.
Abstract: Within the outer membrane of gram-negative bacteria, bacterial endotoxins, also known as lipopolysaccharides reside. As the bacteria dies and begins to lyse, endotoxins are released and act as fever inducing pyrogens, causing severe health issues leading up to mortality. Therefore, deciphering the presence of lipopolysaccharides in substances such as process water are of great interest. The Limulus Amebocyte Lysate Assay was utilized to detect endotoxin in water for injection and purified water samples. As lipopolysaccharides come in contact with amebocyte cells, a gelatinous clot will form. Amebocytes are obtained as a product of lysis from the blood of Horseshoe Crabs. In the analysis, a standard curve was developed with varying concentrations of endotoxin.

An exact volume of amebocytes were mixed in with each standard, as well as with the samples of interest. Upon an hour of incubation, a geometric mean endpoint (GME) was obtained from the standard curve, as a gelatinous clot was observed at 0.03 endotoxin units (EU) per mL. Water for injection and purified water samples tested negative for endotoxin, as no gel clots were observed.

Entry Number: 121 UL
CHARACTERIZATION OF PHENYACETALDEHYDE DEHYDROGENASE IN THE STYRENE DEGRADATION PATHWAY OF PSEUDOMONAS PUTIDA
By: Andrew Skinner and Dr. George T. Gassner
Biochemistry
Faculty Advisor: Dr. George T. Gassner
Abstract: Phenylacetaldehyde dehydrogenase (NPADH) is an integral part of the styrene degradation pathway expressed in Pseudomonas putida. A two component flavoprotein comprised of Styrene Monooxygenase

(SMO) B, a reductase, and SMOA, a styrene epoxidase, handles the first step in degradation. Their conjoined reaction is coupled to an oxidation of NADH to NAD+. This produces styrene oxide, which is converted to phenylacetaldehyde (PAL), the substrate of NPADH, by styrene oxide isomerase. NPADH, in the final step, converts PAL to phenylacetic acid while reducing NAD+ to NADH. Pyridine nucleotide exchange between the SMO complex and NPADH was measured through introduction of cytochrome c to the reaction. Previously, a 1:2 ratio of NADH oxidation:cytochrome c reduction was shown through reaction of SMOB in presence of cytochrome c. This is made possible through access of cytochrome c to reduced FAD in the active site of SMOB. Presence of SMOB in reaction of NPADH in NAD+ and PAL yielded about a 1:1 ratio of NADH oxidation:cytochrome c reduction, however. The working hypothesis asserts that the lowering of cytochrome c reduction stoichiometry is the result of an SMOB-NPADH complex for pyridine nucleotide exchange. This new complex would exclude cytochrome c from the active site of SMOB, limiting access to reduced FAD. To further understand the association of proteins that results in this observed effect a spin-label was developed for use as a molecular probe to deduce distances in this newly discovered protein complex.

Entry Number: 122 UL
PURIFICATION AND CHARACTERIZATION OF THE V-211-I MUTANT OF STYRENE MONOOXYGENASE EPOXIDASE
By: Andy Hoa Vi Vuong, Veronica K. Yuen, and Dr. George T. Gassner
Biochemistry
Faculty Advisor: Dr. George T. Gassner
Abstract: Styrene is converted to styrene oxide by styrene monooxygenase (SMO), the first enzyme in the styrene catabolic pathway of Pseudomonas putida S12. Styrene monooxygenase has two components, which are an FAD-specific styrene epoxidase, SMOA and an NADH-specific flavin reductase, SMOB. In this study, the V211I mutant of the N terminally histidine-tagged SMOA was purified by nickel affinity chromatography and a plate-reader based assay was optimized for the measurement of activity and reaction efficiency. Technical aspects of the assay optimized in this work included establishing a method for the accurate preparation and delivery of styrene to the quartz microplate, characterizing linear response range of the plate reader instrument at 245nm and 340 nm where absorbance measurements were recorded in the assay, and establishing appropriate concentrations of reductase and epoxidase components needed for accurate initial rate measurements. In this work, a highly purified sample of NSMOA-V211I mutant was purified based on assay by SDS-PAGE with a specific activity of 0.23 ± 0.01 µmole mg-1min-1. The mutant was found work efficiently with the reductase component, catalyzing the oxidation of NADH : styrene with a stoichiometry of 1.24: 1 ± 0.05.

Entry Number: 123 UL
DECLINING PH OF SABOURAUD DEXTROSE AGAR
By: Cathryna Miniz and Brian Johnson (Genentech)
Biochemistry
Faculty Advisor: Dr. Teaster Baird Jr.
Abstract: Sabouraud dextrose agar (SDA) plates, used for testing at Genentech are prepared in-house under good manufacturing procedure (GMP) conditions. Under GMP conditions, there are several qualifications for SDA plates to pass before moving on to testing such as growth promotion, which refers to bacterial growth, and a pH range of 5.6 +/- 0.2. Lately, in-house prepared SDA plates have not been passing pH testing, showing a trend of declining pH after autoclaving. To further investigate the situation several procedural factors, such as temperature, pH, and equipment used, were explored to determine why this was happening.

Entry Number: 124 UL
THE EFFECTS OF ALPHA WAVE MUSIC ON GSR, HEART RATE, RESPIRATORY RATE AND MEMORY

By: Amira Nasser, Natalie Taylor, Ingrid Barnoski, Marek Booth, and Connie Lin
Physiology
Faculty Advisor: Dr. Christine Manuguid
Abstract: Previous research has been done to see the effects alpha waves have on the physiology of adults. It is known that alpha waves are electromagnetic oscillations that range 8 to 12 Hz that arise from synchronized and coherent electrical activity of neurons. We would like to test the effects of alpha wave music on 25 adult volunteers to determine how alpha wave music affects GSR, heart rate, respiratory rate or memory.

Entry Number: 125 UL
THE EFFECT OF SLOW, FAST TEMPO MUSIC ON RECOVERY AFTER AEROBIC EXERCISE
By: Gregory Ostolaza, Margarita Belilovskaya, Debbie Li, and Nancy Wen
Physiology
Faculty Advisor: Dr. Christine Manuguid
Abstract: Music has many therapeutic properties that have the potential to modify stress response. Music is often used during exercise as a motivator, but effects of music on cardiac recovery rate post exercise remains limited. Recovery rate was recorded for five minutes from three variables: slow tempo, fast tempo, and no music after subjects reached 80% of their maximum heart rate. We found that slow tempo music had a greater effect on recovery rate than fast tempo and no music. Results will imply the therapeutic effects of music on recovery post exercise. This study found that slow tempo music was more effective than fast tempo music in slowing down heart rate. These results could be used as a standard for future therapeutic uses of music.

Entry Number: 126 UL
THE EFFECTS OF INSULIN ON DEVELOPMENTAL TIMING IN MANDUCA SEXTA
By: Marie Stitt, Louie Ramos, and Dr. Megumi Fuse
Physiology and Behavioral Biology
Faculty Advisor: Dr. Megumi Fuse
Abstract: Investigation into the control of growth and developmental timing indicates that various molecular players are involved in a complex field of endocrine control. Insulin and its related peptides in particular are highly-conserved regulators of growth and metabolism. Despite this, insulin and insulin-like-peptides (ILPs) are not yet fully described in many organisms. Recently, researchers have isolated a growth-delaying factor, Drosophila insulin-like peptide 8 (DILP8) in Drosophila melanogaster that appears to inhibit normal development, but is also released in response to damage to the imaginal disc cells. The imaginal disc cells are the progenitors of many of the adult structures, and are thus critical to the insect. They show a remarkable regenerative capacity, and it is suggested that DILP8 helps delay development as the tissues are repaired. A similar delay is seen in the lepidopteran species Manduca sexta when its imaginal discs are damaged. However, no corresponding growth-delaying peptide has been characterized in M. sexta as yet. Thus, in this study, we tested the effects of insulin on growth and development in larval M. sexta. M. sexta was injected with one of four concentrations of bovine insulin solution and its growth and pupation time was monitored. Insulin was found to decrease pupation time in a dose-dependent manner. Since arrival at a critical weight is one factor which mediates pupation in this species, this data suggests that increases in concentration of insulin have sped up weight gain and pupation. Thus, the timing of pupation in M. sexta may be controlled by insulin or insulin-like peptide by either driving feeding behaviors or altering the metabolism of ingested food. This supports the probability that M. sexta also expresses an insulin-like peptide, but that the ILP associated with delayed growth and pupation in a damaged larva is likely different in structure from insulin. Given the known sequence of DILP8, and the strong ability of other Drosophila peptides to work effectively in M. sexta, we will try similar studies using synthetically-produced DILPs on growth and development.

Entry Number: 127 UL
IRRADIATION DAMAGE CAUSES CHANGESK TO HORMONALLY CONTROLLED DEVELOPMENTAL TIMING OF TOBACCO HORN WORM, MANDUCA SEXTA
By: Mitchell Lopez and Dr. Megumi Fuse
Physiology
Faculty Advisor: Dr. Megumi Fuse
Abstract: Synchronicity of development is essential for the fitness of an organism. The developmental coordination of the hornworm,Manduca sexta is hormonally controlled via endocrine signals released tin part from the imaginal disc tissue. The imaginal tissue is composed of pluripotent cells that will develop into adult structures and thus are crucial for its survival. These signals drive metamorphosis, through stimulation of release of Prothoracicotropic hormone (PTTH) from the brain, followed by release ecdysone from the prothoracic glands. Some of the same signals, such as Insulin-like-peptides, appear to delay development when the imaginal discs are damaged, to delay the release of PTTH and ecdysone. This has been suggested to allow time for repair of the damaged tissue. The use of irradiation is a non-invasive method of studying the changes in development caused by damaged imaginal disc tissues that does not involve genetic alterations. Other studies have used genetic methods that altered the development of the imaginal discs, though it is unclear what other effects these genes may have. The current study will utilize X-ray radiation to selectively damage the imaginal discs and measure the delays in development. Because other developmental events, such as tanning and wing/body expansion are hormonally regulated, we will measure the rate of tanning in the pupal stage to determine if tanning hormones are being affected by the imaginal disc damage. We will measure three morphological parameters: (i) appearance of pupal T-bar (specific tanned region of the thorax) prior to pupal ecdysis, (ii) rate of full cuticle tanning after ecdysis, and (iii) rate of proboscis, wing and body elongation after ecdysis. This study will provide appropriate time points, and will suggest other hormones being affected by the tissue damage, for properly studying the roles of signals released by the imaginal tissues on the endocrine system. Overall, we can investigate how damage to critical organs can cause delays in development. Such delays are analogous to damage/disorders to ovaries, testes, pituitary or hypothalamus that may interfere with the release of hormones that signal organs to develop.

Entry Number: 128 UL
GENDER-SPECIFIC ANALYSIS OF BEHAVIOR REVEALS A UNIQUE PHENOTYPE IN FEMALE MICE WHEN TESTED IN AN OPEN FIELD
By: Pingdewinde N. Sam, Dr. Linda J. Noble-Haeusslein, and Sandra Canchola
Physiology
Faculty Advisor: Dr. Frank Bayliss and Dr. Linda J. Noble-Haeusslein
Abstract: As mice are commonly used for modeling human diseases, it is important to understand baseline behavior that may be in part determined by gender. The objective of this research was to determine the behavioral phenotype of male and female mice when exposed to the novel environment of an open field. We hypothesized that repeat exposure to this novel environment would result in gender specific changes in activity and anxiety. To test this hypothesis, C57Bl6 males (n=8) and females (n= 8) were each positioned in the center of an open field that relies on laser beams to track movement for a period of 10 minutes. This process was then repeated on 2 additional days, each separated by one day; data were then evaluated on each of these three days, representing Session 1, Session 2 and Session 3. A number of parameters were evaluated including total distance moved, total rest time, preference for the center, preference for the periphery, and total times that each animal reared. Both genders showed increased distance traveled and rest time by Session 2 and these changes were maintained by Session 3. In contrast to these time dependent changes across genders, time spent in the periphery remained unchanged in both groups over time and there was a preference in both genders for the periphery versus the center of the open field. Finally, there was a unique difference between genders in the context of time spent in the center. Female mice spent less time in the center of the field than male mice and this distinction was evident in all 3 sessions. Together, our findings demonstrate that while each gender showed a pattern of increased activity per session, suggesting accommodation to this novel environment, females displayed a unique signature, namely, they spent less time in the center of the field than males. In general,

rodents, exposed to a novel environment, typically show an initial preference for the periphery versus the center of the field. This preference is thought to be indicative of anxiety, which is then resolved as animals become familiar with the environment. That females showed less preference for the center than males, suggests a higher level of anxiety that is not resolved with repeat exposure to the same environment. Such a finding emphasizes the importance of gender when considering studies that address anxiety-related behavior in rodent models of neurological diseases.

Entry Number: 129 UL

PHYLOGEOGRAPHY OF A DIRECT-DEVELOPING SEASTAR IN RELATION TO THE SAN FRANCISCO BAY OUTFLOW

By: Riley Smith and Dr. C. Sarah Cohen

Ecology

Faculty Advisor: Dr. C. Sarah Cohen

Abstract: Small six-rayed sea stars, Leptasterias spp., form a cryptic species complex commonly found in the rocky intertidal zone from Alaska to southern California. While many sea star species have a planktonic larval stage, Leptasterias spp. brood their larvae and after direct development, the young crawl away. Limited dispersal may lead to establishment of semi-isolated populations where local differentiation or adaptation to local conditions may occur. In addition, marine populations adjacent to anthropogenic effluent may show altered genetic diversity. To gain insight into the population structure of central California Leptasterias spp., at 9 sites, we compare population genetic variation to local environmental features, specifically terrestrial water flow conditions from the San Francisco Bay, a large fresh water source where reduced salinities, warmer temperatures, anthropogenic pressures, and oceanic conditions mix. Using fragmented sequences of the highly variable mitochondrial control region from 210 individual Leptasterias spp., we found that local populations at sites closest to San Francisco Bay effluents have lower diversity and distinct clade distributions. In contrast, there is a lack of genetic distinction between populations further north and south of the San Francisco Bay outflow. Local environmental features of San Francisco Bay outflow appear to shape opportunities for differentiation among central California Leptasterias populations with restricted dispersal.

Entry Number: 130 UP

DETERMINING THE ROLE(S) OF PRIME-SIDE RESIDUES INMACROMOLECULAR INHIBITION OF TRYPSIN-FOLD SERINE PROTEASES

By: Commodore St Germain and Dr. Teaster Baird Jr.

Biochemistry

Faculty Advisor: Dr. Teaster Baird Jr.

Abstract: Trypsin-fold serine proteases are among the most abundant of allproteases. By identifying residues that are important for enzyme-inhibitor interaction in trypsin, we may advance the development of protease-based therapies in general. Lysine-60 (K60) is a highly conserved prime-side residue that may play many roles in trypsin. In co-crystals, K60 hydrogen bonds to tyrosine-39 (Y39) and is positioned to restrict conformational mobility of phenylalanine-41 (F41), possibly limiting the observed hydrogen bond interactions between those residues and macromolecular inhibitors. Substitution of K60 with other amino acid residues may disrupt these interactions and provide insight to their significance with respect to inhibitor binding. To test this hypothesis, we created trypsin variants K60G, K60A, K60V, K60I, and K60R and characterized them with respect to their activities and sensitivities to the macromolecular inhibitors soybean trypsin inhibitor (SBTI) and bovine pancreatic trypsin inhibitor (BPTI). Our initial results show that, compared to wild-type trypsin, K60A and K60V are catalytically indistinguishable, more resistant to autolysis and more sensitive to inhibition by SBTI and BPTI. Further experiments with ecotin and other trypsin variants can provide additional insight on specific interactions.

Entry Number: 131 UP
THE ELEMENT EFFECT IN NUCLEOPHILIC AROMATIC SUBSTITUTION REACTIONS OF PYRIDINIUMS
By: Jeannette Bowler and Dr. Weiming Wu
Biochemistry
Faculty Advisor: Dr. Weiming Wu
Abstract: The "element effect" in nucleophilic aromatic substitution reactions (SNAr) is characterized by the leaving group order, F > NO2 > Cl ≈ Br > I, in activated aryl halides. However, a different effect is observed in the substitution reactions of pyridinium compounds with piperidine (CN > F ≈ Cl ≈ Br ≈ I). Results from computational studies of the reactions are inconsistent with the observed kinetics. Further examination of the kinetic parameters of the reactions indicates the reaction mechanism of the chloro derivative may be different from those of the other derivatives

Entry Number: 132 UP
CHARACTERIZATION OF IRON NANOPARTICLES BY STEREOSCOPIC SURFACE AREA MEASUREMENT
By: Sunha Yoon, Dr. Bruce Manning, and Dr. David Sklar
Biochemistry
Faculty Advisor: Dr. Bruce Manning and Dr. David Sklar
Abstract: It is well known that Fe(0) nanoparticles are extremely reactive toward dissolved contaminants such as metals and organics and thus are effective environmental remediation materials. However, quantitative determination of the production of new reactive Fe oxide surface and the specific surface area of this material is not well understood. In this project we investigate the measurement of specific surface area of zerovalent iron (Fe(0)) nanoparticles and their oxidation products using a stereoscopic 3D analysis of scanning electron microscope images. 2D SEM images were imported into MATLAB software and converted to 3D images using algorithms that obtain transitions in image brightness and that calculate surface area of the stereo-pair image by using vector-based analysis. Simple images of known shaped/sized particles such as iron oxide-coated polymeric beads were first analyzed to calibrate the method and test for accuracy. More complex images of Fe(0) nanoparticles and their complex corrosion products were then analyzed with the method. We also employed X-ray diffraction (XRD) patterns of Fe(0) and oxidized Fe(0) to determine the crystallography of the oxidation products and to gauge the extent of Fe(0) oxidation. A morphology index model was developed using XRD peak intensities that showed a relationship between the extent of Fe(0) particle oxidation and surface area calculated by SEM stereopair image analysis. The results suggest that the oxidation of Fe(0) nanoparticles produces a large amount of new reactive surface for uptake and reaction with dissolved contaminants.

Entry Number: 133 UP
DETERMINATION OF TRACE METALS IN LUBRICATING OIL MATRICES VIA X-RAY FLUORESCENCE
By: David Guinea
Chemistry
Faculty Advisor: Dr. Peter Palmer
Abstract: The analysis of trace metals (i.e., V, Cr, Mn, Fe, Ni, Cu) in lubricating oils is of growing importance to evaluate engine wear and performance. Most often, this is achieved via Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) due to its low detection limits and ability to perform multi-elemental analysis. However, this method requires significant sample preparation (including acidification, ashing, and dissolution), which is time consuming, labor-intensive, and can lead to erroneous results through the loss of metals during this process. This research involved the development of a X-Ray Fluorescence (XRF) based method for this application. Samples were analyzed "as is" with no sample preparation using 2-minute acquisition times. Authentic standards of the elements of interest were prepared in an oil matrix and used to

generate calibration curves and compute concentrations of each element in the samples. This new method gave calibration curves which were linear from 1-500 ppm and results that in general agreed very well with those from ICP-AES. This method is deemed to be a much faster, easier, and analytically viable method for this and related applications.

Entry Number: 134 UP

STOICHIOMETRY OF REMINERALIZATION PROCESSES IN METHANOGENIC CONTINENTAL MARINE SEDIMENTS

By: Abraham King Cada, Huan Lei Li, Adrian Gerretson, David Burdige, and Dr. Tomoko Komada
Chemistry
Faculty Advisor: Dr. Tomoko Komada

Abstract: The purpose of this study is to look at the pore water sulfate, methane, dissolved inorganic carbon (DIC), and ammonium profiles to understand the stoichiometry of remineralization in anoxic sediments. We use these parameters to establish a property-property plot to yield rC:S values for the stoichiometric ratio of tightly coupled DIC production to sulfate reduction. Neglecting any possible carbonate precipitation or dissolution we expect an rC:S value of 2. However, in many coastal and continental margin sediments, property-property plots yield values of rC:S values of <2. We investigate the factors that can cause this deviation in rC:S values based on pore-water property-property plots. We will examine the results of our recent studies in the Santa Barbara Basin sediments and compare these results with Santa Monica Basin sediments to offer an explanation and possible differences in these sites that can cause such deviations of rC:S stoichiometric ratio.

Entry Number: 135 UP

COMPLETING THE STRUCTURE OF XANTHINE OXIDASE

By: Eric Anderson and Dr. Sergio Aragon
Chemistry
Faculty Advisor: Dr. Sergio Aragon

Abstract: Xanthine Dehydrogenase is a large dimeric structure of 298 kDa molecular weight whose structure was partially determined by x-ray crystallography (1FO4). Sixty six residues (out of 2664) which form flexible loops on the surface of the protein were not localized by crystallography yielding a significantly incomplete structure. To complete the structure, we added all the missing residues using the program Modeller. The resulting structure was tested by comparing the experimental translational and rotational diffusion coefficients with that accurately computed from our completed structure using the hydrodynamic program BEST. The experimental and computed diffusion coefficients differ by 6.4% for translation and 14 % for rotation. We hypothesize that the difference can be accounted for the incomplete folding of the flexible loops added with Modeller. The hypothesis will be tested by performing molecular dynamics (MD) simulations in explicit water using the AMBER suite of programs. To achieve this challenging task, we have to model metal containing residues in the protein, including four iron sulfur complexes, and two molybdenum oxygen sulfur complexes, along with several small organic molecules intercalated in the structure. MD parameters for the organic intercalators were obtained using semi-empirical quantum chemistry methods and the gaff force field. To deal with the metal complexes we constructed simplified models whose structure was computed with Gaussian 09, using Density Functional Theory and a LanL2D basis set. Since MD parameters for the metals do not exist, we will attempt to fix their positions in an effort to model the exterior flexible loops without perturbing the interior of the large protein.

Entry Number: 136 UP
DETERMINATION OF NICOTINE IN ELECTRONIC CIGARETTE FORMULATIONS WITH SOLID PHASE MICROEXTRACTION AND LIQUID EXTRACTION GC/MS
By: Marissa Martinez and Kaleb Asfaha
Chemistry
Faculty Advisor: Dr. Peter Palmer
Abstract: Although the FDA has regulatory oversight over electronic cigarettes, they have yet to develop official analytical methods for monitoring the composition of the formulations used in products. The primary goal of this research was to develop, evaluate, and apply two different GC/MS methods for monitoring nicotine levels in electronic cigarette (e-cig) formulations. These two methods were based on different sample preparation procedures, including direct injection of the liquid formulation and Solid Phase Microextraction (SPME). Both methods involved the use of an autosampler for unattended operation and higher throughput, and the use of an internal standard to provide more precise and accurate quantification. The direct injection method avoids liquid-liquid-based extraction, involves dilution of the sample in chloroform, and provides detection limits on the order of 10 ppm. The SPME technique is simpler and more direct, involves direct sampling of the gaseous headspace, and provides detection limits on the order of 10 ppm. This presentation will describe the details of each method, a critical evaluation of their analytical figures of merit, and their application to monitoring nicotine levels in several commercial e-cig formulations. These methods can be used to ensure nicotine levels in these products meet specifications and may also be used to identify potential contaminants and flavor components in these formulations.

Entry Number: 137 UP
OPTICAL TWEEZERS AS A METHOD OF BACTERIA MANIPULATION
By: Drew Bischel
Astrophysics
Faculty Advisors: Dr. Zhigang Chen and Dr. Anna Bezryadina
Abstract: We are using dynamic optical traps to move, rotate and sort out bacteria such as Bacillus thuringiensis, Micrococcus luteus and mutant Sinorhizobium meliloti. Trapping and sorting rod-shaped bacteria (Bacillus) from sphere-shaped bacteria (Micrococcus) can have important implications in the study of more dangerous rod-shaped bacteria such as Bacillus anthracis (causes anthrax). Development of methods for manipulating mutant Sinorhizobium meliloti, which has multiple appendages and chains, will aid in the study of intermolecular forces and transportation of bacteria through media. We are using a holographic optical tweezer apparatus that allows us to create multiple custom beam profiles that can be made to manipulate one particular strain out of a group of bacteria. This enables us to sort, move and study specific bacteria within a mixed culture.

Entry Number: 138 UP
IMPLICATIONS OF QUANTUM-MECHANICAL CALCULATIONS OF THE BINDING ENERGIES BETWEEN HEAVY METALS AND THE HUMAN APE1 FOR DNA REPAIR INHIBITION
By: Timothy Gushue and Dr. Anton B. Guliaev
Physics
Faculty Advisor: Dr. Anton B. Guliaev
Abstract: It has been demonstrated that heavy metals such as lead, cadmium, and iron can inhibit the activity of the human apurinic/apyrimidinic (AP) endonuclease 1 (Ape1). It has been proposed that these metals can occupy the magnesium binding sites in Ape1, and a change in coordination chemistry or ligand preferences, interferes with the magnesium-dependent catalysis. In this work magnesium, nickel and iron have been tested within Ape1 to evaluate the binding affinity between the metal and enzyme. Magnesium is the naturally-occurring metal in the active site while nickel and iron are not. The preliminary data indicate no significant conformational change in the active site upon substitution of magnesium with nickel or iron. The data do show

the binding energies for the three metals are correlated to the observed protein inhibition and a preference in the enzyme for iron over magnesium.

Entry Number: 139 UP
ACCOUNTING FOR BLACK CARBON IN CLIMATE INVENTORIES: A CALIFORNIA CASE STUDY
By: Ryan Ford and Sarah Rizk
Geology
Faculty Advisor: Dr. Dave Dempsey
Abstract: Climate inventories generally focus solely on greenhouse gas emissions; here we present an inventory which includes other significant climate forcers such as black carbon (BC) and sulfur oxides (SOx). Black carbon is a short lived climate forcer which absorbs all wavelengths of radiation present in the troposphere and despite co-emissions produced with BC that may have a cooling effect, total BC emissions provide a net warming in the climate system. We find that black carbon contributes significantly to warming in California compared to an inventory without black carbon, with total black carbon and organic carbon emissions amplifying warming by 1.42 – 1.73 times on a 20 year time horizon, or 1.24 – 1.42 times on a 100 year time horizon. Previous studies have suggested the evaluation of net forcing by sectors on a global scale to further develop smart climate policy through easily identified mitigation opportunities. This study follows the recommended approach and provides the net forcing by sector for the state of California in 2010 based on equivalency values rather than complex air quality modeling. The approach outlined here can be easily replicated to incorporate BC and SOx into existing GHG programs.

Entry Number: 140 UP
MITIGATING URBAN CLIMATE CHANGE: OBSERVING CARBON, WATER AND HEAT EXCHANGES BETWEEN A LIVING ROOF AND THE ATOMSPHERE
By: Ryan Thorp
Meteorology Atmospheric Sciences
Faculty Advisor: Dr. Andrew Oliphant
Abstract: On May 3, 2013, Dr. Andrew Oliphant and Ryan Thorp deployed a system of micrometeorological instruments on top of the green “living” roof of the California Academy of Sciences. Data will be collected over one month to determine the ability of the roof to sequester carbon from the atmosphere and curb the urban heat island effect. The project utilizes the eddy covariance method to measure nearly instantaneous exchanges of carbon, water vapor and sensible heat between the green roof and the boundary level of the atmosphere.

Entry Number: 141 UP
FORAMINIFERAL MG/CA RATIO AS A PALEOCLIMATE PROXY: IS IT THAT SIMPLE?
By: Rocio Briseno
Earth Sciences
Faculty Advisor: Dr. Petra Dekens
Abstract: Paleoclimatolgy is the study of Earth’s past climate. Scientists can reconstruct climate features such as sea surface temperature (SST), productivity, precipitation patterns, ice volume, ocean salinity, etc by using proxies preserved in deep sea sediments. Foraminifera (forams) are ocean dwelling protists that make shells out of calcium carbonate ($CaCO3$). When the temperature of the water that they are living in is warmer, $Mg2+$ can replace $Ca2+$. When forams die a very small percentage of the shells settle at the bottom of the ocean, where we can collect them through ocean drilling and analyze their shell composition. The ratio of Mg to Ca (Mg/Ca)can be correlated to temperature using calibrations developed through culturing and core top studies. Until now, it was believed that the Mg/Ca signal was primarily controlled by temperature. After conducting a literature review of six articles, I found that this is no longer clear. Although culturing work indicates that salinity has

very little affect on the Mg/Ca SST proxy, two core top studies indicate that salinity may in fact affect Mg/Ca of foraminifera enough that it makes it less reliable as a SST proxy. If salinity does in fact have an influence over the foraminiferal Mg/Ca ratios, this will have to be accounted for or we risk making inaccurate estimates of SST, affecting our understanding of how our climate system works.

Entry Number: 142 UP
KNOTS IN THE CUBIC LATTICE: A MULTIPLE MARKOV CHAIN APPROACH
By: Robert Stolz
Applied Mathematics
Faculty Advisor: Dr. Mariel Vazquez
Abstract: This research is relevant to both mathematics and biological science. Our long-term goal is to understand the topological mechanism of site-specific recombination in Escherichia coli, and its relevance during cell division. In particular we are interested in the process of DNA unlinking mediated by the XerCD-FtsK complex in the absence of type II topoisomerases. Type II topoisomerases are essential enzymes, and are therefore the target for a major class of antibiotic and cancer drugs. To what extent can recombinases rescue the process of cell division when topoisomerases are inactive? Understanding this question has important biological consequences. Furthermore, the tools developed for this purpose have the potential to make novel contributions to the field of computational Knot Theory and low-dimensional topology. In my project, I will focus on determining the likelihoods, and therefore the biological relevance, of different DNA unlinking recombination pathways. The primary mathematical tool for examining the likelihoods of the different recombination pathways emerging is an algorithm that uses a Multiple Markov Chain (MMC) approach to modify a group of DNA conformations, switching parameters between conformations when appropriate to improve efficiency. Designing and Implementing an efficient, expansible, and functional version of this algorithm is the major goal of my research. This research and the software I have developed to do it will also create a means to investigate many potential follow up questions in the area of DNA Topology.

Entry Number: 143 UP
EAT YOUR VEGGIES AND USE YOUR MANIPULATIVES
By: Kyra Redenbaugh
Teaching Mathematics
Faculty Advisor: Dr. Lawrence Horvath
Abstract: A case study determining the effects of choosing mathematical tools for children in order for them to get used to relying on constructive resources rather than tools that offer an easy way out. Project was done with a partnership with CSME and NSF through the Noyce Scholars Program and conducted over 4 months at a public 5th & 6th grade classroom within SFUSD. (a ppt slide can be sent of the poster)

Entry Number: 144 UP
CAN MATHEMATICS BE AN OBSTACLE TO PERFORMANCE IN MATHEMATICS
By: Miguel Hungerford
Teaching Mathematics
Faculty Advisors: Jamie Chan and Dr. Lawrence Horvath
Abstract: In this study, I wanted to see if learning mathematics posed as an obstacle to student performance. I was most interested in the performance difference between students who only speak English and those who are bilingual. I am interested in this difference because I view mathematics as a language and I understand the difficulty that I had with becoming fluent in it. As a future teacher, I want to know as best I can: What benefits or challenges do bilingual students have when asked to write about their understanding of mathematical concepts? Do native English speakers display a higher ability to communicate their understanding of

mathematical concepts in an English speaking classroom? What could be the reasons for either group's performance?

Entry Number: 145 UP
OFF GRID WISEPILL CHARGING SYSTEM
By: Morgan W. Hanssler, Stephen D. Kruger, and Luis A. Arroyo
Electrical and Civil Engineering
Faculty Advisors: Dr. Hao Jiang and Dr. Barry Levine
Abstract: An off-grid batter charging device capable of delivering 220mA @ 5volts.Developed as part of an humanitarian mission to track the effectiveness of AIDS medication in the African Nation of Uganda. Due to limited access to reliable grid power in this country the tracking device known as the Wisepill, requires battery periodic recharging. Our charger solution was built specifically for providing the maximum amount of power possible to quickly and efficiently charge the device's battery in minimal time.

Entry Number: 146 UP
FPGA BASED AUDIO VISUALIZATION
By: Benjamin Fitzgerald, Luke Moselle, and Justin Poole
Electrical and Computer Engineering
Faculty Advisor: Dr. Hamid Shahnasser and Dr. Tom Holton
Abstract: This is a design report for a system that performs real time audio visualizations. The input to the system is analog and of the sound variety. The output of the system will be a stream of pixels, possessing both color and movement through time, which expresses the sound being heard. All digital signal processing will be done on an FPGA. This type of device provides the programatically utmost control through the entirety of the system's data path. The system will be of a streaming based architecture, with a focus on achieving the device's maximum throughput, due to the real-time nature of the envisioned project. The goal is to start down a path where music can be expressed visually in a completely dynamic fashion through a system designed and constructed specifically for this purpose.

Entry Number: 147 UP
HOME AUTOMATION SYSTEM WITH WEBAPP & MOBILE CONTROL
By: David Littrell, Felipe Mendoza, Daniel Alano, and Dr. Hamid Shahnasser
Electrical and Computer Engineering
Faculty Advisor: Dr. Hamid Shahnasser
Abstract: A mobile-based home automation system advances existing home configurations to the mobile age. A wireless control system allows the user to activate their lighting, heating & cooling systems, as well as other home appliances without having to be physically present at the traditional wall switch. Most wireless controls systems require multiple control devices which can be inconvenient. Consolidating these controls into a single mobile device grants the user the ability to control the system from anywhere in or out of the home.

Entry Number: 148 UP
SMART BRIGHTNESS CONTROL SYSTEM
By: Kang J. Bai, Shaker Alsidran, and Dongmei Meng
Electrical and Computer Engineering
Faculty Advisor: Dr. Hamid Shahnasser
Abstract: As energy crisis becomes the worldwide issue nowadays, saving energy draws great attention to people. Under this condition, the project, Smart Brightness Control System, is aiming to save energy. The design is to supply comfortable brightness automatically based on the ambient lighting condition. Meanwhile, a

renewable resource, such as solar energy, will be used as primary energy source to supple power to the control system in order to reduce the power consumption.

Entry Number: 149 UP
iFISH: BIOMIMETIC ROBOTIC FISH
By: Resyl Joy Bejasa and Mikias Ayalew
Electrical and Computer Engineering
Faculty Advisor: Dr. Hamid Shahnasser
Abstract: This project aims to design and build the iFish, a biomimetic robotic fish with a wireless radio-controlled mechanical system. The implementation of the mechanical system includes three modes of motion in which the iFish will have the ability to move forward, turn right and turn left with oscillatory propulsion of the mechanical caudal fin. The iFish will be constructed with a buoyant material, so that it will float and remain still under constant conditions. The control system consists of a transmitter and receiver, which is responsible for processing the signal that will control and power the servomotors. The robotic fish will be wrapped with a waterproof casing to protect the internal circuitry and its mechanical parts. A portion of the body of the iFish will be accessible after the final construction to replace the battery. The user will be able to control the iFish's movement by the use of an external remote control. The final design will attempt to mimic the movement and appearance of a real model of fish.

Entry Number: 150 UP
AN EFFICIENT WIRELESS POWER TRANSFER SYSTEM USING COHERENT RF COILS ARRAY FOR BIOMEDICAL IMPLANTS
By: Yilu Ning and Julie Trias
Electrical and Computer Engineering
Faculty Advisors: Dr. Hao Jiang and Dr. Hamid Shahnasser
Abstract: Implantable sensors are the future of medical technology. They are used across various medical disciplines and they lower health care costs. This project provides a preliminary design process for optimizing the wireless power transfer system using coherent RF coil pairs, which has significant advantages over single coil systems. The project goal is to 1.) Set up a design prototype for AC magnetic field generation of two transmitting coils by using the concept of Class E Amplifier ; 2.) Design a digital feedback system for phase correlation to increase output efficiency. The project is implemented using power mosfet technology and multiprocessing Raspberry Pi micro-controller. The system goal is successfully achieved by having low power input to drive a large current load with enhanced efficiency. Detailed design procedures and results are demonstrated in the poster.

Entry Number: 151 UP
SPOKENLIGHTS
By: James Martin
Computer Science
Faculty Advisor: Dr. William Hsu
Abstract: Spokenlights is a two part system. The first part is a desktop graphical user interface that allows for the user to either create their own images using predefined tools in the application, or to simply insert an image. These images can be saved as a playlist or as single images. These images then can be stored on a micro sd card for use in the Spokenlights hardware. The second part of this project is the hardware that reads the images or playlists that were created by the desktop application. These images or playlists are read by the hardware and displayed using persistence of vision. The hardware consists of a micro-controller and two arrays of LED's all of which mounts inside the wheel of a bicycle. As the wheel turns, the LED's light up at the correct time to give

the effect of a coherent image. This project is a hardware/software interface built with Java for the desktop application, and Arduino for the hardware micro-processor.

Entry Number: 152 UP
REACTION TIME
By: Jason Solnit
Computer Science
Faculty Advisor: Dr. William Hsu
Abstract: Reaction Time is an application designed to provide users with the opportunity to explore and experiment with various algorithms which produce an assortment of graphical patterns. Specifically, the algorithms are all members of the reaction-diffusion class of mathematical models, including the Gray-Scott and Fitzhugh-Nagumo models. Each of these algorithms is slightly different in the underlying mechanisms which allow them to produce unique pattern styles, but they are similar enough overall to behave in much the same way for the purposes of this project. Reaction Time offers users the opportunity to select any of the algorithms mentioned, and then adjust the initial conditions under which the algorithm is run. Specifically, the user has algorithm specific UI controls in the form of simple text fields and buttons to adjust the input parameters of each selected reaction type, make color adjustments from a range of color options, or adjust the resolution of a given algorithm. Furthermore, users can load image files or capture images with their computer's camera to provide a basis for guided reactions whose diffusion patterns follow the contours of the provided image, producing a new but recognizable image out of the reaction visualization. Reaction Time even provides the user with a simple painting interface whereby it is possible to create shapes, lines and patterns instantly to serve as constraints for the reaction, the way the user imported images and photos do. Given that the toolset provided in Reaction Time allows for a wide variety of different patterns and user generated designs to be created, the program also provides users with simple and effective controls for capturing short videos of their reactions as they occur and saving the results to a file. Similarly, Reaction Time can take snapshots of a reaction at any time while it is running and then save it as an image file.

Entry Number: 153 UP
UNIVERSAL TOUCH GAME CONTROLLER
By: Shane Hollon
Computer Science
Faculty Advisor: Dr. William Hsu
Abstract: The project is an Android (touch) based wireless game controller system. The application uses multiple built in controller configurations, based on existing popular game controllers. It allows for customizable keystrokes to be sent to the operating system, which is running the server component. The desktop server application receives all the android communications on the local network. The server is Java based and built to be cross-platform compatible. The controller can be configured to work with a multitude of video games, game system emulators, and other applications. Additionally, the Android app has the ability to control the mouse and keyboard on the server by translating touch input into corresponding mouse movements and clicks, as well as allowing the virtual Android keyboard to type as the desktop keyboard would.

Entry Number: 154 D
SPOKENLIGHTS ANDROID MOBILE APPLICATION
By: James Martin and Shane Hollon
Computer Science
Faculty Advisor: Dr. William Hsu
Abstract: Spokenlights Android Mobile Application is a two part system. The first part is a an Android based mobile application. This application allows the user to create a playlist from images stored in their phone's

gallery, or to download images from flickr, and send them to the Spokenlights hardware on the fly. The flickr images are queried using geolocation from the mobile device's gps coordinates, and then pulls images based off of the query that the user entered. The Android device then prepares the data and sends it through bluetooth to the Spokenlights hardware as well as displays the current image on the screen of the device. The second part of this project is the hardware that reads the images or playlists that were sent by the Android mobile application. The firmware on the Spokenlights wheel was re-written to allow for bluetooth connectivity and a bluetooth module was added. Once successfully received the images or playlists then are displayed by using persistence of vision. The hardware consists of a micro-controller and two arrays of LED's all of which mounts inside the wheel of a bicycle. As the wheel turns, the LED's light up at the correct time to give the effect of a coherent image. This project is a hardware/software interface built with Java for Android , and Arduino with bluetooth for the hardware.

Entry Number: 155 UP
SPEVI
By: Akira C. Zamudio, Kristine F. Inocencio, Mohammad Ahsan Uddin, and Shamal S. Lal
Electrical Engineering
Faculty Advisor: Dr. Hamid Shahnasser
Abstract: The purpose of this final project is to design a portable ETA (electronic travel aid) aimed in helping the visually impaired through sound and radio frequency identification, which is driven by solar energy. By using RFID communication, the user is able to orient themselves around the San Francisco State University campus through data converted into audio-feedback. The apparatus contains a backpack that holds the RFID receiver, rechargeable battery pack, and 3.5mm headphones connected to an Arduino microcontroller. Another component implemented in the design are the solar powered RFID transmitters located on posts along the SFSU pathways; this device will also carry a rechargeable battery pack and its own microcontroller. A major requirement in the final design is the apparatuses ability to communicate hassle-free with low future maintenance costs. Project SPEVi will assist the visually impaired with a relatively affordable ETA through the navigation of sound and RFID technology.

Entry Number: 156 UP
POWER CONVERTER FOR BIOMEDICAL ENERGY HARVESTING
By: Ben LaRiviere
Electrical Engineering
Faculty Advisor: Dr. Hao Jiang
Abstract: Conversion of milliwatts of electric power harvested using small coils at a few centimeters from a source is investigated with the goal of providing an efficient source of direct current power to implanted medical devices. Circuit topology and control were analyzed for an approach utilizing a transmitted power frequency between 100 Hz and 200 Hz, and an efficient device is proposed.

Entry Number: 157 UP
PORTABLE ELECTROCARDIOGRAM WITH ANDROID OS INTEGRATION VIA BLUETOOTH
By: Jamie Lyn Olidan Nonog, Avinash Gokuldas Pai, and Leif-Ian Mendoza Quismorio
Electrical Engineering
Faculty Advisor: Dr. Hamid Shahnasser
Abstract: This report covers all topics concerning the design of a portable Electrocardiogram (ECG or EKG) machine with Android OS integration via Bluetooth. Topics covered include raw signal acquisition, signal conditioning (amplification and filtering), design of analog front-end, and programming of the Android application and microcontroller.

Entry Number: 158 UP
SINGLE DEGREE-OF-FREEDOM HAPTIC KNOB INTERFACE
By: Marcella Ramirez and Andrew Fouts
Mechanical and Electrical Engineering
Faculty Advisor: Dr. Ozkan Celik and Dr. Hamid Shahnasser
Abstract: A haptic interface is one that takes input from, and provides a user with feedback through, touch-sensory information. Research has been done to realize this type of device in varying degrees of complexity. No matter the complexity of the physical system, however, all haptic interfaces are limited by the accuracy with which they are able to estimate velocity. This project aims to aid in implementing an improved velocity estimation system by designing a single degree-of-freedom (DOF) haptic interface that provides measurements of both position, and acceleration. Possible future applications will be research in velocity estimation, utilizing measurements of both position and acceleration. Such an algorithm could then be altered and applied to more complex, commercial systems where an improvement in velocity estimation would be beneficial, such as in remote surgical applications.

Entry Number: 159 UP
ONLINE ACADEMIC PLANNER FOR SCHOOL OF ENGINEERING
By: Yingluan Tan
Computer Engineering
Faculty Advisors: Dr. Hamid Mahmoodi and Dr. Hamid Shahnasser
Abstract: This project is a digitized and enhanced version of the student planning worksheet that the school of engineering uses to keep track of student's academic progress. The main goal of this project is to make the process of tracking academic progress and student advising easier and more efficient. This Online Academic Planner is designed so that it's very convenient to access and use—only requires a web browser, internet access, and an SFSU account. Access is also tiered for enhanced security based on the logged in account.

Entry Number: 160 UP
SMART DOG COLLAR
By: Henry Liu, Cheryl Quan, and Gaurav Sharma
Mechanical, Electrical, and Computer Engineering
Faculty Advisor: Dr. Hamid Shahnasser
Abstract: GPS enabled dog collar with user interaction and an RFID enabled automatic dog door. The purpose of the project is to construct a low cost GPS dog collar and a low cost electronic dog door that work together to provide pet owners with valuable information about their pets while they are away from home. The purpose of the dog collar is to allow the dog the freedom to roam around the home and outside of the house in the backyard without having the owner worry about the pet escaping and getting lost. Using the embedded GPS and GSM module, the pet owner can locate the dog by calling the number associated to the dog collar, which acts as a request for the location of the collar.

Entry Number: 161 UP
MOTION CONTROLLED ROBOTIC ARM
By: Martin Ngo, Kevin Dayacap, and Christopher Sampayan
Mechanical and Computer Engineering
Faculty Advisor: Dr. Hamid Shahnasser
Abstract: The motion controlled robotic arm features a 7 Degree of Freedom arm which can be controlled using a Microsoft Kinect camera. The arm includes a hand, forearm, elbow, and bicep. Using a series of Arduino microcontrollers and sensors, the Kinect can read the user's own arm movements and send data to manipulate the mechanical arm to perform the same motion. The purpose of this project is to demonstrate the use of the Kinect, aiming to achieve accurate resolution in movements in order to benefit those who require a safe distance to perform otherwise dangerous tasks.

Entry Number: 162 UP
R.O.C.EM
By: Erik Brandt, Hung Quan, and Michael Curry
Mechanical and Electrical Engineering
Faculty Advisor: Dr. George Anwar
Abstract: ROCEM or Robot Organized Competition Electronic Match (we're great at naming things) was developed as a final project for engineering 478; this project was intend to be a hello world style project into the field of robotics, featuring both custom made software and hardware. On a fundamental level ROCEM is a complete revamp of the old Rock'em Sock'em Robots game first developed in the 1960's; by taking the users movements we hope to immerse the user in the game as they become the controller.

Entry Number: 163 UP
BARBOT 2013
By: Melissa Saucedo, Alex Mauger, Felicia Escalona, and Christopher Lim
Mechanical and Electrical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: Barbot 2013 is an interactive robot designed to not only mix different drinks but cool them to a refreshing temperature and serve them. Using the pushbuttons and the LCD the user can easily order the drink they want and watch it dispense in a visually appealing fashion. The drinks can be made from one or more of the four different liquids and can be cooled from room temperature to less than 3ºC.

Entry Number: 164 UP
HUMAN POWERED MECHANICAL EXOSKELETON SUIT: THE EXOTRON 8400
By: Noah Beltran, Vikram Mehta, Lawrence Olson, and Daniel Kim
Mechanical and Electrical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: All over the world people use machinery to assist in making an endless amount of everyday tasks easier to perform. Machinery has allowed humanity to achieve many accomplishments, but they are seriously limited by their; difficulty to transport, complexity to operate, intricacy of repairs and cost to own. Accordingly, there is a need to create an alternative to machinery, and the human powered mechanical exoskeleton suit shows great promise. The objective of our design project was to conceive an exoskeleton suit, so that any person could perform tasks that would otherwise require the assistance of special machinery. This semester our project team has developed an exoskeleton suit, using solid modeling software, we designed an elaborate arrangement of pantographs, a mechanical linkage, to give the human body a mechanical and physical advantage. The suit is a tool anybody can use, repair and afford; making it a great alternative to specialized machinery. In the future, we

would hope to develop our design by adding an electrical power source, using lighter aluminum alloys for the frame and improving hand-tooling attachments.

Entry Number: 165 UP
SEGBOT (INVERTED PENDULUM ROBOT)
By: Alexander Mauger and Ringo Fung
Mechanical Engineering
Faculty Advisors: Dr. Mehran Mehrandezh and Dr. Ozkan Celik
Abstract: We've constructed a robot that will balance itself on two wheels. It is controlled my an Arduino microcontroller, and uses an accelerometer and gyroscope to determine its orientation. There are encoders in each motor that will determine how far it's travelled so that it can return to its original position. I will program multiple different control algorithms of varying complexity and analyze their performance.

Entry Number: 166 UP
BIKERS
By: Andrew Fouts and Jordan Hester
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: The purpose of the BiKERS is to capture the energy lost when braking or decelerating by harnessing it in an inertial flywheel that when engaged into the drivetrain, would assist with reacceleration. There are currently no other bicycle kinetic energy recovery systems that use an inertial flywheel. This is a purely mechanical system that when installed, only requires the basic maintenance that a standard bicycle requires such as chain lubrication. This system would perform best when coupled to a touring bike or commuter bike because the increase in weight would not be as noticeable with these types of bicycles.

Entry Number: 167 UP
REMOTE INSPECTION DEVICE
By: Bernardo Gonzalez, Mark Nano, and Keng Yin Aw
Mechanical Engineering
Faculty Advisor: Dr. Ozkan Celik
Abstract: Design a remote controlled, proof-of-concept vehicle for inspection purposes. The remote inspection device must be able to navigate through an obstacle course while the driver has no direct visual of the course. The device will complete several tasks, picking up a sensor and pressing a button while surveying the field, simulating its use in a radioactive zone like that of the disaster in Fukushima in 2011. The device competed in 2013 ASME Student Design Competition in Long Beach, CA on April 26-27.

Entry Number: 168 UP
ELECTROSPUN POLYMER BASED METAL OXIDE INFUSED NANOFIBERS DEPOSITED ON INSULATING SUBSTRATES
By: Bret Cooke, Michael Kinsler, Rabiah Harrison, and Dr. Kwok-Siong Teh
Mechanical Engineering
Faculty Advisor: Dr. Kwok Siong Teh
Abstract: Nanofibers of poly(ethylene oxide) (PEO) infused with titanium dioxide were deposited by an electrospinning process at ambient conditions. The main goal of this experiment is to investigate the possibility of producing conductive nanowires for potential applications in nanoelectronics, tissue engineering, and biochemical sensors and actuators. Two types of solution were employed in an attempt to create a conductive path through the nanofibers. The first method used was to simply infuse TiO_2 nanoparticles in the

electrospinning solution using a surfactant to counteract the issue of agglomeration. The second method employed was to infuse the solution with titanium tetraisoproxide which forms TiO2 and isopropanol when exposed to water. Using tyzor (titanium tetraisoproxide) showed more promising results than nanoparticles.

Entry Number: 169 UP
GETSUM LAUNCHER
By: Clint McElroy, Augusto Navas, Shelley Kim, and George Bainbridge
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: Our project is a variable position clay pigeon launcher. It has both an automatic and a manual selection mode. Under automatic, the controller will randomly generate both elevation and windage for the shooter. The manual mode allows the user manually set the elevation and windage according to user's preference.

Entry Number: 170 UP
PARABOLIC TROUGH SOLAR COLLECTOR
By: Ethan Clifford, Cody Darwin, and Alex Valeyev
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: The parabolic trough solar collector captures the sun's rays and concentrates it on a pipe called a receiver. The position of the collector is also adjustable so that the aperture of the collector can be directed to the sun to increase the heat gained. As the water flows through the receiver, the concentrates rays of the sun heat up the water to produce steam that can be used for power generation by a steam engine. Once the steam has condensed, the excess heat from the condensate can then be used for domestic hot water. This system is greater than other collectors because of its capability to be modular, and its ability to be disassembled and stored when not in use.

Entry Number: 171 UP
HUMAN POWERED GENERATOR
By: Gabriel Suller, Juan Carlos Chavez, Alejandro Garcia Orozco, and Roberto Samame
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: The Human Powered Generator makes use of the user's everyday walking or running motion by capturing kinetic energy and storing it into a battery that can be used to charge most cell phones and other small electrical devices. Our project consists of a DC motor that is used to generate power rather than output power. Our generator is powered using a spring-loaded pulley mechanism that is fastened at the waist and attached to the ankle by a wire and ankle strap. Considering ideal conditions and a steady walking pace, the generator can fully charge a battery in approximately 7 hours. The electrical and mechanical components of this project are concealed within a custom enclosure that is 3D printed using the facilities here at SFSU.

Entry Number: 172 UP
MULTILINK SUSPENSION
By: Giancarlo Lara, Ringo Fung, and Tamer Alawad
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng

Abstract: Our Project was to built a Multilink suspension containing five links. This project hopes to bridge that gap by laying ground in the design/testing process of the multilink suspension in order to yield it a more viable, cost effective option for the average passenger/off-road vehicle. The requirements for our project include a balance between performance and handling, possible decreases in weight, compactness, and of course, cost. In order for this to be done, a simulated environment with various road conditions would need to be created. This was accomplished through the use of SimMechanics in MATLAB and by Reinhold von Shwerin's Multibody System SIMulation as a reference. Once a benchmarking system has been setup, various design models are created through SolidWorks, and then converted into a SimMechanic model through SimuLink. Testing was then done for stability, maximum loading, and shock displacement by the developed simulated road conditions in order to choose the most viable design possible.

Entry Number: 173 UP
SOLAR POWERED PORTABLE REFRIGERATOR
By: Giovinder Avilez, Atilio Gil, and Brian Tu
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: For our engineering senior design class (ENGR 697), we entered the ASHRAE sponsored 2013 Applied Engineering Challenge. The usual aim of these applied challenges is to encourage student creativity and innovation on an applied engineering concept, as well as to optimize equipment technologies in order to solve market or societal problems. The 2013 version asks its competitors to design a portable refrigerator with a food storage area of 1 cubic foot. The portable refrigerator is to be powered by a renewable energy, i.e. solar power. The use of gas, diesel, kerosene, natural gas, wood, propane or any other fossil fuel will be disqualified. The temperature in the storage area must be maintained at 25°F continuously for at least 5 days without an external power supply, in an ambient environment of 100°F. The refrigerator must be easy assembled anywhere in the world, even in under developed countries.

Entry Number: 174 UP
CONTINUOUS VARIABLE TRANSMISSION (CVT)
By: John Dak Luong, Daniel Pereira, and Jason Pelina
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: A general application of a custom continous variable transmission (CVT) on display. A CVT is a transmission with an infinite amount of gear ratios within a set range. This will be powered by a hand crank and shifting will be manually actuated. This is a senior project for Engr-697.

Entry Number: 175 UP
SHOTGUN BARREL CLEANING DEVICE
By: Kyle G. Smith, William Baw, and Jessica M. Hoke
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: The conventional method for shotgun barrel cleaning is time consuming and energy intensive. The purpose of this design project was to develop a device which would make the process faster and easier. In conventional cleaning, a device called a barrel brush is used. This device typically consists of a brush or padded material which is pushed down the barrel of the shotgun to remove waste material left behind by the fired shell. This method involves considerable disassembly of the shotgun and is difficult to perform quickly. Given the necessary materials and time to perform the cleaning, it is almost impossible to complete the cleaning without being in one's home where the materials are available and there is no sense of urgency. The purpose of

this design project was to develop a device which solves this problem and allows for a full shotgun barrel cleaning to be performed quickly with very few tools required. Ideally, the device would allow for a full barrel cleaning before leaving the shooting range or hunting property and would do so in a very short amount of time. The device would be user friendly and keep the mess and hassle of barrel cleaning to a minimum. Shooting is supposed to be a fun sport so the goal of this project was to make the barrel cleaning as quick and easy as possible.

Entry Number: 176 UP
SFSU SOLAR CAR TEAM
By: Mark Giannini and T. Craig Brinton
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: The American Solar Challenge is a long distance, multi-day race for teams from universities in North America, racing solar powered cars in a rally format. The biennial race covers distances up 2000 miles crossing several states. Teams from top engineering schools across the country bring amazingly sophisticated vehicles to the event that provides a high-profile venue for students to show their skills with design, engineering and management. Ricardo Sfeir P.E. and Mike Putnam P.E., San Francisco State University engineering alumni, approached our senior design project class with a proposal to start a solar car team at SFSU. This is a remarkable opportunity for us as students and the engineering school at large. Acting as mentors for this nascent project, Ricardo and Mike tasked our group with the first step of the project – designing the chassis to house, and protect the car's infrastructure. And so, the goal of our project is to design a frame for the solar race vehicle and build a full-scale mock-up version of the frame for testing.

Entry Number: 177 UP
CHARACTERIZATION OF RAPIDLY DEPOSITED AND ANNEALED ZINC OXIDE THIN FILMS
By: Michael Kinsler, Rabiah Harrison, Kyle Ng, and Dr. Kwok-Siong Teh
Mechanical Engineering
Faculty Advisor: Dr. Kwok-Siong Teh
Abstract: By adapting a plasma enhanced chemical vapor deposition system we are able to not only deposit zinc oxide thin films but to also rapidly anneal them. This means synthesis times of 45 minutes and annealing times around 15 minutes. This cuts hours off of the current methods.

Entry Number: 178 UP
WRIST GIMBAL - A FOREARM AND WRIST EXOSKELETON FOR STROKE REHABILITATION
By: Paul Ng and Dr. Ozkan Celik
Mechanical Engineering
Faculty Advisor: Dr. Ozkan Celik
Abstract: In this project, we designed and implemented Wrist Gimbal, a three degree-of-freedom (DOF) exoskeleton developed for forearm and wrist rehabilitation for stroke patients. Wrist Gimbal has three active DOF, corresponding to pronation/supination, flexion/extension and adduction/abduction joints. We focused on a robust, safe and practical device design to facilitate clinical implementation, testing and acceptance. Several control strategies were implemented to accommodate various stroke patients with different motor function capabilities. Besides that, both the graphical user interface (GUI) and the visual interface were implemented for an intuitive use in a clinical setting by the patient and the therapist. In the future, we look to collaborate with medical schools to carry out experimental trials with stroke patients.

Entry Number: 179 UP
AUTOMATIC SOOTHING CRADLE
By: Shan Zhang, Guanxin Liu, and Cheng Peng
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: The purpose of this project is to help parents to take care of their babies automatically by the cradle. The cradle can swing automatically driven by magnetic force. We use the combination of the electromagnets and permanent magnet as driving part, and we also have designed a brand new swing mechanism. This product has several advantages such as low noise, stable swing, and low power consume.

Entry Number: 180 UP
ASME RC BAJA COMPETITION CAR
By: Tesfu Gebretsadik, John-Eric Massey, Jesse Verzano, and Phillip Wong
Mechanical Engineering
Faculty Advisor: Dr. A.S. (Ed) Cheng
Abstract: We wanted to build an RC car for the annual ASME Baja competition. We designed the car to be fast and well balanced so that it can be competitive in all of the diverse challenges we will face. We also wanted the RC car to be simple and cost effective. We were faced with a straight line speed challenge, a slalom challenge and a difficult off-road Baja challenge. We brought the car we built to CSU Long Beach on Saturday April 27th and competed against three other schools in the challenge. We took second place in the slalom, first place in the drag race, and we were the only team able to complete the Baja course. The judges decided not to give rankings so all the teams were listed as "placed." Although we were sure we would finish either 1st or 2nd, not getting a placement didn't get us too upset because we were very proud of how well the car we built performed.

Entry Number: 181 D
HYDROGEN IMPLANTED ZINC OXIDE NANOCYSTALLINE THIN FILMS
By: Rabiah Harrison and Michael Kinsler
Mechanical Engineering
Faculty Advisor: Dr. Kwok-Siong Teh
Abstract: A method of doping zinc oxide nanocrystalline thin films is presented. Films were treated with hydrogen (h+) ions using two accelerating voltages (4keV and 3keV) for twenty minutes, and characterized using a four point probe to observe changes in sheet resistance.

Entry Number: 182 UP
SEISMIC DESIGN COMPETITION: TAI TOWER
By: Robert Hartsock, Jonathan Cantu, Edmund Hom, Juan Fuentes, Jessica Kim, Ly Ly Lam, Adrian Castillo Valencia, and Josh Ikjong You
Civil Engineering
Faculty Advisor: Dr. Cheng Chen
Abstract: Tai Tower is a model structure that we entered in the Seismic Design Competition (SDC) hosted by the Earthquake Engineering Research Institute. We are a team of Civil Engineering students who took on this project for our ENGR 696/697 Senior Project course. Over the course of about a year, starting in June, we conducted research on various small-scale building materials and designed a model structure to withstand ground motions from an earthquake simulating Shake Table. With our initial design, we constructed two models improving upon our design with each build to perfect our structure, building technique and group collaboration. All the while, team members took up specific responsibilities individually and in subgroups to produce all other aspects of the project such as reports for class and the competition, Powerpoint presentations,

structural analysis by the use of SAP2000 (analysis program), drafting on AutoCAD (computer aided drafting), utilizing a laser cutting machine by teaming up with mechanical engineering students, amongst other administrative tasks. The culmination of all our work has resulted with our winning 16th place, out of 36 competing schools and top 10 in the categories Architecture and Structural Innovation.

Entry Number: 183 UP
STEEL BRIDGE 2013
By: Joshua M. Vera, Mani Noroozi, Roger Chavez, Zhimin Hu, Ibrahim Eyad, Nenad Radmonovic, Jialiang Li, Hector Santillano, and Douglas Martinez
Civil Engineering
Faculty Advisor: Dr. Timothy D'Orazio
Abstract: ASCE & AISC hold regional and national level competitions that consist of the following mission: The mission of the Student Steel Bridge Competition (SSBC) is to supplement the education of civil engineering students with a comprehensive, student-driven project experience from conception and design through fabrication, erection, and testing, culminating in a steel structure that meets client specifications and optimizes performance and economy. The SSBC increases awareness of realworld engineering issues such as spatial constraints, material properties, strength, serviceability, fabrication and erection processes, safety, aesthetics, project management, and cost. Success in inter-collegiate competition requires application of engineering principles and theory, and effective teamwork. Future engineers are stimulated to innovate, practice professionalism, and use structural steel efficiently.

Entry Number: 184 UP
TIMBER BRIDGE 2013
By: Adam Carvalho, Samir Patel, Paul Niglio, Matt Thomas, Shawn McGarrah, and Jesus Cortes
Civil Engineering
Faculty Advisors: Dr. Cheng Chen and Dr. Timothy D' Orazio
Abstract: Our project was a submittal to the National Timber Bridge Competition. We were required to design and construct a bridge that was required to withstand a specific loading situation. The Bridge would then be judged in a variety of categories. We created a bridge that was modular and also a bridge that would use a lower percentage of non-wood materials. We set out to win the competition and we wanted to take first place in aesthetics and innovation. The design that we choose was able to achieve this feat and we ended up taking 2nd overall in the competition.

Entry Number: 185 UP
FOUNDATION ANALYSIS & DESIGN
By: Derrick Saito, Scott Lam, Derryl Bagalay, Karanveer Bains, and Tan Lieu
Civil Engineering
Faculty Advisor: Dr. Timothy D'Orazio
Abstract: Our group will design a foundation for a 100,000 kip building given a site location and soil profile. Requirements are to keep total soil settlement under 0.4 ft and differential settlement under 0.0025ft. Methods of consideration were preloading location with fill, installing drainage pipes, including a basement, and analysizing the effects of different deep and shallow foundations. This projects primary constraint was cost and like any other project in engineering, the performance was weighed versus cost to choose the most reasonable foundation design.

Entry Number: 186 UP
SFSU STORMWATER CONVEYANCE AND TREATMENT FACILITIES
By: Kathryn Mandapat, Michael Wiltermood, Joseph Alejandro, Josh Hughes, Maurice Kimball, SM Saklaen, and Abdul-Rahman Mezal
Civil Engineering
Faculty Advisor: Dr. Elahe Enssani
Abstract: The purpose of this project is to repurpose the stormwater from SFSU campus to recharge Lake Merced. Lake Merced is a fresh water lake and is a major natural resource for the city of San Francisco. It is an emergency water supply, a habitat to several endangered and threatened species as well as non-endangered species, and a recreation area. Although measures have been taken to reduce the draining of the water table, it is still desirable to divert stormwater to the lake for recharge. Diverting the stormwater to Lake Merced will also reduce the demand on the Oceanside Treatment facility which currently treats our stormwater. Since the system does include small scale treatment and storage facilities, having an easily maintainable system was a priority. The design also creates a pipeline route with the least amount of construction or work involved and was able to use a majority of the existing pipelines, only upsizing a few.

Entry Number: 187 UP
STEEL BRIDGE
By: Nicholas Smyth, Davin Wentworth-Thrasher, Neli Avramova, Jens Norman, Clay Rasor, Spencer Morris, John Voskuyl, and Donna Dris
Civil Engineering
Faculty Advisor: Dr. Timothy D'Orazio
Abstract: Our steel bridge is a 1/12th scale model of a simple beam bridge designed to compete in the 2013 ASCE Steel Bridge Regional Competition. As part of the competition, our bridge also has a cantilever portion on one end. Our team is made up of nine civil engineering undergraduates with emphasis in structural design and construction management. Our team has participated in and overseen all aspects of the completion of our bridge from initial design, structural analysis, material testing, cost and efficiency analysis, fabrication, and construction. We have also benefited from the support of engineering professors, metal suppliers, and welders.

Entry Number: 188 UP
GEOTECHNICAL DESIGN PROJECT- PROJECT DIRT
By: Portia L. Davis, Taylor Strack, Taylor Nelson, Samuelson Ramos, and Isabell Mysyk
Civil Engineering
Faculty Advisor: Dr. Timothy D'Orazio
Abstract: The Geotechnical Design Project examines various parts of the foundation design process, attributed to various project limitations such as differential settlement, and the composition of our soil profile. We applied multiple methods to create the most cost-effective and reliable foundation design including preloading and drains to mats, widely/closely spaced endbearing piles, widely/closely spaced friction piles, and footings.

Entry Number: 189 UP
GEOTECHNICAL DESIGN
By: Van Dang, Oswaldo Hernandez, Y La, Jacky Lau, and Anh Luu
Civil Engineering
Faculty Advisor: Dr. Timothy D'Orazio
Abstract: In this project, we analyze the many foundation alternatives and choose the best and most cost efficient option. The foundations we explore are footings, mat, widely/closely spaced friction piles and piers, and widely/closely spaced end bearing piles and piers. In order to satisfy the project parameters of having a total settlement of less than 0.4 ft. and a differential settlement of less than 1/400 ft., we use the foundation in combination with preloading, wick drains, basement, and reducing column spacing.