1. Casey Huegel, Grand Valley State University **Archaeology**

An Analysis of Historic Ceramics at Indian Landing (20BA02) in Hastings, MI

This report is an analysis of the ceramic assemblage excavated from Indian Landing site (20BA02) in Hastings, MI. The artifacts collected are associated with a mid nineteenth century log cabin which transferred ownership on multiple occasions throughout its existence. Originally built in 1850 to function as a schoolhouse for Indian Mission School District No. 5, the property was later sold by local Native Americans to Europeans in 1855 and became a permanent residence. The primary goals of this research are to determine the socioeconomic status of the occupants and give further insight into the cabins primary occupation dates. This will be done by examination of ware type, decoration, and form to create a general distribution of the ceramic assemblage. Further analysis will classify the earthen wares into four levels of economic significance as recommended by George Miller in his article Classification and Economic Scaling of Mid-Nineteenth Century Ceramics. This mode of classification presents a detailed representation of social class based on common earthen wares; an effective tool when studying the settlers of the rural Midwest.

2. Alexandra Cok, Calvin College **Biochemistry**

(Co-Authors: Adeleye Opejin, Christina Plaisier, and Larry Louters)

Effects of Cinnamaldehyde on GluT1 Transporter Activity

In recent years, there have been many studies indicating that cinnamon can be used to treat type 2 diabetes mellitus, by increasing the sensitivity of glucose transporter GluT4 to insulin. GluT1 is a membrane-bound, non-insulin responsive transporter. Previous research has shown that GluT1 can be activated by depriving cells of glucose. This project investigated the effects and mechanism of action of cinnamaldehyde, the active ingredient of cinnamon extracts, and cinnamaldehyde analogs on GluT1.

3. Amanda Hanks, Grand Valley State University **Biochemistry**

(Co-Authors: Scott T. Lefurgy, Virginia W. Cornish, and Rachel A. Powers)

Expression, purification and characterization of the Asn152Thr mutant P99 cephalosporinase

Resistance to β-lactam antibiotics has emerged as a major public health issue due to the over-prescription and widespread use of these drugs. β-lactamase enzymes are the most common bacterial resistance mechanism to these antibiotics and a major concern is evolution of extended β-lactamase enzymes. Several mutants of the class C β-lactamase P99 have been identified which exhibit a substrate selectivity switch due to a mutation of the conserved Asn152 residue. The Asn152Thr mutant was expressed and purified using nickel affinity column chromatography and pure protein was reproducibly obtained at a concentration of 5 mg/mL. Crystallization attempts are underway. Structural determination of this and other enzymes may aid in the design of more effective β-lactam antibiotics.

4. Angelica Willis, Hope College **Biochemistry**

(Co-Authors: Steven Lewis, and Maria Burnatowska-Hledin)

Mutation analysis of VACM-1/cul5 exons in T47D cancer cell line

VACM-1 protein is a cul-5 gene product which functions via an E3 ligase complex and has an antiproliferative effect on many cell types. Structure-function analysis of the VACM-1 protein sequence identified consensus sites specific for phosphorylation by protein kinases PKA and PKC and a Nedd8 modification site. We showed previously that mutation in the PKA-specific phosphorylation site at Serine 730 reverses the phenotype and thus negates the antiproliferative effect of the VACM-1 gene. This effect was associated with the appearance of larger Mr species when Western blots were probed with anti-VACM-1 specific antibody. Since T47D breast cancer cells express a modified form of the VACM-1 protein, we hypothesized that this modified form results from mutations at one of the sites described above. To sequence all exons identified in the genome of VACM-1, we designed 18 sets of primers. We used genomic DNA and mRNA isolation methods and amplified both genomic DNA and mRNA through PCR and RT-PCR, respectively. Since Serine 730 is located in the 19th exon of the VACM-1 genome and was our region of interest, we began by sequencing exon 19. Our results suggested that no mutation exists in exon 19 of the VACM-1 genome. Our next goal is to amplify the other 18 exons of VACM-1 and examine their sequences for mutations. Our ultimate goal is to identify a mutation in VACM-1 that could be used as a biomarker in cancer characterization and development of new antiproliferative treatments.

5. Ben Klepser, Calvin College **Biochemistry**

(Co-Author: Dr. Carolyn E. Anderson)

Synthesis of N-Alkyl Pyridones Using Gold Catalysis

N-alkyl pyridones are frequently found in natural products and compounds of pharmacological interest. In recent years, the Anderson lab has developed a unique method for the synthesis of N-propargylic pyridones using a lithium iodine catalyst. However, in some cases trace amounts of an N-alkenyl pyridone was also observed. While continuing to pursue the N-alkyl pyridones, work is also underway to optimize the reaction for the production of strictly N-alkenyl product. In this pursuit, gold catalysis was viewed as an alternative approach to the synthesis of an N-alkenyl pyridone analog. Surprisingly, however, this approach resulted in the production of a new class of ketone containing N-alkyl pyridones in moderate to good yield.

6. Cheri Ackerman, Calvin College **Biochemistry**

(Co-Author: Dr. Eric J. Arnoys)

Diffusion and Transport of Galectin-3

Galectin-3 (Gal3) is a carbohydrate-binding protein that is up-regulated in thyroid, colon, breast, and prostate cancers. In order to perform its cellular roles, Gal3 must move in and out of the nucleus of the cell. In this project, we are studying three characteristics of Gal3 and its mutants to understand its localization and shuttling: (1) flexibility; (2) binding to exportin-1; (3) rate of nuclear export and import under specific cellular conditions.

7. Benjamin M. Brandsen, Calvin College **Biochemistry**

(Co-Author: Roger L. DeKock)

Theoretical Study of Hydrogen Bond Strength in a Pyridone

Theoretical studies were performed on an N-alkenyl pyridone. Unpublished X-ray crystallographic studies have shown that there is no hydrogen bond in the solid state, but rather the molecule is locked in a “twisted” conformation. Experimental NMR data provides evidence this molecule likely has an intramolecular hydrogen bond in solution. We found energy minima for both the hydrogen-bonded conformation and the twisted conformation, and predict the energy barrier between these structures. The hydrogen bonded structure is 2-2.5 kcal/mol more stable than the twisted structure. We predict the transition barrier to be in the range 3.3-4.5 kcal/mol. In addition, theoretical NMR spectra were computed to compare with experimental data. In summary, we examine the energy, structure, and NMR properties of the pyridone molecule.

8. Christian Damon, Hope College **Biochemistry**

(Co-Author: J. Patrick Lutz)

Inhibitory effects of lead on erythropoietic transcription factor GATA-1

GATA-1 is a key transcription factor that regulates erythrocyte development and maturation in vertebrates. Studies of lead and GATA-1 have shown that lead decreases the binding affinity of GATA to DNA. In purified GATA protein, lead is thought to disrupt a GATA zinc-binding finger by replacing GATA's zinc ion with a lead ion, thereby changing the protein's conformation and lowering DNA binding affinity. Our current work addresses the implications of lead interference with GATA function in living cells.

9. Christina Hicks, Hope College **Biochemistry**

(Co-Author: Dr. Aaron Best)

Suspected Function of the Archaeal Cluster of the GHMP Kinase Superfamily as Characterized by Methanococcus maripaludis and Salinibacter ruber

The Archaeal Cluster of GHMP Kinase Superfamily has been studied as to its role as a pantothenate kinase in coenzyme A biosynthesis. Coenzyme A is essential to a variety of metabolic processes. Currently, there are three known forms of pantothenate kinase (PanK); the suspected fourth is thought to be unique in its mechanism and gene sequence. The three known forms of PanK are found in Bacteria and Eukarya, but thus far a homologous form has not been found in Archaea. The genes found in the Archaeal cluster of the GHMP Superfamily are hypothesized to be the fourth novel pantothenate kinase. Additionally, one bacterial species, Salinibacter ruber, clustered within the Archaeal cluster indicating that this species has a homologue of the predicted PanK gene. This was most likely acquired via horizontal gene transfer. Two species from the Archaeal cluster, Methanococcus maripaludis and S. ruber, were selected. The suspected PanK gene was cloned and overexpressed in E. coli cells. Then the protein was obtained, purified and analyzed in a coupled biochemical assay.

10. James F. Ruble, Grand Valley State University **Biochemistry**

(Co-Authors: Scott T. Lefurgy, Virginia W. Cornish, and Rachel A. Powers)

Effects of Asn152 mutation on substrate selectivity of P99 cephalosporinase

Since the early half of the 20th century physicians have been able to combat bacterial infection by administration of β-lactam antibiotics. These drugs are able to destroy various types of bacteria by disrupting the final stage of cell wall synthesis. Bacteria, however, have evolved resistance to these compounds by producing β-lactamase enzymes, which hydrolyze the β-lactam ring of the compound and render it inactive. Of major concern are bacteria that have become resistant by acquiring mutations in their β-lactamase genes. These mutations alter the selectivity of enzyme for substrate, thereby allowing the mutant enzyme to effectively break apart many different β-lactams, either in addition to, or at the expense of, their "preferred substrate". For the enzyme P99 cephalosporinase, it has been shown that mutation of the highly conserved asparagine residue at position 152 can have a substantial effect on substrate selectivity of the enzyme (Lefurgy, 2007). In this study, a full kinetic characterization of the N152G mutant was performed using several β-lactams. Attempts to crystallize the mutant are being performed under previously published conditions as well as new conditions obtained from high-throughput screening techniques. Further studies of mutational effects on the Asn152 will help to elicit the detailed structure and function relationship for this residue and could potentially allow researchers to develop improved antibacterial drugs for clinical use.

11. Jarrad Utter, Calvin College **Biochemistry**

(Co-Author: Professor David Benson)

Searching for a Novel Crosslinked Protein Derived Cofactor in Hemoglobin

Based on a previous computational study of the protein database which indicated 191 proteins as having a preattack conformation for Tyr-Cys formation, research was conducted to investigate the possibility of forming a Tyr-Cys crosslink in hemoglobin under oxidative conditions. Studies were done in which hemoglobin was exposed to H2O2 and then digested to near completion using Pronase, a proteolytic cocktail. Analysis of these samples was done using high performance liquid chromatography and mass spectrometry, with inconclusive but promising results.

12. Lejla Cesko, Calvin College **Biochemistry**

Identifying a Replication Inhibitor in Saccharomyces cerevisiae by Investigating a/α Repressor

Saccharomyces cerevisiae, serve as an ideal eukaryotic model for mitotic studies because they reproduce quickly through mechanisms that are conserved in multi-cellular organisms. Interestingly, yeast exhibit different mating behaviors as haploid cells; in the haploid stage, the cells can turn on the expression of either hml or hmr , located on the MAT locus, and can become either type a or type α cell respectively. This, in turn, helps haploid cells to find each other's membrane receptors and mate to become a diploid cell. The genes that regulate the expression of hml and hmr belong to the sir gene family. In other words, by deleting the sir2 gene from the temperature sensitive yeast strain, we can induce a diploid cell to express both a and alpha mating behaviors. In this condition, the cell produces a/alpha repressor protein that inhibits replication inhibition thus allowing cells to grow at permissive temperature of 37 degrees Centigrade. In addition to the sir2 deletion, if hml gene is deleted, the diploid cell can only express the a mating phenotype, and consequently, there is no a/alpha repressor. This strain does not grow at 37 degrees. It has been shown that seventeen genes are repressed by the a/alpha repressor. In the M940 strain, all seventeen genes are expressed. By knocking one gene at a time, we can test the mutants' growth at the permissive temperature; this method will hopefully allow us to identify the gene that codes for the replication inhibitor.

13. Luke Zwart, Calvin College **Biochemistry**

(Co-Author: Dr. Darla McCarthy)

Pentachlorophenol Degradation by Mycobacterium chlorophenolicum

Pentachlorophenol (PCP) is a chlorinated compound synthetically developed in the 1930's as a wood preservative, but later found to be toxic. M. chlorophenolicum is a slow-growing actinomycyte which can degrade PCP. Based on previous research, and the results shown here, we have reason to believe that a cytochrome P450 enzyme is involved in converting PCP to tetrachlorohydroquinone (TCHQ). Understanding how this bacterium degrades PCP can lead to more efficient methods for cleaning up PCP-contaminated sites.

14. Mehreteab Y. Mengsteab, Grand Valley State University **Biochemistry**

(Co-Authors: Scott T. Lefurgy, Virginia W. Cornish, and Rachel A. Powers)

Effects on substrate selectivity due to Asn152 mutation of P99 Cephalosporinase

Within this past century, medicine has saved the lives of millions by effectively putting into use antibiotics based on a B-lactam core structure. B-lactam antibiotics combat bacterial infections by disrupting the latter stages of bacterial cell wall synthesis. Bacteria have evolved efficient ways to resist these antibiotics by producing B-lactamase enzymes. These enzymes interfere with B-lactams by hydrolyzing the lactam ring, thus rendering it inactive. One way bacteria gain resistance to B-lactam antibiotics is through new mutations in their B-lactamase genes. These mutations enable the enzyme to change substrate selectivity; in addition to or at the expense of the native substrate, thus allowing one B-lactamase to potentially hydrolyze different B-lactams. In the enzyme P99 cephalosporinase, mutation of a conserved asparagine residue at position 152 can have a large effect on substrate selectivity. In this study, a kinetic characterization of N152S mutant was performed. Crystallization efforts are underway. Further studies on N152S mutant of P99 B-lactamase may aid in the design of new antibacterial drugs for clinical use.

15. Nathaniel I. Strong, Grand Valley State University **Biochemistry**

(Co-Authors: Kaelee Roberts, Aleksandr Archiyan, Alyssa Lopez, and Toni Rice)

Synthesis of Novel Cyclic Polyamides as Potential DNA-Interactive Agents

Telomerase is an enzyme discovered in over 80% of all human cancer cells and is a target for anticancer drug development. Telomerase works by copying specific sequences of DNA that can fold into three-dimensional structures, due to hydrogen bonding within the guanine-rich sequence. It is postulated that once this DNA is three dimensional, telomerase cannot copy the DNA and so the cell eventually dies (normal cell death occurs when telomeric DNA reaches a shortened length). Polyamides are a class of known minor-groove duplex DNA-interactive compounds. Linear forms of these compounds have been shown to bind to DNA via hydrogen bonding to specific base pairs. Utilizing the properties of polyamides, the purpose of this research is to design, synthesize and evaluate a number of cyclic polyamides that resemble Telomestatin (a potent, cyclic inhibitor of telomerase) to bind selectively to telomeric DNA and prevent telomerase from copying it. Ongoing efforts in this area are described in this presentation.

16. Robert Sjoholm, Hope College **Biochemistry**

(Co-Authors: Megan Lee, Lauren Lee, Balaji Babu, Sameer Chavda, and Moses Lee)

Synthesis and cytotoxic properties of combretastatin analogs

Combretastatin A4 (CA-4) is a powerful agent that causes microtubule depolymerization in cells, and it is known to possess potent cytotoxic activity against the growth of cancer cells in culture. Due to its poor solubility in water a phosphate-containing water-soluble prodrug was developed, and it is presently undergoing phase II clinical trials for human cancer treatment. In this study, twenty new and presumably more water-soluble analogs of CA-4 were designed and synthesized. The synthesis and cytotoxicity studies of these compounds will be described.

17. Susanna Lynch, Calvin College **Biochemistry**

(Co-Authors: Rachel Battershell, Jordan Scott, and Kumar Sinniah)

A Single Molecule Approach to Studying Insulin-Quadruplex DNA Interactions

The formation of guanine (G)-quadruplex in the guanine-rich tandem repeats of the insulin-linked polymorphic region (ILPR) is linked to transcriptional effects on the insulin gene. Recent studies demonstrate that these G-quadruplexes can bind insulin, and while this may impact the transcription of insulin, little is known about the binding mechanism. A single molecule force spectroscopy study was performed to examine the selective binding of insulin to the ILPR G-quadruplex DNA. In this study, the insulin was covalently attached to a flat, gold surface while the quadruplex DNA was attached to an AFM probe. The rupture force between insulin and quadruplex DNA was measured at various force loading rates. To confirm the specificity of the binding, control studies were performed by blocking the tethered G-quadruplex with “free insulin” in solution. Results from the dynamic force-pulling studies are described based on the Dudko-Hummer model.

18. Kimberly Boyd, Hope College **Biochemistry/Cellular Biology/ Neuroscience**

Real Time Analysis of System xc- Trafficking in Human Glial Cells

Oxidants regulate the activity of a transporter, xCT. This transporter imports cystine and exchanges it for glutamate. Large quantities of the cDNA that encode the GFP-xCT fusion protein from DAM-E. coli were prepared and purified. Transfections have been performed on human glioma cells, utilizing the calcium phosphate technique. The GFP-xCT construct was identified using western blots. Increased xCT expression in transfected cells was verified using upatke assays with 14C-cystine. Biotinylation assays were performed to analyze the location of the xCT proteins (intracellular vs. membrane). The transfected cells have been viewed under an ApoTome/ Fluorescence Microscope Digital Imaging System. Transfected cells did exhibit green fluorescence also indicating expression. We are currently examining the time dependence of trafficking of System xc- following peroxide treatments.

19. Carson Prichard, Grand Valley State University **Biology**

(Co-Authors: Carl R. Ruetz, and James McNair)

A dynamic programming model of patch selection by stream invertebrates

Downstream drift of benthic invertebrate larvae is an ubiquitous property of stream ecosystems. It consists of a cyclical process whereby benthic invertebrates enter the water column from the stream bed, are transported downstream by the current, and eventually settle on the bed again. Invertebrate drift is important in determining the spatial distribution and abundance of stream invertebrates in streams, and the availability of food for fish. Evidence suggests that entry into the water column and settling on the bed are not entirely passive, but that invertebrates may exercise choice in these activities. We developed a stochastic model of drift behavior that allows active choice in movements between the bed and the water column, but also accounts for passive transitions. Thus, an invertebrate is allowed to have partial but not complete control of transitions. We present results for a simple case with two patch types on the bed, with transitions allowed between either patch type and the water column, but not directly between patch types. Using a discrete-time dynamic programming approach, we determined the behavioral decisions for each time step that maximize the component of individual fitness due to net energy gain and survival to maturation. We show how these optimal decisions depend on properties such as patch type, level of energy reserves, and time remaining until maturation to adulthood.

20. Jake Carpenter-Thompson, Grand Valley State University **Biomedical Sciences**

(Co-Author: Merritt K. Taylor)

Vector Construction of shRNA to Suppress Nato3 Expression in the Embryonic Gallus Gallus Central Nervous System: design and advances

Our long term goal is to disrupt the expression of the gene Nato3 in the Gallus Gallus embryo to better understand the role of Nato3 in the development of neural progenitor cells. Previous in vitro studies showed that Nato3 inhibits transcription by genes that promote neuronal differentiation. Preliminary data from our lab has shown that Nato3 is selectively expressed in the floor plate of the developing neural tube and can promote ectopic expression of floor plate specific markers. We hypothesize that when Nato3 expression is disrupted, there will be a decrease in the number of floor plate cells. We are targeting Nato3 expression using a retroviral vector that is competent for the expression of shRNA in Gallus Gallus cells. To develop this vector I have designed an oligonucleotide that specifically targets a region of the Gallus Gallus Nato3 gene. The shRNA will form a simple hairpin, and specifically bind to the mRNA encoded to produce Nato3 protein, thus targeting Nato3 for degradation by the cell. This poster describes the design and advances in the construction of this shRNA vector. Once generated, the vector can express shRNA against Nato3 in the developing neural tube by in ovo electroporation. If our hypothesis is correct then there will be fewer cells that express floor plate markers when shRNA targeting Nato3 is expressed, demonstrating that Nato3 plays a crucial role in the development of neural progenitors in the floor plate.

21. Sarala Sarah, Grand Valley State University **Biomedical Sciences**

(Co-Author: Merritt K. Taylor)

Nato3, a bHLH Protein, is Expressed in the Floor Plate of the Developing Neural Tube at all Axial Levels in the Chicken and Mouse Embryo.

In development, bHLH transcription factors are responsible for guiding cells to a tissue-specific fate and initiating differentiation. Nato3, a bHLH transcription factor, is expressed in the developing mouse and chick developing CNS or neural tube. Currently, published literature suggests Nato3 is a transcriptional inhibitor of the neurogenic transcription factor MASH1, suggesting that Nato3 would be a negative regulator of neurogenesis. The objective of our study was to determine the physiological location of neural progenitor cells in the neural tube that express Nato3. We hypothesized that Nato3 expression is restricted to the floor plate region of the developing neural tube at all axial levels in both the mouse and chick embryos. We established and optimized the in situ hybridization technique to detect endogenous Nato3 mRNA expression. Embryos were harvested and sectioned at multiple developmental stages. We found Nato3 is expressed in the floor plate region of the spinal cord, hindbrain and midbrain at the onset of neurogenesis and continues until late gestation. Most of the cells of the floor plate region serve as a signaling center and do not differentiate into neurons. The expression pattern suggests that Nato3 may have a role in the function of floor plate cells throughout the course of development. A critical question that remains is to determine if Nato3 is necessary and sufficient to promote the floor plate cell lineage at the expense of neurogenesis.

22. Betsy Breuker, Calvin College **Cell and Molecular Biology / Genetics**

(Co-Author: Dr. Amy Wilstermann)

Characterization of Intermolecular Interactions that Influence Topoisomerase IIα-mediated DNA Relaxation

ATP binding and hydrolysis are required for proper functioning of topoisomerase IIα, an enzyme that plays critical roles in DNA replication and cell division. To characterize the interactions between topoisomerase IIα and its ATP cofactor that influence cofactor binding and enzyme activity, DNA relaxation assays and ATP hydrolysis assays were performed using ATP and various ATP analogs. Results indicate that interactions between topoisomerase IIα and the sugar ring of ATP are important for enzyme activity, while interactions with the C6 position of ATP are required for both enzyme activity and enzyme-cofactor binding.

23. Corey Davis, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Author: Tim Evans)

A Preliminary Phylogenetic Analysis of the Genus Aneilema (Commelinaceae) based on chloroplast DNA sequences

Molecular phylogenetic studies using the chloroplast-encoded matK, rps16, psbA-trnH, and trnL-trnF genes are underway to examine relationships among species of Aneilema and to clarify the relationship of Aneilema to other genera in tribe Commelineae, particularly Pollia, Polyspatha, and Rhopalephora. The genus Aneilema consists of 64 species in seven sections, distributed primarily in tropical Africa and Australia. The species sampled represent all seven sections plus A. brasiliense, whose generic position was considered uncertain. Aneilema brasiliense is found to fall outside of the rest of Aneilema and is either sister to Polyspatha or to a Pollia/Polyspatha clade. The basal grade of Aneilema consists of species of two sections, the Australian sect. Aneilema and African sect. Amelina. Amelina appears to be polyphyletic. Strong support is found for the monophyly of sect. Brevibarbata based on two West African and one South Africa forest species. The East African section Lamprodithyros is also monophyletic. Rhopalephora is placed within Aneilema. The inclusion of Rhopalephora within Aneilema and the exclusion of A. brasiliense from the genus would render Aneilema monophyletic. Sufficient molecular data to construct a phylogentic tree for the genus Portea (family Bromeliaceae) were not obtained, so all analyses focused on Commelinaceae species. The Commelinaceae molecular phylogeny will be used to evaluate speciation and extinction rates in the family.

24. Darcy Kaufman, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Authors: Douglas J. Peterson, William D. Johnson, and Merritt K. Taylor)

Nato3 is Sufficient to Promote Ectopic Floor Plate Marker Expression in the Rostral Neural Tube of the Chicken Embryo

Nato3 is a basic helix-loop-helix protein that is expressed in the floor plate region of the neural tube during development. Floor plate cells release the morphogen Shh, which influences neural fates of neighboring neural progenitors in the neural tube. To determine if Nato3 expression is sufficient to promote floor plate cell lineage in the developing neural tube we misexpressed Nato3 in the neural progenitors of spinal cord and rostral neural tube using in ovo electroporation. We monitored neural progenitors and their progeny that misexpressed the electroporated Nato3 during development using a bicistronic EGFP reporter expression vector. Using immunohistochemistry we compared the effect of Nato3 misexpression on neural progenitors in the spinal cord and hindbrain using the floor plate cell marker Foxa2. Nato3 misexpression after the closure of the neural tube did not change the expression of floor plate, glial or pan-neuronal markers w in the spinal cord. However, Nato3 misexpression in the hindbrain at the same developmental stage caused ectopic expression of the floor plate marker Foxa2. These results demonstrate that Nato3 is sufficient to promote the expression of the floor plate marker Foxa2 in the neural progenitors of the hindbrain but not the spinal cord. These results indicate that there are regional differences in neural progenitor response to Nato3 overexpression in the neural tube.

25. Ekaterini Iordanou, Grand Valley State University **Cell and Molecular Biology / Genetics**

Alternate Source of Serum for Mammalian Cell Culture

Fetal bovine serum (FBS) is a common ingredient of mammalian cell culture media. It is usually harvested from fetuses derived from pregnant cows. FBS is a highly complex fluid that is known to support and sustain growth of mammalian cells in vitro. Although FBS is a good cell culture supplement, the use of this serum is contentious. A major reason is that FBS is not fully characterized, and there is a wide variation in composition between harvested sera. In addition, there is concern that FBS could potentially be a vehicle for disease transmission to humans, such as, Bovine spongiform encephalopathy (BSE). The serum is very costly to collect, and there are strong moral issues in regards to the way it is harvested. Because of this, chicken serum (CS) is a suggested alternative. It is easily collected and it is much more cost effective. Therefore, in this study, the effect of FBS and CS on two human derived cell lines, HEK 293 and HELA, were compared in tandem. The preliminary studies revealed that data from media supplemented with FBS 5% and 10% were consistent with literature, and CS 5% was shown to support mammalian cell growth to an extent. Further studies are necessary to validate and extend the present findings. (EI supported by Edward Salski Research Fellowship)

26. Heather A. Danhof, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Author: Patrick A. Thorpe)

Nestling Oral Microbial Colonization in Tree Swallows (Tachycineta bicolor)

Microbes may have a positive impact on fitness of birds through improving host nutrition and/or host pathogen defense. The oral microbial community of nestling tree swallows was characterized by sampling of the pharyngeal region. Nestling tree swallows were sampled at Nesting Day (ND) 3 and ND 18. Nestlings typically leave the nest box on ND19. Both parents were also sampled. DNA was extracted from samples and a hypervariable region of the 16s rRNA gene was amplified. PCR products were run on a denaturing gradient gel (DGGE) which separates similar sized products based on their individual sequence variation. We predict that parents and offspring will be more similar to each other than unrelated swallows due to transfer of microbes between mates and between parents and offspring. We also predict that adult-like microbial communities will develop over time and show increasing similarity to adults by ND18. Characterization of the patterns within and between families as well as identifying microbes represented by specific bands will provide a direction for determining the influence of specific microbes on avian fitness.

27. Jameson Carbary, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Author: Georgette Sass)

PCR characterization of the pkndlnΔ5 derivative in Drosophila melanogaster

The delorean mutation in Drosophila melanogaster was created using a strategy known as " an enhancer trap". The "enhancer trap" transposon p{lacW} inserted into the first intron of the Protein kinase N (pkn) gene of Drosophila generating the delorean mutation. The wings of flies that are homozygous for the delorean mutation are held away from their body and are noticeably curved downward. It is thought that the delorean mutation alters the function of the Protein kinase N gene during the morphogenesis of the adult wing. I have characterized a derivative of the pkndln mutation that was generated by imprecise excision of the p{lacW} transposon. This derivative, the pkndlnΔ5 allele, when heterozygous with the original pkndln allele exhibits a wing phenotype that is less severe than the "delorean" phenotype. In addition, pkndlnΔ5 allele is not a "loss-of-function" mutation given that it exhibits a wild-type phenotype when heterozygous with a deficiency of the Protein kinase N gene. Additional genetic evidence suggested that a portion of the p{lacW}transposon remained in the pkndlnΔ5 allele. PCR analysis of the Protein kinase N (pkn) gene indicated that the pkndln Δ5 allele still contains exons three and four and the downstream deletion breakpoint is most likely in the second intron.

28. Jennie Heidmann, Calvin College **Cell and Molecular Biology / Genetics**

(Co-Author: Dr. David Dornbos)

Woody Invasive Shrubs as Potential Sources of Cellulosic Ethanol

Cellulosic ethanol is receiving attention as a biofuel that is renewable, reduces the carbon footprint, and does not necessarily jeopardize food stocks. It is derived from the breakdown of cellulose and hemicelluloses from plant cell walls into simple sugars which are then fermented into ethanol. Switchgrass, a C4 plant that grows exceptionally well in the warm, dry climate of the plains, has been the focus of much cellulosic ethanol research because it grows rapidly there. In Michigan's cooler, wetter climate, however, we hypothesize that C3 plants such as the invasive shrubs autumn olive and buckthorn may represent higher potential for cellulosic ethanol in Michigan than switchgrass. Two studies were used to determine the suitability of these invasive shrubs. The practicality of growing and harvesting these plants was looked at in a re-growth study in which all of the plants grew back equally well. The chemical composition of each plant was also determined by initial ethanol extraction followed by acid hydrolysis and derivitization and identification of sugars by gas chromatography. The extractives in each plant decreased with age while lignin concentration increased. The highest concentration of sugar was glucose followed by xylose. Three year old Autumn Olive had the lowest extractives concentration and the highest glucose. A further biomass accumulation study will help to identify whether invasive shrubs are good potential cellulosic ethanol sources.

29. John Lelli, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Authors: Kimberly M Wisniewski, Viral Patel, and D. M. Linn)

Multiple possible protective mechanisms associated with the alpha7 nAChR in pig retina: Agonist, modulator & feedback mechanisms

Retinal ganglion cells (RGCs) are responsible for transmitting visual information from the retina to visual centers in the brain. Previous research on RGCs has revealed their vulnerability to glutamate-induced excitotoxicity, a possible glaucomatic mechanism. However, activation of nicotinic acetylcholine receptors (nAChRs) located on RGCs has been shown to provide protection (Wehrwein et al., 2004). Previous results (Bader&Linn,2007) showed that PNU-282987 displayed significant neuroprotective effects against glutamate toxicity. The α7-specific nicotinic antagonist, methyllycaconitine (MLA), blocked this neuroprotective effect at 100nM indicating a direct agonist action. We found further protective effects of α7 (nAChR) activation by applying a modulator with the agonist to RGCs. The selective allosteric modulator, PNU-120596, enhanced the protective action of the agonist in a dose-dependent manner with maximal effects exceeding survival seen under control conditions. Agonist and modulator, in the absence of glutamate, showed increase in cell survival. This suggests that the modulator provides protection against other causes of cell loss. In addition, evidence exists that α7 receptors may exist on the cholinergic amacrine cells themselves. Tropisetron was found to evoke labeled ACh release comparable to kainate with having a more potent and prolonged effect of increased basal release. These data suggest direct and indirect activation of neuroprotective mechanisms in RGCs.

30. Kendra Hoekzema, Calvin College **Cell and Molecular Biology / Genetics**

(Co-Authors: Alana Alexander, and C. Scott Baker)

Mitochondrial identity of stranded New Zealand sperm whales in relationship to global diversity

Sperm whales (Physeter macrocephalus) have a strange propensity to mass strand, often without obvious cause. Here, we examined 80 sperm whale stranding samples (including mass and single stranding events) collected from New Zealand and 247 live biopsy samples collected from the Indian and Pacific Oceans by the Odyssey. We extracted total genomic DNA and amplified X and Y chromosome markers to identify the sex of the stranded samples. Of the 67 stranding samples that were successfully sexed, 55% were males and 45% females. To identify the maternal lineage we sequenced 630 bp of the mtDNA control region. Eighteen unique haplotypes were present in the New Zealand samples, including six new haplotypes not reported among the 28 previously discovered worldwide haplotypes. Sex-specific control region FST indices were calculated between New Zealand and neighboring regions to investigate geneflow. Statistically significant genetic differentiation was found between New Zealand and several neighboring populations, indicating that maternal geneflow between New Zealand and other areas is restricted. Haplotype diversity values from the mass strandings in New Zealand showed that the only male mass stranding (n = 12) was more diverse than either of the two female mass strandings (n = 12, n = 3), possibly because of the unique social structure of sperm whales. New Zealand sperm whales also have a higher nucleotide and haplotype diversity compared to the other populations studied.

31. Kyle Edewaard, Hope College **Cell and Molecular Biology / Genetics**

Identifying Global Transcription Sites in the Genome of Giardia lamblia

Giardia lamblia, an early diverging eukaryote and mammalian parasite, has previously been found to possess a relatively complete system of eukaryotic RNA polymerases (RNAP) RNAPI, RNAPII and RNAPIII. However, of the basal transcription initiation factors shared by and vital to both Archaea and Eukarya, only Transcription Factor IIB–related factor (BRF) and a highly divergent TATA–binding protein (TBP) have been identified. Our ongoing research is focused on identifying the possibly novel functions of TBP and BRF in giardial transcription. We are utilizing chromatin immunoprecipitation and sequencing (ChIP-seq) technology to identify all genomic binding sites of TBP, BRF, and Myb2 (a Myb-like protein already known to regulate six giardial genes). These data will then lead us to the identification of both classes of targeted genes and differential occupancy sites in varying environmental conditions.

32. Michael Schillaci-Schofield, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Authors: Brent Hehl, and Bradley J. Wallar)

Characterizing the cellular regulation of the Diaphanous-related formin, DAAM1, by the expression of the constitutively active full-length protein

Diaphanous-related formins (DRFs) are a highly conserved family of proteins critical to the regulation of the cytoskeleton. The regulation of DRFs involves an autoinhibitory process in which the binding of the C-terminal Diaphanous- autoregulatory domain (DAD) to the N-terminal Diaphanous-inhibitory domain (DID) keeps the protein in an inactivated state. Upon binding of an activated Rho GTPase to the DRF GTPase binding domain (GBD), the DID-DAD interaction is released, thereby activating the DRF protein. One DRF family member that has been shown to be localized to both axons and dendrites of neuronal cells is the Dishevelled-associated activator of morphogenesis-1 (DAAM1). DAAM1 has also been demonstrated to interact with the Rho GTPases, RhoA and Cdc42, and play an important role in a variety of biological processes and pathways, including gastrulation and the development of the tracheal cuticle in the respiratory system. Our laboratory has worked to identify the crucial DID-DAD interaction of DAAM1 as well as utilize this knowledge to create a constitutively active full-length DAAM1 to elucidate the localization and cellular effects of the protein in cells. Here, analogous to the M1041A and M1182A mutations in the DAD regions of mDia2 and mDia1 respectively, we show that the F1032 residue in DAAM1 is critical to the DID-DAD autoregulatory interaction of the protein. Fluorescence anisotropy demonstrates that the F1032A mutation in DAD results in the complete inability to bind to the DID region of DAAM1. The loss of DID-DAD binding is consistent with the localization and impact of full-length constitutively active DAAM1 in mammalian cells. Expression of F1032A DAAM1 in three different cell lines (NIH3T3/mouse fibroblast, PC12/rat pheochromocytomas, N1E-115/mouse neuroblastomas) resulted in cells with an increased number of abnormally-shaped filopodia and cellular protrusions than wild type DAAM1. The F1032A DAAM1 was found to be evenly distributed throughout the entire filopodia, which is in contrast to the constitutively active mDia2 and mDia3 being mostly localized to the tips of the filopodia. Together, these results demonstrate the critical contribution of F1032 to DAAM1 autoregulation, as well as shed some light on the cellular effects and localization of full-length constitutively activated DAAM1.

33. Rebecca Hyatt, Aquinas College **Cell and Molecular Biology / Genetics**

(Co-Author: Dr. Jennifer Hess)

Characterization of the Recombinant Streptococcal Protein IdeZ and its interaction with Human Protease Inhibitor Cystatin C

The bacterial pathogen Streptococcus zooepidemicus enhances its ability to cause disease and combat the immune system of its host, primarily humans and horses, through the use of the cysteine proteinase, IdeZ (Immunoglobulin G-degrading enzyme of S. zooepidemicus). This occurs because IdeZ, which has uniquely high substrate specificity for immunoglobulin G (IgG), is capable of evading detection by cleaving the antibody at its hinge region. In functional studies, IdeZ has yielded similar results to the well characterized homologous enzyme IdeS (Immunoglobulin G-degrading enzyme of Streptococcus). Previously in this laboratory, site-specific primers were designed to target nucleotide sequences to change the amino acids thought to influence the cleavage of IgG. These primers were then utilized in the mutation of plasmid DNA containing recombinant IdeZ obtained from E. coli. In this study, prior research was expanded upon through the creation of additional mutants and experimentation with the protease inhibitor, cystatin C, and the well characterized inhibitor, iodoacetate. Results from functional assays were consistent with previous studies, and indicated that the purported mutations involving the cysteine and arginine/aspartic acid/glycine residues in the active site of IdeZ prevented cleavage of IgG from occurring. Additionally, this study verified that, cystatin C enhanced the IgG-cleaving ability of lysates capable of cleaving IgG. It is possible that further experimentation with IdeZ will result in a variety of practical applications pertaining to human and veterinary medicine, as well as therapeutic drugs targeting proteolytic enzymes, as has already been demonstrated with homologous enzymes.

34. Samantha K. Seaberg, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Author: Bradley J. Wallar)

Characterizing the Cellular Regulation of the Diaphanous-related Formin, mDia3, by Expression of the Constitutively Active Full-length Protein

A family of proteins known as Diaphanous-related Formins (DRFs) are important in the regulation of the cellular cytoskeleton. DRFs are regulated by autoinhibition, a mechanism which involves maintaining the DRF protein in an inactive state by the intramolecular binding of the Diaphanous-inhibitory domain (DID) to the Diaphanous-autoregulatory domain (DAD). Upon binding of an activated Rho GTPase to the DRF GTPase binding domain (GBD), the DID-DAD interaction is released, thereby activating the DRF protein. Possessing a very similar sequence homology to the well characterized mDia1 and mDia2 proteins, mDia3 (mouse) / hDia2 (human) is among the least studied DRF family members. While a past study has shown that mDia3 interacts with Cdc42 to regulate microtubule attachment to kinetochores, the autoregulation and cellular localization of activated mDia3 has not been widely characterized. Therefore, our laboratory has been probing the similarities and/or differences in the regulation and cellular localization between mDia3 and other DRF proteins. Here, we show that M1053 in the DAD region of mDia3, much like the M1041 in mDia2 and the M1182 in mDia1, is involved in regulation by DID-DAD binding. By engineering full-length, constitutively active mDia3, we have been able to express mDia3 in three different cell lines (NIH3T3/mouse fibroblast, PC12/rat pheochromocytomas, N1E-115/mouse neuroblastomas). Constitutively activated mDia3 results in dramatically increased numbers of filopodia-like extensions in which mDia3 is significantly localized at the tips of the filopodia. This is similar to the expression pattern of mDia2, yet different from DAAM1, another DRF family member, which has recently been shown to be localized throughout the entire filopodia. In summary, these results demonstrate the critical contribution of M1053 to mDia3 autoregulation, as well as shed some light on the cellular effects and localization of full-length constitutively activated mDia3.

35. Thomas Rogers, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Authors: Mark Katakowski , Xuguang Zheng ,Feng Jiang, Alexandra Szalad, and Michael Chopp)

Mir-146b-5p suppresses EGFR expression and reduces migration and invasion of glioma in vitro

The microRNA mir-146b-5p down-regulates expression of epidermal growth factor and suppresses invasion and experimental lung tumor metastasis. Human mir-146b-5p is located on chromosome 10q24.3. Loss of the 10q24-26 region is frequently observed in gliomas. Here, we demonstrate that mir-146b-5p suppresses expression of epidermal growth factor receptor (EGFR) in U87-MG and U251 human glioblastoma cells. Mir-146b-5p was under-expressed in these cell lines compared to normal cortical human astrocytes. Introduction of mir-146b-5p decreases cell invasion, migration and phosphorylation of protein kinase B (AKT). Mir-146b-5p suppresses transcription of EGFR, and binds to the EGFR 3'-UTR. Furthermore, analysis of U87-MG laser-capture micro-dissected cells in tumor-bearing nude mice indicated that expression of mir-146b-5p was inversely correlated with distance from the tumor core. These findings suggest mir-146b-5p warrants investigation as a novel treatment for this aggressive tumor.

36. Whitney Askew, Hope College **Chemical Engineering**

(Co-Authors: Michael Misovich, and Amy Miller)

Truncation Error of PRSV Vapor Pressures Calculated by a Series Method

Equations of state (EOS) describe relationships among pressure, molar volume, and temperature. Cubic EOS can be solved for liquid and vapor volume as well as equilibrium properties such as vapor pressure. A specific cubic EOS, Peng-Robinson-Stryjek-Vera (PRSV), was studied in this work. An existing technique expressed vapor pressure as a polynomial series in temperature. The series coefficients depended upon two substance-specific parameters, the acentric factor ω and a parameter labeled κ1. Vapor pressures were calculated when the series was truncated after the first, fifth, eighth, and tenth power in temperature and were compared to exact vapor pressures calculated by a fugacity algorithm. Results were determined for values of the acentric factor ω between -0.4 and +0.4 and values of the κ1 parameter between -0.2 and +0.3. Plots of truncation error versus reduced temperature were made by fixing the value of one of the two parameters and allowing the other to vary. In some cases, varying one of the parameters caused the sign of the truncation error to change. Plots showing 10% error contours were also produced for a fixed value of one parameter while reduced temperature and the other parameter were varied.

This material is based upon work supported by the National Science Foundation under NSF-REU Grant No. PHY-0452206 and the Michigan Space Grant Consortium (MSGC).

37. Alex R. Ketchum, Hope College **Chemistry**

(Co-Authors: Eric P. Lauzon, and Elizabeth M. Sanford)

The preparation of highly conjugated organic materials for device applications

Our work in the synthesis of new materials for device applications focuses on substituted poly(arylenevinylenes). Poly(arylenevinylenes) are a class of semiconducting polymers that can emit light through electroluminescence, a form of luminescence where light is emitted from a substance when it is excited by an electric field. Poly(arylenevinylenes) are now used as components of organic light emitting diodes (OLED's) and light emitting electrochemical cells (LEC's). These technologies are used for molecular electronics including cutting edge displays and light sources. This poster describes the preparation of conjugated thiophene derivatives. These small molecules can be used to study the properties of poly(arylenevinylenes). The synthetic plan includes making core and end cap molecules that can be connected via carbon-carbon double bonds formed using a Wittig reaction. This methodology allows us to synthesize a family of materials ranging from small to polymeric for device testing.

38. Alvin Aquino, Calvin College **Chemistry**

(Co-Authors: Joshua D. Neukom, and John P. Wolfe)

Palladium Catalyzed Synthesis of Benzodiazepines

Nitrogen heterocycles are important molecules as they display a wide range of biological activity. Previous research in the Wolfe Group has focused on the synthesis of 5-membered nitrogen heterocycles (pyrrolidines and pyrazolidines) as well as 6-membered nitrogen heterocycles (piperazines). Using a similar Pd-catalyzed carboamination strategy, we sought to access potentially valuable 7-membered rings such as 1,4-benzodiazepines. Many 1,4-benzodiazepines have biological activity and are currently marketed drugs such as Valium® (anti-anxiety) and Xanax® (anti-anxiety). Other 1,4-benzodiazepines currently in clinical trials, such as BMS-214662 and B2-423, exhibit anticancer activity. Employing a Pd2(dba)3/BINAP catalyst system in the presence of base and aryl bromide, we have been able to access substituted 1,4-benzodiazepines in moderate to good yields from appropriate alkenyl diamine precursors. The alkenyl diamine substrates were prepared in good yields (65%) over 3 steps from commercially available methylanthranilate or 2-methylbromobenzoate. The present work presents an overall efficient 4-step synthesis of substituted 1,4-benzodiazepines.

39. Amanda Ferguson, Hope College **Chemistry**

(Co-Authors: Ryan Davis, Laura Westrate, Toni Brown, Hilary Mackay, Sameer Chavda, Balaji Babu, and Moses Lee)

DNA sequence specific recognition of DNA by a novel fluorescent structural motif

A developing area of cancer treatment uses molecules that have the ability to bind DNA through the minor groove and target specific sequences. These compounds can bind specific promoters and alter the expression of cancer-causing genes in cancer cells. Doxorubicin is a drug currently on the market which uses the described method to target cancer cells and bind to DNA through intercalation and regulating genome transcription. Polyamides, which are primarily composed of imidazole (I) and pyrrole (P) heterocycles, are significant in this area as well because they can be tailored to target and bind to any predetermined DNA sequences. The polyamides currently under biophysical analysis are derivatives of the fluorescent DNA binding molecule Hoechst 33258. These molecules can be studied using standard techniques, such as DNA melts, circular dichroism, isothermal titration calorimetry, surface plasmon resonance, as well as DNase I footprinting. Additionally, the fluorescent properties of these molecules allow microscopy studies to be conducted in order to ascertain the compounds' ability to penetrate cells and localize in the nucleus.

40. Brandon Burkhart, Calvin Colllege **Chemistry**

(Co-Author: Roger DeKock)

Theoretical Study of Ligand Migration

Theoretical studies allow a specific and in depth look at reactions and mechanisms as the relative energies of each step can be compared with one another. We utilized computational chemistry methods to investigate two ligand migrations: (1) A proposed mechanism for a reaction of butadiene with an Ir-Ir system. (2) Hydrogen atom migrating between a Rh - Os system to form an agostic methyl. We examine the relative energy barriers between structures and the validity of these two proposed ligand migrations.

41. Breanna Powell, Hope College **Chemistry**

(Co-Author: Jeffrey B. Johnson)

Carbon-carbon single bond activation using aromatic substituted compounds

Carbon-carbon single bonds, while abundant in organic compounds, are inactive in many organic reactions due to their thermodynamic and kinetic stability. Recent developments have shown that high energy carbon-carbon single bonds can be activated and functionalized with the use of a metal catalyst (Jun, C-H. Chem. Soc. Rev., 2004, 33, 610). Such processes promise new and exciting synthetic pathways using inexpensive starting materials. Dreis and Douglas have demonstrated the intramolecular activation of a non-strained substrate followed by alkene insertion which isomerizes the starting material into a 5-membered ring. (J. Am. Chem. Soc., 2009, 131, 412-413). The goal is to gain mechanistic insight by synthesizing quinolinyl-ketones with varying aromatic substituents. Several substrates have been successfully synthesized and run in competition experiments to determine the rate limiting step and mechanism of this reaction. Early results indicate that substitution affects the reaction rate, suggesting that C-C activation is the rate limiting step of catalysis.

42. Camille Riddering, Hope College **Chemistry**

(Co-Authors: Moses Lee, Sameer Chavda, and Balaji Babu)

Addressing the Alignment Issue in the Recognition of Polyamides with DNA Sequences

Based on the naturally-occurring compound Distamycin which binds in the minor groove of DNA, polyamides containing pyrrole (Py) and imidazole (Im) heterocyclic units have been synthesized. These polyamides localize to the nucleus, where they recognize and bind to specific DNA sequences, thus controlling gene expression. The binding affinity of polyamides to DNA has been found to be dependent on the number of heterocycles the polyamides consist of. A polyamide containing three heterocycles has been determined to have the highest level of binding, with binding affinity decreasing as the heterocycle number is increased. It is thought that this is due to shifts in alignment between the polyamide's imidazole and pyrrole heterocycles and their corresponding DNA base pairs. Each additional heterocycle contributes to the alignment spacing, and the accumulation of these shifts results in decreased binding affinity. By correcting this improper alignment between polyamides and their cognate DNA sequences with "spring-like" amino acids, binding affinity for polyamides of any length will likely be increased.

43. Caylee Fias, Aquinas College **Chemistry**

(Co-Author: Dr. Katrina Hartman)

Biofuels: A study of the transesterification process and the extraction of usable soaps

Biofuel is formed through a transesterification process during which triglycerides are transesterified by reaction with methanol, NaOH or KOH, and oils, most commonly waste vegetable oil (WVO). This reaction does not only yield fuel, but forms three distinct layers; two of which have not been fully analyzed. It has been determined that the fuel formed is composed of methyl esters; yet, there are two layers composed of a combination of trapped fuel, soaps, methanol, water and glycerol. Emphasis was placed on extraction of the soaps and trapped fuel. The middle layer, an emulsion, was used to perform soap extractions to determine the most productive and cost-effective method. The bottom, glycerol, layer was tested for the presence of soaps, glycerol, methanol and water and was used to determine the percent recovery of methanol through distillation. The Infrared Spectrometer (IR) was used to determine the exact composition of the three layers. Using the IR, we were able to determine which fatty acids were most abundant in the oils used through comparison with known fatty acid spectra; we were then able to determine which methyl esters formed in the fuel through TLC using standard methyl esters and creating methyl esters from different oils. The IR was also used to determine which type of oil was transesterified to produce the extracted soaps and the structural properties of these soaps.

44. Conrad Tobert, Hope College **Chemistry**

(Co-Author: Christian Calyore)

Utilizing Fluorescent Techniques to Investigate Biopolymer Functions and Probe Dynamics

In order to better understand the binding and structural dynamics of biopolymers we utilize several fluorescence techniques. In addition we collaborate with other group members to compare experimental results with their computationally generated molecular dynamics data. We are specifically interested in the binding of the Gata-1 protein to DNA and the structural dynamics of the Hairpin Ribozyme. Gata-1 is a transcription factor that is essential in the regulation of hematopoiesis—the production of red blood cells. The Hairpin Ribozyme is a small catalytic RNA with both endonuclease and ligase activities. Currently we are studying model DNA and RNA systems based on the Hairpin Ribozyme that will allow detailed examination of the dynamics of the probe molecules themselves. These studies will allow us to measure the structural dynamics of Gata-1 and its DNA target as well as the Hairpin Ribozyme with more fidelity than has been possible with FRET previously. We present early results of these model systems from both ensemble and single-molecule fluorescence techniques.

45. Curtis Merrick, Hope College **Chemistry**

(Co-Authors: Kristi Wu, Sameer Chavda, Balaji Babu, Robert Sjoholm, Dereje Desta, and Moses Lee)

Analogs of DAPI as new antiparasitic agents

Nearly a billion people are affected by parasitic diseases worldwide and millions die annually. Finding new and effective treatments against these parasites such as Plasmodium, Trypanasoma, and Leishmania is extremely important to the global community. Finding better treatments will benefit the global community by improving the way of life of many countries affected by these diseases. Compounds such as DAPI and Hoechst 33258, are small molecules that target A/T rich sequences of DNA in the minor groove. These compounds bind selectively to AT-rich DNA sequences and are toxic towards the aforementioned parasites. Inspired by the significant activity of DAPI against these parasites, four new analogs of DAPI were designed. The synthesis of these analogs as well as their DNA binding properties will be described.

46. Hao Shen, Hope College **Chemistry**

(Co-Authors: Sameer Chavda, Moses Lee, and Balaji Babu)

Synthesis of N-aminoalkylpyrrole-containing polyamides

Pyrrole (P) and imidazole (I)-containing polyamides can be designed to target specific DNA sequences in the minor groove. These polyamides affect DNA sequence specificity as well as binding affinity. H-pin polyamides containing alkyl linkers have significantly increased binding affinity over their non-linked counterparts. Also, polyamides that contain a pendant N-aminoalkyl side chain have also been found to enhance binding affinity over simple polyamides. The main goal of this project is to successfully synthesize several polyamides that contain the N-aminoalkylpyrrole unit. The synthesis of these polyamides will be presented.

47. Jeff Christians, Calvin College **Chemistry**

(Co-Authors: Andrew DenHartigh, and David Benson)

Analysis of Single Molecule Biosensors

Metalloprotein was attached to ZnS-coated CdSe semiconductor nanoparticles in order to form a fluorescent molecular biosensor with tunable excitation and emission wavelength. The nanoparticles were capped with MHDA for solubility reasons. The fluorescence of the nanoparticle exhibits is quenched via an electron transfer mechanism from the nanoparticle to the metal complex. The effect of different metal and organic quenching ligands on the nanoparticle fluorescence was observed in bulk solutions in a quest to simplify the production of the sensor. Several different possible quenchers were discovered which at the bulk solution level which can be used further for single molecule analysis. The pH dependence of fluorescence was explored on the single molecule level by adsorption onto a glass slide and analysis via fluorescence microscopy. From this analysis, it was determined that there is no appreciable pH dependence of fluorescence.

48. Jennifer Bruinius, Hope College **Chemistry**

(Co-Authors: Nicholas Rebhan, Timothy Shannon, and Dr. Wallace Fu)

Two Organic Syntheses of Mycosporinoids

Mycosporine-like amino acids are naturally occurring UVA absorbing compounds that protect plants and organisms such as cyanobacteria and fungi from the sun's harmful radiation. Currently, some commercial sunscreen products consist of mycosporine-like amino acids (MAAs). Although some of these compounds have a high absorption coefficient, they are also water-soluble and they easily aromatize. The goal of this research project is to synthesize MAAs that are more stable, while increasing or at least equaling the UVA absorbing profile of the compounds currently on the market. To go about synthesizing these compounds, two unique routes were attempted. The first route was successful for some analogs, but unsuccessful for others. The contrast of the two routes will be presented.

49. Kaitlyn Driza, Grand Valley State University **Chemistry**

(Co-Authors: Angela Defore, Maggie Weinert, Eric Strickler, Scott Kendall, and Bopiah Biddanda)

Changing Trends in Production, Respiration and Carbon Balance of Lake Michigan

Lakes are emerging as key players in the global carbon cycle. Over the last few years (2006-2009), we have studied the inter-annual gross primary production (GPP) and respiration (R) occurring at four locations along a land to lake gradient in Lake Michigan: a Laurentian Great Lake. Discrete measurements were employed to detect changes in dissolved oxygen which were then be used to estimate GPP and R of carbon. Results suggest that both GPP and R decrease with increasing distance from the shore. However GPP decreases at a much faster rate than R. This leads to near-shore net autotrophic systems giving way to net heterotrophic systems offshore. This gradient shows that terrigenous inputs of carbon and nutrients support significant bacterial metabolism and phytoplankton production near shore, while planktonic respiration is at the mercy of the current as well as past primary production in offshore Lake Michigan. Interestingly, R increased more than GPP during warmer years (2006-2008) and GPP declined more than R during a cooler year (2009), suggesting potential enhancement of R over GPP in Lake Michigan if a warming trend continues. Such a trend would lower the GPP/R ratio, rendering the lake a net source of released CO2 to the atmosphere. Further studies will seek to identify the driving forces provide to a better picture of the changing carbon cycle in Lake Michigan.

50. Katie Brandt, Aquinas College **Chemistry**

(Co-Authors: Yunjing Meng, and Dr. Jared Anderson)

Efficiency of Benzyl-dimethylimidazolium bis(trifluoromethyansulfonyl)imide ([BI2M][NTf2]) in extracting PAHs by SPME-GC/FID

Solid-phase microextraction (SPME) is a technique used to pre-concentrate chemical compounds from various matrices by exposing a coated fiber to the sample. This fiber is then desorbed in a gas chromatograph where the analytes are separated. In this project, new coatings based on polymeric ionic liquids (PILs) were used to identify the optimal extraction parameters for harmful aromatic compounds (polyaromatic hydrocarbons). The effect of extraction parameters on the fiber reproducibility was examined.

51. Kent Kammermeier, Hope College **Chemistry**

(Co-Authors: Sameer Chavda, Balaji Babu, and Moses Lee)

Preparation of N-(t-butoxycarbonyl)-cyclopropylbenz[e] Indoline (N-Boc-CBI), a Benzo-analogue of the Duocarmycins

CBI compounds are potent anti-cancerous alkylating agents that covalently bonds to Adenine-N3 of AT-rich DNA sequences and triggering apoptosis. Protozoan parasites of the plasmodium, trypanosome, and leishmania sp. contain high levels of A/T base pairs in the genome or in the kinetoplast DNA allowing for increased activity of the AT-rich DNA targeting compounds. Synthesis of the N-Boc-CBI subunit is required for the exploration of duocarmycin analogs for evaluation of their anti-parasitic properties.The goal of this project is to synthesize quantities of N-Boc-CBI sufficient for thorough evaluation of a broad range of analogues. Subsequent synthesis of the CBI-containing duocarmycin analogs will also be presented.

52. Keun Ah Ryu, Calvin College **Chemistry**

(Co-Author: Professor Carolyn Anderson)

Synthesis of N-Alkyl pyridones

The research focus was directed towards preparing N-alkyl pyridones from O-alkyl pyridines with the migration of propargylic systems. Efforts to optimize these conditions for propargylic substrates and explore the scope of differently substituted propargylic systems were also part of this summer's research.

53. Kurt M. Van Allsburg, Calvin College **Chemistry**

(Co-Author: Dr. Douglas A. Vander Griend)

Molecular Tinker Toys: Synthesis of Supramolecular Cubes

As researchers seek to tackle new problems in materials science, electronics, medicine and other fields using nanotechnology, they need radically new assembly techniques.One of the most promising methods for building structures in nanotechnology is self-assembly. This is our area of research. Our focus is on taking simple molecules (akin to tinker toys) and putting them together to form complex structures.Since we can't put our microscopic "tinker toys" together as we would a normal set (with our hands), we choose targets that will be naturally favored by thermodynamics. Thus, under the right conditions, they will self-assemble.The structures we work to build using self-assembly are cubes. Each cube has 8 metal corners and 12 linker molecules.We let thermodynamically-driven self-assembly do for us what we can't – build with molecular tinker toys in solution. Our focus is on studying the assembly process itself, not the structures we can make.

54. Lauren Kelley, Calvin College **Chemistry**

Controlling Chemical Reactivity Via Noncovalent Interactions

The protein galacatose oxidase contains the most studied example of a tyrosine-cysteine crosslink. The crosslink forms easily with copper and air in galactose oxidase. However, it is unknown how readily tyr-cys crosslinks form in other systems. The object of this research was to study the formation of tyr-cys crosslinks in 6-mer, 12-mer, and 20-mer peptides, along with tyr-tyr crosslinks in 20-mer peptides. These peptides contain β-hairpin turns that allow the tyrosine and cysteine (or another tyrosine) to be in close proximity to each other, thus enabling the crosslink. Short peptides containing dopa, in place of tyrosine, were used as model to study the effectiveness of various methods of oxidation to form the crosslink. The primary method for the formation of the tyr-cys or tyr-tyr crosslink used Ru(bpy)3+2 and ammonium persulfate (APS), along with a peptide, which were photolyzed using xenon light (365 nm). Each peptide was exposed to the light for one, five, and ten minutes. Two alternative methods were also used to form the crosslinks. One method was bulk electrolysis of the peptide at pH 10 using a potential of 0.37V with a Ag/AgCl reference electrode. The second alternative method was cerium oxidation, using a 2:1 concentration of cerium ammonium nitrate:peptide. Analytical HPLC using a diode-array detector (DAD) and fluorescence detector (FLD) and pronase digestion were used for the detection of the tyr-cys and tyr-tyr crosslinks. One method for the cyclization of the dopa-containing peptides involved oxidation using sodium periodate in different ratios of peptide to sodium periodate. Another method was bulk electrolysis at pH 10 using a potential of 0.37V with a Ag/AgCl reference electrode. Detection of the cyclized peptide by the sodium periodate method used analytical HPLC with a DAD and FLD. Detection of the cyclized peptide using bulk electrolysis involved taking UV-vis spectra before electrolysis and after various time intervals of electrolysis. Analytical HPLC of the photolyzed peptides without pronase digestion revealed that longer exposure to the xenon light results in more products. However, this method produced several products, rather than just the tyr-cys or tyr-tyr crosslinked peptide. Analytical HPLC results from the pronase digested peptides did show the red-shifted peaks characteristic of the formation of a tyr-cys or a tyr-tyr crosslink. No results of the formation of tyr-cys crosslinks have been found from bulk electrolysis or cerium oxidation, as the bulk electrolysis machine broke and modifications to the HPLC method for cerium oxidation still need to be made. Analytical HPLC runs for the sodium periodate oxidation of cys-gly-dopa, show that a 79:1 ratio of peptide: sodium periodate results in the cyclized peptide. A 50:1 ratio produced less of the cyclized peptide, while 16:1 and 1:1 ratios had too high of a sodium periodate concentration for cyclization. UV-vis spectra from the bulk electrolysis of cys-gly-dopa also showed evidence of the cyclized peptide.

55. Luan T. Nguyen, Grand Valley State University **Chemistry**

(Co-Author: Dr. George C. McBane)

Trajectory surface hopping study of energy disposal in the triplet channel of ozone photodissociation in the Hartly band

Photodissociation of ozone in the Hartley band (4 eV < h*nu < 6 eV) yields roughly 90% of its products in the singlet channel, and most of the remainder in the ground state triplet channel. The triplet products are produced by a transition between the initially excited B diabatic state and the repulsive R state of ozone, and have a broad distribution of kinetic energies centered around 2 eV. The translational energy distribution as measured by Brouard and coworkers at 226 nm shows reproducible structure with three distinct maxima corresponding to molecular oxygen in vibrational levels near v=7, 12, and 16; between these maxima the measured distributions fall by about 10%. The measured distributions at 248 nm are similar. The broad features of the distribution are reproduced by surface hopping calculations on new B and R potential surfaces, though the computed distribution is less structured. The maxima in the vibrational and translational energy distributions are clearly related to maxima in the distribution of the emerging oxygen bond lengths at the time the B/R crossing is encountered. Explorations of the physical basis of the translational energy distribution will be presented.

56. Mary Pressler, Hope College **Chemistry**

Convergent synthesis of diamino polyamides for DNA sequence specific recognition

Pyrrole (P) and Imidazole (I)-containing polyamide compounds are small molecules that can diffuse into the nucleus of a cell, bind to the minor groove of DNA at specific sequences, and potentially control gene expression. Ultimately, polyamides have the potential of being useful in preventing the spread of cancerous tissues. The focus of this study is to design polyamides that target the MluI cell-cycle box or MCB promoter of a cancer-causing gene in prostate cancer. The polyamides contain an additional amino functionality. This group should be positively charged at physiological pH and the resulting extra positive charge should enhance binding affinity to DNA. The synthesis of the polyamides will be described in this poster presentation.

57. Matt Borr, Calvin College **Chemistry**

Fluorescence of Narra Wood

Narra (Pterocarpus indicus) is a hard-wood, rainforest tree native to the Philippines. Throughout history its infusion has been prescribed as a remedy for kidney ailments. Interestingly, this same extract also fluoresces a magnificent blue color when exposed to sunlight or a blacklight. These properties have made it the subject of investigation for many centuries. Despite these investigations, the identity of the fluorescent compound has remained unknown. This study seeks to identify that compound and describes its properties.

58. Pieter Norden, Hope College **Chemistry**

(Co-Athuors: Chris Tronrud, Kent Kammermeier, Balaji Babu, Sameer Chavda, and Moses Lee)

Synthesis of Cyclopropylfuranoindole analogs of the duocarmycins

Millions of people die annually due to the infectious diseases and the global scientific community is stressed to find new treatments. Naturally occurring duocarmycins target A/T rich sequences in DNA and they form covalent bonds that ultimately damage the targeted DNA sequence. However, these naturally occurring compounds are too toxic for treatment to a host and thus there is a need for less toxic, more stable and more potent analogs. The focus of this study is the synthesis of cyclopropylfuranoindole (CFI)-containing analogs of duocarmycins. Results from the synthetic studies will be presented.

59. Ryan Enck, Grand Valley State University **Chemistry**

Progress Towards an Efficient Synthesis of a Truncated Ergoline: The Development of TAAR Regulators

Many people are diagnosed with thyroid related disorders, and many more are unaware of their existing thyroid problems. T1AM, a naturally occurring metabolite of the thyroid hormone (TH), has been shown to activate the trace amine associated recepter 1 (TAAR1) and exhibits physiological effects that oppose those of the TH. It is possible that there is regulatory relationship between T1AM and the TH. In order to better understand this relationship we want to evaluate the molecular basis of TAAR1 regulation. Previously, our lab has examined the two different enantiomers of apomorphine. S(+)-apomorphine was found to be an antagonist, while R(-)-apomorphine was an agonist. This project is targeted toward the synthesis of a truncated ergoline, which is structurally similar to both T1AM and apomorphine. For the ergolines, only one enantiomer is naturally occurring and several known ergolines have been shown to be agonist for TAAR1. To determine if the non-natural enantiomer is an effective antagonist, it is essential that an efficient synthesis be developed to generate both stereoisomers. To this end, we have proposed a novel synthesis involving an intramolecular cyclization of an aziridine and an indole. Our progress towards the synthesis of this truncated ergoline along with optimization is reported herein.

60. Sarah Havlik, Hope College **Chemistry**

(Co-Author: Jeffrey Johnson)

Nickel-Mediated Decarbonylative Alkylation of Cyclic Imides

Previous research conducted by Rovis et al. utilizes oxygen-carbonyl bond activation and subsequent alkylation of meso-anhydrides with dialkyl zinc reagents via a Ni(COD)2—bipyridal metal ligand system. The catalytic reaction desymmetrizes the starting material forming the corresponding keto acid product (J. Am. Chem. Soc. 2002, 124, 174-175). Additional research presented the stoicheometric decarbonylation of anhydrides using an excess of the Ni(COD)2 catalyst and subsequent alkylation via diphenyl zinc (J. Am. Chem. Soc. 2003, 125, 10498-10499). This summer, a related reaction system was studied using cyclic imide starting materials. These molecules were subjected to alkylation under similar reaction conditions with the goal of producing β-ketoamides. However, using a stoicheometric amount of the Ni(acac)2 catalyst afforded the decarbonylated (not β-ketoamide) product. Imides with aromatic backbones and differing N-substitutions undergo activation of the nitrogen-carbonyl bond, decarbonylation, and following alkylation. In addition to diethyl zinc, a variety of diaryl zinc compounds were successfully synthesized and implemented in the alkylation process. Promising aspects of this new reaction methodology, beyond the development of a synthetically useful transformation, includes the potential to use meso-cyclic imides to simultaneously define two new stereocenters in an enantioselective reaction.

61. Sarah Tasker, Calvin College **Chemistry**

(Co-Author: Carolyn Anderson)

Synthesis of a Novel N-Alkenyl Pyridone

N-alkyl pyridones are a structural motif found in a variety of pharmacologically active compounds. Our group recently developed a lithium iodide promoted migration reaction for the efficient synthesize a variety of N-benzyl pyridones from the corresponding O-benzyl pyridines (57-99% yield). When these conditions were extended to propargyl groups, in addition to the expected migration product, trace amounts of a different product were observed. This product ('Product B') was found to contain a dense core of orthogonal functional groups including a vinyl iodide. Because of its structural and synthetic interest, our group has been working on optimizing conditions for synthesis of Product B. Thus far, optimization has increased the yield from trace quantities to 57%, and several mechanistic insights have been gained.

62. Scott R. Hawken, Hope College **Chemistry**

(Co-Authors: Amy L. Speelman, Jonathan P. Moerdyk, Christos A. Sikes, and Jason G. Gillmore)

Oxazinoquinolinespirohexadienones – N,O-Bridged Quinoline Analogs of Perimidinespirohexadienone Photochromes

Photoinduced charged transfer (PICT) is a process in which light energy is converted to chemical potential through the creation of charge separated ion radicals. "Gating" PICT (such that only under certain conditions is a material sensitive to visible light initiating electron transfer) is of particular interest in various materials science applications. Perimidinespirohexadienone photochromes are being investigated for their ability to selectively gate PICT due to the difference in the excited state reduction potential of the short wavelength (SW) and long wavelength (LW) isomers. Previous work in the Gillmore Research Group has led to the synthesis of N,N-bridged quinoline analogs of the parent photochrome, which result in modestly better gating due to the electron deficient quinoline creating a more reducible LW isomer while the excited state reduction potential of the SW isomer remains relatively unchanged. Computational modeling predicts that replacement of one of the bridging nitrogen atoms with an oxygen atom will increase the ground state reduction potential (Eored) of both the SW and LW forms, making them significantly more potent photooxidants. The syntheses of these N,O-bridged quinoline analogs are being investigated.

63. Shannon Alger, Hope College **Chemistry**

(Co-Authors: Balaji Babu, Sameer Chavda, and Moses Lee)

Synthesis of N-aminoalkylimidazole-containing polyamides

Imidazole (I) and Pyrrole (P)-containing polyamides are crucial design elements that permit small molecules to bind to specific sequences of DNA and control gene expression. For example, the polyamide f-PIP binds as a stacked dimer in the minor groove of the inverted CCAAT box-2 promoter of the topoisomerase IIa gene in confluent cancer cells and interferes with the binding of NF-Y. As a result, the transcription of the topoisomerase IIa gene in confluent cells is activated rendering confluent cancer cells sensitive to topoisomerase II-targeted anticancer drugs to be active in killing the cancer cells. In this study, several novel f-PIP analogs that contain the N-aminoalkylimidazole unit were designed and synthesized. The results from these studies will be presented.

64. Timothy Boman, Hope College **Chemistry**

(Co-Author: Jeffrey B. Johnson)

Rhodium(I) catalyzed intramolecular carbon-carbon single bond activation in quinolinyl ketones

Carbon-carbon single bond activation is an extremely rare and difficult synthetic technique due to the thermodynamic and kinetic stability of these bonds, and has mostly been approached using transition-metal catalysis. Dreis and Douglas have shown the first examples of intramolecular alkene insertion into a carbon-carbon single bond activated by rhodium(I) catalysts on quinolinyl ketones with tethered alkenes (A.M. Dreis and C.J. Douglas, J. Am. Chem. Soc., 2009, 131, 412-413).

A number of quinolinyl ketones have been synthesized, varying substitution on the alkene. Different rhodium(I) catalysts were employed to attempt the isomerization of each with varying success. Competition reactions will subject two different quinolinyl ketones to identical catalytic conditions and reveal which reaction is faster. This will provide insight as to whether alkene insertion is the rate limiting step, ultimately giving information about the mechanism of the reaction.

65. Timothy Thielke, Calvin College **Chemistry**

(Co-Author: Mark Muyskens)

Laser Photochemistry of HFAA and TFAA

Hexafluoroacetylacetone (HFAA) is a molecule which undergoes an unusual decomposition via internal conversion as a means of non-radiative relaxation from an excited state. Several studies have been conducted on this reaction which generates a ring product and eliminates hydrogen fluoride, and there is information in the literature documenting some details about it. However, no one has researched the equivalent reaction with trifluoroacetylacetone (TFAA). Three main experiments were conducted. The first was looking at the power dependence of the ring product forming reaction. The second was observing the effects of the presence of an inert gas upon the reaction. The third was determining the rate of several reactions that were taking place including but not limited to the one producing ring product. Before any of this was possible, two other experiments were conducted to determine leak rates throughout the vacuum line and minimize them and to determine how to get the most power, best beam shape, and most consistency out of the laser.

66. Todd Major, Grand Valley State University **Chemistry**

(Co-Authors: Dr. Stephanie Schaertel, Dr. George McBane, and Luan Nguyen)

Diode-laser-based measurement of a fundamental molecular parameter: the pressure broadening coefficient

A fundamental understanding of chemical reactions requires a detailed knowledge of energy transfer during molecular collisions. Like measuring blood pressure in order to determine heart health, measuring the pressure broadening coefficient between two gases furthers the understanding of the energy transfer between two molecules. The goal of this research is to develop a diode-laser-based technique to measure the pressure broadening coefficient of CO2 in air. The measurement of the pressure broadening coefficient requires a non-linear least squares fit of a complicated function. In order to facilitate the fit, experimental techniques were developed to estimate parameters that can't be directly measured. Under normal circumstances, the pressure broadening coefficient of CO2 in air can be obtained successfully. We have measured a pressure broadening coefficient of CO2 in air of 0.094 +/- 0.003 cm-1/atm. The literature value is 0.0952 cm-1/atm, according to the HITRAN database. We are currently exploring the reproducibly of our measurement.

67. Toni Rice, Grand Valley State University **Chemistry**

(Co-Author: Lee Jackson)

Synthesis of Anthraquinone Derivatives as Potential Anti-Cancer Agents

Each year, 6.7 million people worldwide are diagnosed with cancer and 22.8% of annual deaths are as a direct result of this disease. Cancer cells are immortal and this is a major reason for the difficulties encountered in treating this disease. An enzyme (telomerase) has been discovered in over 80% of all human cancer cells and is thought to contribute to this observed immortality. Telomerase works by copying specific sequences of DNA that are found in all cells. These sequences of DNA can fold into three-dimensional structures. Once they are three-dimensional, the enzyme cannot copy the DNA and so the cell eventually dies. The purpose of this research is to synthesize a number of novel compounds that will bind to this three-dimensional DNA and so prevent telomerase from copying it. The long-term goal of this project is to try and prevent cancer cells from becoming immortal. The attempted synthesis of two different, but related, groups of compounds will be described, along with the successes and challenges of the research.

68. Trevor A. Coeling, Hope College **Chemistry**

(Co-Authors: Christine L. Bodden, Amy L. Speelman, and Jason G. Gillmore)

Toward carbonyl-substituted perimidinespirohexadienones to gate sensitivity toward photoinduced charge transfer

Photoinduced charge transfer (PICT) occurs when a photooxidant is energized by light, enabling it to oxidize a substrate to make an ion radical pair. The Gillmore group is designing photochromes that can be used to "gate" a molecule's ability to act as a photooxidant. This “gating” requires UV light to isomerize the photochrome from its short wavelength isomer (SW) to its long wavelength isomer (LW) and visible light to excite the LW. LW must be much more reducible than SW. Our group has been creating analogs of the perimidinespirohexadienone (PSHD) photochromes to make LW more reducible. The PSHDs worked toward in this report are carbonyl-substituted analogs which have proved somewhat synthetically challenging. Synthetic attempts toward these analogs have involved nitration of acenaphthene to dinitroacenaphthene, then bromination followed by elimination to yield dinitroacenaphthylene, and selective reduction to diamino-acenaphthylene. This provides the necessary substrate for coupling with di-tert-butylbenzoquinone to make a PSHD in which the naphthalene bottom has been replaced with an acenaphthylene. This new photochrome will not be much different from the parent. However this new photochrome can be oxidized to an acenaphthenequinone analog which, due to its carbonyl electron-withdrawing groups, is predicted by computation to be the most potent photochromic photooxidant yet prepared.

69. Valerie J. Winton, Hope College **Chemistry**

(Co-Author: Jeffrey B. Johnson)

Investigation of Palladium-Catalyzed C-C Bond Activation in Tertiary Alcohols

The activation and functionalization of carbon-carbon single bonds presents a significant challenge due to their thermodynamic and kinetic stability. Miura et al. have demonstrated the cleavage of carbon-carbon single bonds followed by functionalization through coupling with an aryl halide (Journal of Organic Chemistry, 2004, 69, 6942).
Carbon-carbon bond activation is proposed to occur via Pd-catalyzed β-aryl elimination of an aryl group from a tertiary alcohol. A series of differentially substituted tertiary alcohols was prepared and tested for relative reactivity in this transformation. Reactions examined the relative propensity to cleave groups containing differing hybridization, sterics, and electronic properties. Preliminary results suggest that steric effects dominate over electronics when comparing relative reaction rates. Further investigation promises to give insight into the process of selective carbon-carbon bond activation and the development of synthetic methods.

70. Michael DeLaMarre, Grand Valley State University **Chemistry**

(Co-Authors: Mary Karpen, and Andrew Lantz)

A Computational Exploration of Binding Between Pesticides and Native Cyclodextrins
Removal of small hydrophobic molecules, such as pesticides, from food items by non-toxic means is challenging. Cyclodextrins, non-toxic and water soluble carbohydrates, bind readily with small hydrophobic guest molecules and could be used to improve the aqueous solubility of commercial pesticides. Binding between three common agricultural pesticides (2,4-D, dicamba, and propanil) and native β-cyclodextrin (β-CD) was modeled with the CHARMM general force field, in order to explain trends in experimentally obtained binding free energies. Gas-phase simulated annealing of each pesticide with β-CD yielded several low-energy conformers. On viewing the conformers, it was apparent that the low experimental binding free energy of 2,4-D, relative to the other pesticides, could be explained by a steric hinderance between a chlorine group of 2,4-D and the β-CD cavity. This observation, however, did not explain the relatively high binding affinity 2,4-D has with α-cyclodextrin, which has a smaller cavity than β-CD. Preliminary findings indicate a sugar subunit of the α-CD may invert relative to the others, creating a small chlorine-binding pocket.

71. Nathaniel Burns, Calvin College **Computer Science**

(Co-Author: Dr. Harry Plantinga)

Melodic Similarity and Music Search

The aim of this project was to create a search tool for tune melodies, accepting input in musical notation, with the capability to find exact, partial, and similar tune matches. The tool was created specifically for the website Hymnary.org, an online index of hymns, hymnals, and hymn-related information. While most of the data on Hymnary.org is easily accessible through text-based searching, finding a hymn tune with those same tools can be nearly impossible when the tune's composer, publication date, or other metadata is not known. So, the challenges involved in creating a melodically-based search system stemmed from representing music in a computer-friendly way, modeling similarities between two tunes numerically, and applying the above techniques in such a way that can search musical information quickly and efficiently.

72. Jon Roshko, Calvin College **Computer Science**

Google Android

Google Android is an exciting new platform for software development on mobile devices. Backed by Google's powerful Maps API, location-based applications can be built for an educational, scientific, and other purposes.

73. Andrew Wiersma, Calvin College **Computational Biology / Bioinformatics**

(Co-Authors: Susan Boersma, and Dr. David Dornbos)

Land Management Implications of Carbon Assimilation Rate Differences Among Plant Communities (II)

Plants can be viewed as a tool to harvest CO2 from the atmosphere, countering emissions and enhancing soil quality. Our objective was to evaluate the potential of various plant communities to assimilate CO2, potentially reducing the carbon footprint of Pierce Cedar Creek Institute (PCCI). Apparent photosynthesis rates were determined for 13 plant species at 9 light levels allowing the determination of light use efficiency (LUE) relationships for these species. These species comprised the majority of the leaf area in each plant community type. The process of scaling up from leaf level photosynthesis to the landscape involved integrating hourly light levels during the growing season, species composition of the plant communities at PCCI, and the area of each plant community using leaf area index as a way to model canopy density. Significant differences existed among the thirteen plant species evaluated and the communities that they comprise. The total CO2 contribution of each plant community was dependent on both the rate of assimilation and the area of that community. Restored prairie and brushy fields were significant contributors to fixed carbon because of fast CO2 uptake rates. Old woodlands were less productive than young. Restoration practices to optimize carbon assimilation rates, while protecting biodiversity and aesthetic attractiveness, could include selective harvest of wood products from old woodlands and conversion of shrubby fields to native tall grass prairie.

74. Susan Boersma, Calvin College **Ecology and Evolution**

(Co-Author: Andrew Wiersma)

Land Management Implications of Carbon Assimilation Rate Differences Among Plant Communities (I)

Roughly half of the carbon dioxide assimilated by photosynthesis is sequestered in wood products or more importantly in soils as organic carbon. Plants can be viewed as one tool to harvest CO2 from the atmosphere, countering emissions from combustion. The objectives of this project were to determine the area and species composition of the plant communities at Pierce Cedar Creek Institute (PCCI) and to measure the quantity of CO2 assimilated by community. The seven plant communities were old field, shrubby field, restored prairie, young and mature successional forest, mixed swamp and sedge fen. Species composition of each community was determined at six or more GPS coordinates. Of the 74 species recorded, 13 accounted for between 57 and 85% of each plant community's canopy. Using GIS, the land area each plant community type was determined. When coupled with the leaf area indices of each plant community, hourly light intensity during the growing season, and transmission rates of light through canopy layers, the canopy-level CO2 assimilation rate for each plant community could be calculated from species-specific light use efficiency curves. We found that the CO2 contribution of plant communities varied with community CO2 assimilation rate and the area of the community. Restored prairie, mixed swamp, and early succession forest were significant contributors of assimilated carbon, but for different reasons. Prairie comprised a relatively small area but exhibited high assimilation rates. Mixed swamp and early succession forest exhibit modest assimilation rates but encompass a large proportion of the PCCI landscape. Between April 15 and August 9, 2009, 132 MT of CO2 was assimilated at PCCI representing a significant asset in its carbon budget.

75. Ben Groenhout, Calvin College **Ecology and Evolution**

Forest Mitigation on Calvin College's Campus

At Calvin College in the summer of 2008 an area of lawn west of the main entrance drive and south of DeWitt manor was herbicided, roto-tilled, mulched and had over sixty trees and hundreds of native plants and shrubs planted. The same process was also applied to an area of lawn North and East of Ravenswood. As well in the late fall of 2008, next to the new vanReken residence hall, trees and shrubs were planted after completion of the building. As continuation of the habitat creation work of 2008 I focused my study on the effect of soil treatment on the success of weedy invasive plants at the Burton site. This was important research since there is very little data on how weeds affect the process of habitat creation. I assessed the diversity and biomass of weeds in six different replicated quadrats, each with four soil treatments. I also inventoried all the weeds present at this site.
Preliminary results indicate that most weeds are easily controlled by a heavy layer of mulch, four inches in our study, while the no mulch treatment was the least effective in preventing weed growth. Interestingly the two inch mulch and two inch mulch plus roto-tilling often yielded similar results. The weed inventory yielded a total of 71 weeds of which only 16 were native to Michigan. This is compared to the 43 native grasses, plants, shrubs, and trees that have been planted and make up what will soon be a native woodland.

76. Bradley Houdek , Grand Valley State University **Ecology and Evolution**

Sex differences in innate immunity in Tree Swallows

Evolutionary theory predicts that exposure to more diverse pathogens will lead to the evolution of more effective immune responses. The innate immune system defends the host from pathogens in a non-specific manner and can be thought of as an important first-line of defense preventing pathogens from gaining a foothold in hosts. We predicted that female Tree Swallows have more robust innate immunocompetence than do males; during the breeding season females are exposed to more sexually transmitted microbes (STMs) (e.g., bacteria, fungi, viruses) than are males because (a) females participate in extra-pair copulations with multiple males, (b) the transmission of STMs during copulation is likely to be asymmetrical because ejaculates move from males to females, and (c) Tree Swallow semen contains potentially pathogenic STMs. We tested our prediction in the 2009 breeding season by conducting an assay of the innate immune system. The microbicidal assay produced an index of the capacity of the blood to rapidly “thwart” an invasion by potential pathogens. Results of this assay will be presented.

77. Chantel Caldwell, Grand Valley State University **Ecology and Evolution**

(Co-Author: Eric Snyder)

Disturbance to river ecosystems due to low-head dams

Dams alter the physical and chemical habitat of streams by altering natural discharge and temperature regimes which negatively impacts biota. The objective of this study was to assess the impacts of the Nashville Dam on the Thornapple River, Barry County, MI, during reservoir draw-down—a precursor to dam removal. Three parameters were monitored at 6 reference sites and 3 impact sites; (i) water chemistry (ii) physical habitat (iii) benthic macroinvertebrate community. Dissolved oxygen did not show a measurable difference in downstream sites. Specific conductivity showed a measurable decrease of 21.5 m S/cm downstream of the dam. Turbidity decreased downstream of the dam by 22.7 NTU during high discharge periods and increased by 7.74 NTU downstream once the spillway was opened and reservoir draw-down had commenced. One week after the start of reservoir draw-down, ~15 cm of sediment was deposited downstream. Macroinvertebrate family richness increased downstream by ~4 families; while diversity showed an average decrease of 0.25 immediately below the dam, and family biotic index decreased by 0.65 at the two sites most immediately below the dam. In addition, the macroinvertebrate community had higher family taxa richness—consistent with an increase in resource richness available from the reservoir outflow—but lower diversity and FBI values both of which indicate that the community was negatively impacted by the reservoir. Recovery occurred within 5 rkm downstream.

78. Courtney Alysse Long, Hope College **Ecology and Evolution**

(Co-Authors: Dr. Winnett-Murray, Dr. Murray, and Kelsey Reimink)

Effect of Distance from Forest Edge on the Soil Seed Bank at the Hope College Nature Preserve

According to F.G. Baker (1989) the soil seed bank protects a species by having a ready population to fill slots in the forest left by natural/unnatural death, disease, predation, disturbance, and consumption. I conducted research to examine the effects of forest edge on the soil seed bank, in order to better understand the potential impacts of forest fragmentation on forest dynamics. Measuring from the edge of the forest to the interior, soil samples were collected along ten transects every 5, 25, 100 and 200 meters. Samples were examined for seed diversity, composition, abundance, and viability. I recorded over thirty-three species of seeds. In general, species richness decreases with distance from the edge, and the interior soil seed bank is more uniform in terms of species composition than on the forest edge. Seed abundance also decreases as distance from the edge increases. Two species of Rubus dominate soil samples from near the edge, as illustrated by a dominance diversity curve. Viability of the seeds did not vary significantly with distance from the edge, indicating that seed survivorship is not influenced by edge effects and/or that conditions necessary for germination (likely different for different seeds) do not vary predictably with edge effects. Species-area curves constructed for each sampling distance indicate that maximum species richness in these samples was not achieved. In this forest, there are likely many more "rare" species. Nonetheless, all of the patterns taken together indicate that the soil seed bank at the edge of the forest is different from that of the interior, and likely to have important consequences for forest composition in fragments where the proportion of "edge" comprises a larger and larger fraction of the forest.

79. Dr. Scott Herron, Ferris State University **Ecology and Evolution**

(Co-Authors: Brenna Chencinski, Josh Byers, Lauren Mitten, Nicole Patrosso, Sarah Thompson, Michael Reynolds, and Andrea Lodholtz)

The Mutualism of Cultural and Ecological Restoration of Wild Rice Communities in Michigan

The Wild Rice and Ethnobiology Lab at Ferris State University is utilizing undergraduate researchers to help Dr. Scott Herron investigate the best practices for establishing a thriving wild rice culture and community in Michigan's Lower Peninsula. We have collaborated on the experiential learning model of wild rice camps in 2007 (White Earth, Minnesota), 2008 (Lac Vieux Desert, Michigan) and 2009 (Mecosta, Michigan) used to train students and interested participants (both tribal and non-tribal) in the production of tools and techniques used in wild rice harvesting and processing. The lab has used these camps to gather wild rice seed used in research conducted by the students, including water chemistry analysis, seed viability and germination, fungal smut pathogen lifecycles, and restoration potential in local seed sources. Without the rice camps teaching new generations how to hand-harvest wild rice with tools produced with their own hands, we would not only the ricing culture of the Great Lakes past, but we would lack the wild rice seed used by ecologists, natural resource managers, and citizens to reseed public and private waters across Michigan. This mutualistic relationship between the rice camps and the restoration research and application is demonstrated quantitatively and qualitatively on the poster presented here today.

80. Elizabeth LaRue, Grand Valley State University **Ecology and Evolution**

(Co-Authors: Carl R. Ruetz III, and Ryan A. Thum)

Population structure of the invasive round goby in Lake Michigan

The recent establishment of the round goby (Neogobius melanostomus), an invasive fish to the Great Lakes, provides a model system to examine fine-scale evolutionary processes that can create genetic structure within a population. We genotyped seven nuclear polymorphic microsatellite markers (N = 11-17 individuals per site) from round gobies from 12 pierhead locations around the entire shoreline of Lake Michigan to characterize their population structure. Our primary objective was to determine whether there are significant patterns of genetic differentiation among sites along the shore of Lake Michigan. By the use of pairwise FST values, our results indicate that round goby pierhead sites exhibit population structure in Lake Michigan. Having established that significant pairwise genetic differentiation exists among many pierhead locations, we set out to determine evolutionary processes responsible for population structure. A migration-drift equilibrium model for population structure was supported by a positive correlation between genetic diversity and geographic distance along the eastern and western shores of Lake Michigan. A correlation between genetic diversity and geographic distance breaks down around the entire lakeshore. Round goby gene flow by shipping route transport and genetic drift from population isolation also explains some of the population structure in Lake Michigan.

81. Ingrid Slette, Hope College **Ecology and Evolution**

Isolation and Identification of Fungistatic Compounds from Tropical Pioneer Plant Seeds

Despite formidable pressure from organisms including rodents, arthropods, and microbes that consume seeds, the seeds of many tropical plants are able to remain dormant and viable in the soil for tens to hundreds of years. This is especially true for pioneer plants such as Phytolacca rivinoides, a plant common in Central America. Pioneer plants are fast-growing, shade-intolerant species that play an important role in forest regeneration. For many species of pioneers, protection against animals and microbes seems to be conferred by toxic chemicals in the seeds. At Monteverde, Costa Rica, P. rivinoides seeds accumulate in the soil to densities over 100 times the annual seed rain, suggesting strong chemical defense. We used several extraction and identification procedures, guided by poisoned-medium assays, to isolate and identify anti-fungal compounds responsible for persistence of P. rivinoides seeds in the soil. An anti-fungal defense compound was extracted from P. rivinoides and was identified as bisphenol A. Bisphenol A is a well-known compound used in the industrial production of some plastics, but is not known to occur commonly in nature. Using the same set of procedures, seven more compounds have been isolated from the closely related species Phytolacca americana, though these have yet to be identified definitively. Similar procedures were utilized to isolate compounds from another pioneer plant species, Guettarda poasana; these compounds also have yet to be identified.

82. Jennifer Liebig, Grand Valley State University **Ecology and Evolution**

(Co-Authors: Jeremy May, and Robert Hollister)

Changes in distribution of northern and southern Arctic plant species due to warming

Vegetation in high latitude regions is expected to respond to climate change more than vegetation in other parts of the world. In this study we examine the response to experimental warming of plant species at four sites in northern Alaska. Data collected in 2007 and 2008 are used; plant cover was sampled using a point frame method. Previous studies have found that when compared to the control plots, the warmed plots show an increase in the cover of vascular plants. For this study we classified the species' historical geographical distribution using four zones. Zone 1 species occur in the northernmost Arctic, while Zone 4 species only occur in the southernmost Arctic. We found that species from the two southernmost zones are not well represented in our sites. Species from Zone 1 did not perform well under the warming treatment and in three of the four sites showed a decrease in cover in response to warming. Species from Zone 2 showed an average 21% increase in cover in the warmed plots, with an increase at all four sites. This analysis showed that the general increase in cover in warmed plots is being driven by species from Zone 2. Thus, the study supports the prevailing wisdom that warming results in an increase in cover of southerly species.

83. Lisa Bol, Grand Valley State University **Ecology and Evolution**

(Co-Authors: Liberty Hightower, Brad Houdek, Marci Baiz, Angel Hayden, and Matthew Romeyn)

Factors that affect the mass of eggs laid by inexperienced Tree Swallows

In female Tree Swallows, environmental factors and breeding phenology influence the mass of eggs laid by experienced breeders. Egg mass is positively correlated with nestling weight at hatching and subsequent survival. In 2008 and 2009 on the GVSU campus, we noted the laying sequence and measured masses of eggs laid by swallows in their first breeding season. Weather data were recorded at a nearby weather station. Egg mass was positively correlated with mean and high temperatures one day before laying and negatively correlated with the amount rainfall three days before laying. Air temperature and rainfall affect the availability of aerial insects. Eggs are produced one day before they are laid. Laying order had a significant effect on egg mass; eggs 1-3 were significantly lighter than eggs 4-6. When all eggs were considered, there was no significant relationship between egg mass and laying date. However, egg mass significantly increased with laying date in both early (8-29 May) and late (2-25 June) nests. These results suggest that first-time breeders, like more experienced swallows, vary their investment in egg production by responding to environmental factors, laying order, and laying date.

84. Marci Baiz, Grand Valley State University **Ecology and Evolution**

(Co-Authors: Angel Hayden, Matthew Romeyn, Lisa Bol, Liberty Hightower, and Brad Houdek)

Parental anti-predator responses during the nestling period in Tree Swallows

Parental effort influences the success of altricial young in monogamous bird species. Previous research demonstrated that female Tree Swallows (Tachycineta bicolor) make more parental effort during the nestling period than do males, and also suggested that female and male patterns of effort differed across the nestling period. In 2009, we examined parental responses to a potential human predator during both the first and second halves of the 20-day nestling period. During each trial we recorded the (a) predator's distance from the nest when a parent first responded to its approach (b) number of attacks and vocalizations by both parents, (c) brood size, (d) weather conditions, and (e) time of day. We found no differences between males and females in the number of attacks and vocalizations during either the first or second half of the nestling period, but both attacked and vocalized more frequently during the second half of the nestling period. Male attacks significantly varied during observation periods; the number of female attacks did not. Parents that attacked often during the first half of the nestling period also did so during the second half. Responses to the predator were not influenced by brood size, weather conditions, or the time of day. While these results suggest that parents increased defense as nestlings got older, male and female patterns differed; the rate of male attacks decreased during observations periods.

85. Peter Dornbos, Calvin College **Ecology and Evolution**

(Co-Authors: Rachel Abma, and Keith Grasman)

Assessment of Immune Function of Wild Birds using Cryopreserved Lymphocytes

Exposure of common loons (Gavia immer) to mercury through atmospheric deposition and biomagnification is a concern throughout the upper Midwestern and Northeastern US and Canada. In the laboratory, mercury suppresses immune function in young loons. The objective of this study was to measure immune function in wild loons exposed to mercury by adapting in vitro methods using cryopreserved lymphocytes. The loon population of interest was in the Adirondack Park of upstate New York, an area known to contain large quantities of mercury due to depositional, geological, and pedological characteristics of the area. While some immune assays necessitate recapturing birds, in vitro immune assays require only a single blood sampling and are useful in species such as loons that are difficult to recapture. In field studies, cryopreservation facilitates the transport of lymphocytes to the laboratory since tissue culture equipment is usually not readily available near study sites. This presentation reports on the adaptation of lymphocyte cryopreservation and culture methods to common loons. Loons were spotlighted and netted at night for collection of heparinized blood. Within six hours of collection, lymphocytes were isolated using a slow spin technique (varying between 100, 120, or 150 xg for 25 minutes). White blood cells were counted in the field to quantify lymphocyte yield as well as contamination by other white blood cells, including thrombocytes. Counts were performed with a hemacytometer using Natt-Herricks stain. The slow spin method worked well in loons, although thrombocyte and heterophil contamination was higher than in other species. Overall the 150xg speed yielded the highest median number of lymphocytes (2,650,000 cells/ml) with relatively low medians of thrombocyte (850,000 cells/ml) and heterophil (1,425,000 cells/ml) contamination. The heterophil to lymphocyte ratio was similar for all three speeds. Lymphocyte samples were frozen in culture medium containing 10% DMSO. The samples will be thawed, and lymphocte proliferation will be induced via mitogens (phytohemagglutinin (PHA), Concanavalin-A (Con-A), lipopolysaccharide (LPS), pokeweed mitogen (PWM) and phorbol myristate acetate (PMA)). Proliferation will be assessed by an ELISA measuring the incorporation of Bromodeoxyuridine (BrdU) into newly synthesized DNA. These cryopreservation and cell culture methods will be used in future studies on the immunotoxicity of mercury in wild loons.

86. Tammy Stambaugh, Grand Valley State University **Ecology and Evolution**

Development of Innate Immunity in Nestling Tree Swallows, Tachycineta bicolor

The innate immune system provides an immediate, first-line of defense against pathogens. Few studies have investigated the development of the immune response as juveniles transition into adults. The ability to respond to pathogens confers fitness benefits in terms of health, survival and reproductive success, and it follows that functions such as rapid growth cannot be fully met simultaneously since energy is a limiting resource. Defense mechanisms are compromised at an early age due to energy allocation to rapid growth. Therefore, immunity should increase as individuals mature. I studied the development of innate immunity in nestling Tree Swallows. Microbicidal assays were conducted in vitro to assess the ability of the immune system to kill E. coli via lysis. I used blood drawn from nestlings at three stages of development: day 6 after hatching when the eyes open, day 12 when endothermy has developed, and day 18 just before fledging. The results show an increase in lysis as birds matured. Additionally, the innate immune system and wing chord in 18 day olds were not fully developed relative to adults indicating that development of the innate immune system and growth continued after fledging. These data suggest that nestling Tree Swallows allocated energy to rapid growth, with apparently less energy towards the development of innate immunity. This may reflect a balance of predation and pathogen pressures on nestlings ultimately favoring selection on rapid growth.

87. Alex Wieten, Grand Valley State University **Ecology and Evolution**

(Co-Authors: M.J. Cooper, D.G. Uzarski, and A.D. Parker)

Great Lakes coastal wetland habitat use by seven turtle species: influences of wetland type, vegetation, and abiotic conditions

Coastal wetlands are important habitats within the Great Lakes for turtles, but few studies have examined turtle community structure in these systems. We used an eight-year fish monitoring dataset in which turtles were also documented to examine differences in turtle communities between wetland types and vegetation. Overall,1370 turtles were captured in 734 net-nights. Turtles were most common in coastal riverine wetlands and 57% of these nets contained at least one turtle. Overall, painted (Chrysemys picta) was the most common species (68.5%, relative abundance), followed by snapping (Chelydra serpentine, 14.6 %), map (Graptemys geographica, 7.2%), musk (Sternotherus odoratus, 5.6%), blandings (Emys blandingii, 3.3%), spiny soft-shell (Apalone spinifera, 0.4%), and red eared slider (Trachemys scripta, 0.4%). Our results show that coastal wetlands are important habitats for a number of turtle species and coastal riverine wetlands may be particularly valuable for conservation.

88. Rachel Abma, Calvin College **Ecology and Evolution**

(Co-Authors: Peter Dornbos, and Keith Grasman)

Assessing the Health Effects of Environmental Contaminants on Herring Gulls at Muskegon Wastewater Treatment Plant

Fish-eating birds are effective sentinel species for assessing and monitoring the impacts of environmental stressors, especially contaminants. Breeding herring gulls (Larus argentatus) were studied during 2006-9 at the Muskegon County Wastewater Management System in Michigan to assess potential adverse health effects of contaminants. Approximately 150-190 pairs of herring gulls bred amongst 5000 pairs of ring-billed gulls (L. delawarensis) on a dike separating two 850-acre wastewater storage lagoons that, by design, contain no fish. Reference data came from previous years at Chantry Island, Lake Huron, a site with low contaminant concentrations. Nests were marked during laying and monitored weekly. Embryonic viability was determined during mid/late egg incubation using a detector for heartbeat and movement. Nonviable eggs were opened and examined for development and deformities. Prefledgling health was assessed through growth measurements and the phytohemagglutinin (PHA) skin test for T-cell mediated immunity. An intradermal injection of PHA stimulated a T-cell dependent influx of white blood cells, and the resulting inflammatory swelling was measured 24 h later. Clutch sizes and egg masses were not significantly different from other sites, suggesting adequate food during the laying period. Loss of eggs and nests and frequent relaying were observed, possibly caused by predators and (or) contaminants. Egg non-viability was significantly elevated at Muskegon in all four years (9.2 % in 2006, 13.5 % in 2007, 19.1 % in 2008, and 12.8% in 2009) compared to the reference site (3.2%). Embryonic failures were spread throughout development, with significant numbers of infertile eggs and dead embryos of various ages. Embryonic effects may have been associated with persistent organic pollutants from fish or water-soluble contaminants from the wastewater lagoons. Chicks lost a significant amount of body mass (-7.5 g/day) between three and four weeks of age during 2007. However, in 2008 they grew at a rate (26.7 g/day) comparable to that of the reference site and other Great Lakes sites with sufficient food. In 2007 the PHA-response was comparable to that of the reference colony. In summary, this study found that herring gulls breeding at a wastewater treatment plant experienced significant reproductive impairment at multiple stages of the breeding chronology, possibly associated with a combination of toxicological and (or) ecological stressors.

89. Joel Blok, Hope College **Engineering**

(Co-Author: Gregory Hubers)

Load-Induced Debonding of FRP Composites Applied to Reinforced Concrete

Fiber-reinforced polymer (FRP) composites are widely used as a method of external reinforcement for damaged concrete structures. While composites have been demonstrated to significantly increase the strength of a damaged structural element, less is known about the long-term durability of FRP systems. This research investigated the effects of fatigue loading on FRP systems and utilized thermal imagining as a means for evaluating bond between the FRP composite and the concrete substrate. Twelve small-scale reinforced concrete (RC) beams were constructed and FRP was applied to the tension faces to simulate flexural strengthening. Cyclic loading was applied at various levels of the strengthened beam's monotonic load capacity and periodic infrared thermography inspections were performed. The condition of the bond was quantified through statistical analysis of the resulting phase images obtained at each load reversal increment. The relationship between bond condition and overall system performance was then investigated using a combination of deflection and strain data.

90. Christina Beaudoin, Grand Valley State University **Exercise Science**

(Co-Authors: Matt Wittbrodt, Kendall Cook, and Alicia Beste)

Does Exercise Identity Influence Psychological and Physiological Responses to Wii Fit and Wii Sport?

The aim of this study is (1) to examine if exercise identity influences psychological and physiological responses to Wii Fit and Wii Sport in college students; and (2) examine if Wii Fit and Wii Sport activities meet exercise intensity recommendations (ACSM, 2010). 37 undergraduate students (20.86 + 1.90 yrs) completed 2 testing sessions. Session 1 consisted of completing the Exercise Identity Scale (EIS), physical measures (e.g., height, weight, estimated VO2max), and Wii Fit and Wii Sport familiarization. During session 2 participants played both Wii Fit and Wii Sport for 20 minutes. VO2was measured using a portable metabolic system, and the Physical Activity Enjoyment Scale (PACES) was completed after playing Wii Fit and Wii Sport. A median split of EIS scores (HI EIS vs. LO EIS) was conducted and one-way MANOVAs examined differences in Wii Fit and Wii Sport enjoyment; Wii Fit and Wii Sport VO2; and physical measures. MANOVA revealed no significant differences in enjoyment between Wii Fit and Wii Sport, no significant differences in Wii Fit and Wii Sport VO2 responses, and a significant effect for physical measures. ANOVA revealed estimated VO2max differed between HI and LO exercise identity participants. VO2 for Wii Fit and Wii Sport were below ACSM intensity recommendations for healthy adults. Participants enjoyed Wii Fit and Wii Sport independent of exercise identity, providing support for Wii Fit and Wii Sport as plausible physical activity options.

91. Steve Pohler, Calvin College **Engineering**

Woody Invasive Species as Biomass Sources for Cellulosic Ethanol

Global energy demand and diminishing petroleum resources have led to increased research into alternative liquid fuels that burn cleanly and interface easily with existing infrastructure. Ethanol from biomass is being considered due to its renewable nature and abundance of raw material. Woody biomass contains three main components: cellulose, hemicelluloses and lignin. All three are natural polymers which require different processes to break apart into sugar molecules, and are then fermented by a microorganism into fuels such as ethanol. Sources such as corn, corn stover and alfalfa either require large energy inputs or are necessary for soil rejuvenation and therefore not preferred. For this reason three invasive species (common and glossy buckthorn, autumn olive) were chosen for a growth and sugars composition study. The goal is to determine if any of the three species are suitable for use as biomass to convert to ethanol, and where they compare to current sources economically and environmentally.

92. Austin Westhuis, Grand Valley State University **Geology**

(Co-Author: Dr. Linda L. Davis)

How Old are the East-West Trending Dikes at Spanish Peaks Colorado?

This study is part of a larger research project examining the genesis of a group of unusual rocks exposed just east of the Rocky Mountain Front from Montana to New Mexico. We focus here on a particular subset of these unusual rocks found near the Spanish Peaks igneous complex in southern Colorado. The igneous events at Spanish Peaks took place as three separate stages of magmatic intrusion: the first stage (oldest) is represented by east-west trending, tabular dikes and sills; the second stage of younger magmatism is represented by two enormous stocks and radial dikes that cross-cut those of the first stage; and finally the third stage of magmatism is represented by another set of east-west trending dikes. Many varied and unusual igneous rock types are present here, but only the older east-west trending dikes are examined in this study. These rocks are rich in potassium and magnesium and have a significantly different petrogenesis than the rocks of the other two stages.
Distinguishing these rocks in the field proves to be difficult, but because of the way the rocks weather we are able to identify potential outcrops with the help of topographic maps, satellite imagery and previously published geologic maps. Because the field relationships in the area are complex, we located and plotted the samples analyzed by previous researchers on our satellite photographs; ensuring that the sample locations from which we collected had not been previously studied or dated, and were actually good candidates for our study. After locating the potential outcrops, we collected our samples and verified the rock compositions by a preliminary examination of the mineralogy. After collection, the samples were brought to the lab for further analysis. The samples were cut into billets and then prepared as thin sections. We re-examined the mineralogy by analyzing the thin sections using petrographic microscopes. Using the mineralogy we determined which samples were the best candidates for radiometric dating based on the presence of phlogopite and the absence of alteration. Our overall goal is to confirm that the oldest E-W trending dikes are of the correct geologic age (about 38 million years old). Then we can proceed to the next stage of the project to compare the genesis of these potassic, mafic rocks near Spanish Peaks to the genesis of similar rocks of similar age along the Rocky Mountain Front, in order to understand what triggered the melting event leading to the igneous intrusions. With the work completed to date, a solid foundation has been established that justifies the need for more sophisticated analytical analyses. Grand Valley State University does not have the appropriate specialized laboratory; however, we have obtained funding through GVSU, the S-STEMS program and the Geology Department to travel to the New Mexico Geochronology Research Institute to obtain four 40Ar-39Ar radiometric age determinations. The director of the institute has invited us to come and use the necessary rock preparation equipment in “clean laboratories” and to prepare our samples for Ar-Ar radiometric age determinations. Our analytical work at the lab begins in early November, and the age determinations for the samples are expected by before the year’s end.

93. James Barr, Grand Valley State University **Geology**

(Co-Authors: Curtis Barkley and Ginny Peterson)

Petrofabric and Timing Constraints on the Exhumation History of the Buck Creek-Chunky Galultramafic/Mafic complex and adjacent Chunky Gal Mountain Fault in the Southern Appalachian Blueridge

The Buck Creek-Chunky Gal (BC) ultramafic/mafic complex, among the largest in the southern Appalachian Blue Ridge, lies adjacent to the Chunky Gal Mountain Fault (CGMF), a syn-metamorphic terrane-bounding structure. Detailed comparative evaluation of the post-peak metamorphic and structural history of the BC complex and CGMF provides new P-T-t-deformation constraints on their exhumation history. Previous work indicates that meta-troctolites in the BC complex preserve high P/T anhydrous conditions, and experienced localized hydration at and following peak metamorphism. In hydrated meta-troctolites the dominant (S2?) foliation appears defined by coarse edenitic amphibole (EdA), part of the peak (~825oC-1.2GPa) hydrated assemblage. A few outcrops that preserve late structural fabrics and interference relations reveal up to 5 planar fabrics, mostly defined by edenitic amphibole (EdA) and chlorite (chl) of varied sizes and textures. The dominant foliation (S3?) in these outcrops, defined by chl grains and recrystallized EdA and chl domains strikes NNE with a steep dip. A later E-W spaced cleavage (S4) is defined by chl with associated crenulations. Two fine pre-S3 chl foliations appear to transect a relict compositional layering. To date, the deformation and metamorphic character of the CGMF is constrained by detailed outcrop description and petrofabric studies of its defining SSW-facing road exposure along US Hwy 64. The dominant (S2?) moderate/shallow foliation is deformed by steep NNE-striking high strain zones, defined by mylonite, ultramylonite, and brittle faults, with apparent outcrop-scale normal offset, spaced several meters apart within biotite gneiss and along the contact with Chunky Gal amphibolite. Shear zones preserve a shallow lineation, typically with dextral shear sense, and/or a down-dip lineation associated with a normal shear sense. Estimated peak conditions from a garnet mylonite are >650oC @ ~8 GPa. Local dynamic recrystallization and possibly fast-migrating grain boundaries in feldspar, strain-induced myrmekite growth, and plastic deformation of hornblende point to relatively high temperature (peak?) deformation associated with dislocation and diffusion creep. Continued retrograde deformation marked by localized domains of foliated muscovite, including muscovite fish, resulted from similar mechanisms at somewhat lower temperatures, facilitated by localized fluid flow. Preliminary EPMA monazite ages from the same garnet mylonite (above) point to monazite growth (cores) at peak metamorphism (~470 Ma), likely associated with higher temperature deformation and later growth at ~450 Ma of rims and small matrix grains, some with dextral matrix tails, perhaps linked to retrograde muscovite deformation.

94. John Weber, Grand Valley State University **Geology**

(Co-Authors: Phil Kenroy, Jeremy Espinosa, James Barr, Kyle Crosby, Kelvin Koster, Christie Kroskie, Ben Matzke, Martha Roldan, Mary Russo, Kyle Siemer, Mike Slot, Kent Walters, Peter Wampler, Austin Westhuis, and Chad Williams)

Digital geologic and geomorphic mapping in the GVSU (Allendale) campus ravines

As part of a long-term class (GEO 315) project, we are mapping the Pleistocene (ice-age) geologic deposits exposed in the GVSU campus ravines, and mapping geomorphic features (e.g., gullies, landslides, etc.) related to active erosion there. Our goal is to better understand and quantify how storm water run-off related to waterproofing of natural land surfaces during campus development and urbanization, and the recent move toward "greening" of campus, has affected/affects the ravines system. We are also estimating long- and short-term down-cutting and headward erosion rates to compare pre-urbanized (natural) values with urbanized values. This term, we will start tracking the decade-long history of change recorded on our maps (1999-2009) by producing a time-series of digital geologic and geomorphic maps in the ArcMap GIS environment.

95. Kyle Siemer, Grand Valley State University **Geology**

(Co-Author: Davis L.)

Clogging of the Southern Kent County Landfill Drainage System

The Southern Kent County Landfill is a hazardous waste facility with a confined drainage system. This drainage system acts as a barrier to migration of contaminated leachate from the landfill into the subsurface environment. The landfill contains solid waste (MSW) and is adjacent to a fly ash pit of incinerated waste. The drainage system becomes clogged with a precipitate designated as bio-rock. A focus of research has been to evaluate the composition and genesis of bio-rock. The bio-rock is constructed of layers of calcite (CaCO3) separated by algal or fungal mats. A second mineral may also be present. Calcite is present as equant and plumose crystals: the crystal morphology indicates very rapid growth. A set of experiments was designed during the second phase of research to force precipitation of the bio-rock under controlled conditions. Experiments were guided by field observations: bio-rock forms where leachate from the fly-ash pit and the municipal solid waste (MSW) landfill mix. Seven samples were collected. From preliminary analysis, evaporated leachate samples contain a zeolite instead of calcite precipitates. Analysis of the remaining precipitates is underway. While precipitation of zeolite was unexpected, it indirectly redirected our research focus. The landfill and fly-ash pit are by nature rich in Ca and CO2 and the combination of these, calcite, is almost inevitable at the Earth's surface. A new experimental model is being designed in which Na-rich zeolites are added to the Ca-rich fly ash leachate (before mixing with MSW leachate) in order to induce a reaction, pulling Ca out of solution and thereby hindering the formation of bio-rock.

96. Mallory Morell, Grand Valley State University **Geology**

(Co-Authors: John Weber, and Pablo Llerandi-Román)

Coastal terrace tectonic geomorphology, Trinidad, West Indies

Geomorphic features in northern Trinidad reflect westward sinking and tilting into the active Gulf-of-Paria pull-apart basin. Raised coastal terrace deposits have been mapped at ~15 meters above modern sea level along the northeastern and northern coasts. The purpose of our study is to determine the stratigraphic and tectonic origin of the eastern terraces. We are testing two hypotheses: (1) as the western end of the island sinks, the eastern end rises in a seesaw-like motion, and (2) as the western end of the island sinks, the eastern end remains fixed relative to changing sea level. We measured and described stratigraphic sections and conducted granulometric, XRD, and optically stimulated luminescence (OSL) dating analysis in a total of 15 terrace deposits near Toco and Blanchisseuse. Terrace deposits range in thickness from 60 to 280 cm and contain sand and gravel. Fifty pebbles were selected and measured from one outcrop, plotted on a Zingg diagram, and clustered as rounded. XRD showed that fine sieve fractions consisted almost entirely of quartz. Three OSL ages obtained from 5 samples ranged from 40 to 138 ka; two ages fall near global sea level high stands. Field and laboratory data support that the terraces are marine in origin. The OSL ages suggest that they could be high-stand deposits. These preliminary data suggest that as the western side of Trinidad sinks into the Gulf-of-Paria, the eastern side probably remains fixed relative to changing sea level.

97. Ember Clark, Aquinas College **Mathematics**

K-Step Domination in Select Families of Graphs

We worked at and succeeded in deriving formulas for a few different kinds of graphs which would yield the domination number of the graph when given "n" and "k." We did this mostly by constructing efficient dominating sets and finding upper bounds, lower bounds, and patterns. We are also striving to make some more general statements involving diameter, radius, and center.

98. Adrienne Gibson, Grand Valley State University **Microbiology**

(Co-Author: Dr. Alexey Nikitin)

The Effect of Caffeine on the Bacterial Populations in a Freshwater Aquarium System

This study was devoted to the analysis of the effects of dissolved caffeine on aquatic systems. Initially, we set out to test modifications in fish behavior in response to increased doses of caffeine. We soon found out that there are dramatic changes in water chemistry with the caffeine, which prompted a switch in experimental design. The presences of caffeine in the aquarium's environment resulted in an increase of ammonia to lethal levels, accompanied by an increase in nitrites. In addition, a biofilm-like sheen appeared on the inside of the aquarium's glass. We cultured the organisms from the sheen, as well as from the water in the aquarium. Both locations appeared to contain bacteria of the genus Pseudomonas. The caffeinated aquariums showed considerably larger amounts of bacterial colonies compared to the control aquariums. We hypothesize that the increased ammonia concentrations in the caffeinated aquariums are correlated with the metabolic activity of the Pseudomonas bacteria, making the caffeinated environment toxic for aquatic life.

99. Aleksander Archiyan, Grand Valley State University **Microbiology**

(Co-Authors: Jordan Evans, Lucas Snider, William Schroeder, Robert Smart, and Roderick Morgan)

Carboxylic Amides as Potentially New Antibacterial Agents

Increasing resistance to antibiotics by certain bacterial species has made it imperative that novel compounds be discovered, developed and approved to help alleviate the rise of resistance to antibiotics. Improper use of antibacterial compounds has led to the rise of resistant species of bacteria such as methicillin resistant Staphylococcus aureus (MRSA), vancomycin resistant enterococci (VRE), and extreme drug resistant tuberculosis (XDR-TB). We have discovered a potentially new class of antibiotics that inhibit the growth of Gram-positive bacteria. Since inhibition against S. aureus and E. faecalis occurred, MRSA and VRE strains were tested and inhibition by our compounds was identical to non-resistant strains of each species. Additionally, this class of antibiotic also inhibits strict anaerobic Gram-positive organisms including Clostridium difficile, which can cause diarrhea humans. The minimum inhibitory concentration against these bacteria range from 2ug/ml to 64ug/ml, depending on the organism and specific chemical derivative used in the testing. These results demonstrate that our carboxylic amides compounds are a novel, non-penicillin based antibiotic that could be used to treat MRSA and other Gram positive infections.

100. Emily Resseguie, Calvin College **Microbiology**

(Co-Author: Professor Arlene J. Hoogewerf)

Heavy Metals and Resistance Mechanisms in Staphylococcus aureus

Staphylococcus aureus is a bacterium that commonly causes infections in humans and fouling of pipes in industry. It produces self-adhesive communities called biofilms that can be resistant to antibiotics and heavy metals, which makes it problematic to eliminate the biofilms. The purpose of these experiments is to functionally characterize the mechanisms involved in the responses to metals by observing changes in biofilm quantity and transcription of several key biofilm genes.

101. Melissa Buzzard, Grand Valley State University **Natural Resource Management**

(Co-Author: Dr. Erik Nordman)

Evaluation of Local Parks Using the Recreation Opportunity Spectrum with an Additional Education Factor

We used the Recreation Opportunity Spectrum (ROS) to analyze local parks and determine if Van Zoeren Woods (VZW) offered unique recreation opportunities in the Zeeland area. Purchased by Zeeland Charter Township ten years ago, VZW is undeveloped and could be used for recreational and educational purposes. All state, county, and local parks and unimproved open spaces within an 8-mile radius of Van Zoeren were selected using ArcGIS 9.2. Thirty-four total properties were identified and analyzed based off the six ROS management factors plus an addi¬tional factor of education, whose ratings ranged from primitive to modern. Comparing the medians in each of the categories using the non-parametric chi-square, Van Zoeren Woods was found to be unique in its unimproved state. We made recommendations to the township to improve access and educational facilities at VZW.

102. Emily Leathley, Hope College **Neuroscience**

(Co-Author: Dr. Greg Fraley)

A Role For Galanin-Like Peptide (GALP) in the Regulation of Reproduction and Energy Homeostasis in Female Rats

GALP is thought to be a link between metabolism and reproduction. GALP's actions in the male rat have been well described, however, there is a dearth of information about GALP's role in females. Some reports have suggested that GALP may have very different effects in the female because of its interactions with estrogen. In this study, we explored GALP's effects on feeding, metabolism, and reproduction in female rats with or without estrogen replacement therapy. Female rats were ovarectomized and given either a 1mm estradiol benzoate (EB, low physiological estrogen), 4mm EB (high physiological estrogen), or were given no EB replacement (n = 6 per group). We found that GALP had a similar effect on feeding behavior as described in the male; an initial significant ($p < 0.05$) increase in food intake over the first hour, though there was no significant effect of GALP over twenty-four hours. Unlike in male rats, GALP did not significantly alter metabolic rate, regardless of estrogen status. Similarly, there were also no significant changes in reproductive behavior in response to GALP, though the different estrogen treatments exhibited well-established differences in sexual behaviors. GALP effects on gonadotropin secretion and central fos activation will be discussed. These data suggest that there are distinct sex differences in GALP's actions on energy homeostasis and reproduction. These sex differences may be due to sexual dimorphisms in target sites of GALP neurons.

103. James Carrow, Aquinas College **Neuroscience**

(Co-Author: Dr. Tom Bahl)

Courtship Behaviors of Periplaneta americana (the American Cockroach): Innate or Learned?

In this experiment the courtship behaviors of sexually experienced P. americana were compared to the courtship behaviors of sexually naïve P. americana to determine if behaviors are inate or learned. The pairings used were experienced-experienced and experienced-inexperienced, with both inexperienced males and females being paired up with experienced members of the opposite sex. Thirty-four such pairings were observed, and the results were compared between the different pairings to determine if experienced and inexperienced courtship behaviors were similar (suggesting "nature") or if the behaviors were different (suggesting "nurture.") When comparing the average number of times a behavior was displayed per trial there was a difference when comparing the wing flutters, mount attempts, and number of copulations between experienced male/naïve female and experienced male/experienced female (control) ($P<.1$) When comparing the percentage of cockroaches displaying a behavior at all during a trial there was a difference in copulation and mount attempts between male/naïve female and experienced male/experienced female and a difference in antennae fencing between both experimental groups and the control. The data suggest that although the behaviors themselves are not learned, at the very least they are refined in their application through either experience or observation of other individuals.

104. Julia Becker, Hope College **Neuroscience**

(Co-Authors: K. Castillo, Dr. Greg S. Fraley, and G. Torres)

Resveratrol Ameliorates Brain Damage Induced By Surgical Cannulae: Potential For Treatment Of Parkinson's Disease

During advanced-stage Parkinson's disease (PD), many patients resort to deep brain stimulation (DBS), a treatment in which electrodes are implanted into the subthalamic nucleus (STN). This treatment provides relief from tremors, rigidity dystonias, dyskinesias, and helps in initiating movements. Even though this treatment has proven highly effective for many PD patients, the main side effects are due to a 1 mm3 area of cell death around the electrode. The lesions are due to the physical presence of the electrodes and eventually lead to an ineffectiveness of DBS to ameliorate the signs of Parkinson's disease. Resveratrol (RESV) is a plant derivative and antioxidant found in grape skins (specifically in red wine) that has shown to have protective effects against cellular degeneration. Thus, we hypothesized that RESV may have neuroprotective effects to prevent brain lesions associated with the physical presence of cannulas in the brains of rats. To determine whether injecting RESV can protect the brain from injury, 16 adult male rats were injected both with RESV on one side of the brain and DMSO (control) into the contralateral side of the brain, creating a within-subjects design study. The subthalamic nucleus (STN) was targeted with these injections because the STN is the target site in humans with DBS. A rotorod test was used to quantify motor coordination following injections. We found that all rats showed significant ($p < 0.01$) motor-deficits 7 days post surgery. Neuronal damage was assessed using Nissl stain, GFAP immunocytochemistry (to measure gliosis), and Fluoro-Jade stain for neuronal degeneration. These histological techniques demonstrated that lesions worsened over time after injections. The control side injection showed increased gliosis, necrosis, and increased neuronal degeneration. Qualitative assessments suggest that RESV-treatment attenuated all of these effects, thus preventing much of the neuronal damage associated with cannula placement. In a follow-up study we injected RESV or control solutions bilaterally ($n = 6$ per treatment). Initial analyses suggest that bilateral treatment with RESV may prevent motor deficits associated with the bilateral injections. Our studies suggest that resveratrol may have neuroprotective effects that may be a useful tool in the treatment of Parkinson's disease.

105. Karlie McManaman, Hope College **Neuroscience**

(Co-Author: Kathleen Lorenz)

A role for incertohypothalamic dopamine on the development of female feeding and reproductive systems

Mesolimbic dopamine systems are well studied, however, very little is known about the functions of the incertohypothalamic dopamine system. Dopamine projections to the arcuate nucleus of the hypothalamus are thought to be involved in feeding and reproduction in males. However, these effects have not been systematically investigated in females. In order to determine dopamine's role in feeding and reproduction in females, we utilized immunolesion technology to eliminate dopamine projections to the arcuate nucleus of the hypothalamus. Injections of the toxin Saporin bound to an anti-dopamine transporter monoclonal antibody (DAT), or unbound Saporin (SAP) were given bilaterally into the arcuate nucleus in prepubertal Long-Evans female rats (n = 6 per group). SAP is a toxin that kills cells by deactivating ribosomes but is unable to enter a cell without a transporter. When SAP is bound to the DAT, it kills all cells with dopamine transporters, eliminating dopamine neurons that project to the site of injection. We compared the post–surgery food intake, metabolic rate, motor skills, sexual behaviors, puberty onset, estrous cyclicity, and body weight. No significant differences were observed between the two groups in the age of pubertal onset, estrous cyclicity, or motor skills. Throughout the post-surgical analyses, DATSAP rats weighed significantly ($p < 0.05$) more than the SAP rats. Initially, DATSAP rats also showed a significant ($p < 0.05$) reduction in metabolic rate compared to SAP controls. When compared to the SAP rats, DATSAP rats also showed a significant reduction in proceptive sexual behaviors. Receptive sexual behaviors did not seem to be affected. Although there was no significant difference in 24 hr food intake between the two groups, DATSAP rats did show significantly ($p < 0.05$) altered meal size compared to SAP controls. These data suggest that hypothalamic dopamine is involved in specific aspects of both feeding and reproduction.

106. Ronald Kress, Grand Valley State University **Neuroscience**

(Co- Authors: John Capodilupo, Ryan Wissner, Louis Moran, and Zachary Breen)

Analysis Of GAP-43 In An Animal Model Of Alzheimer's Disease Using Two Dimensional Gel Electrophoresis

We are examining a growth associated protein, GAP-43, which is a brain protein expressed in a wide variety of species including humans and has been shown to become biochemically altered in the process of learning and memory. Specifically, levels of phosphorylated forms of GAP-43 have been shown to increase following a paradigm of learning and memory in several animals including rat and mouse. We are interested to see if any differences in the profile of GAP-43 are associated with dementing illnesses that severely disrupt memory and learning. Since human brain tissue is difficult to obtain, we utilize brain tissue from a chemically treated rat engineered to resemble Alzheimer's disease, a human neurodegenerative disorder characterized by profound cognitive impairment. Therefore, to test the hypothesis that the profile of phosphorylated isoforms of GAP-43 are changed in the brains of a rat used to model Alzheimer's disease, GAP-43 will be examined by 2 dimensional SDS polyacrylamide gel electrophoresis. Isoforms of rat brain GAP-43 will be detected by immunocytochemistry and silver staining and, further, quantified by computerized densitometry. Alterations in quantities of phosphorylated forms of GAP-43 might result from a pathological biochemical processes.

107. Wendi-Jo Ervin, Grand Valley State University **Neuroscience**

(Co-Authors: Embriette Hyde, and Martin G. Burg)

Histamine and eGFP co-localization in flies bearing an Hdc promoter-eGFP gene fusion

Histamine is a biogenic amine that is used as a neurotransmitter by photoreceptors and possibly by central histaminergic neurons. Histidine decarboxylase (HDC) is the enzyme that synthesizes histamine, using histidine as a substrate. Mutations in the Hdc gene have been identified which result in functional blindness (Burg et al., 1993) and other phenotypes, such as temperature preference (Hong et al., 2006). We are interested in understanding how tissue-specific expression of Hdc is controlled by examining the function of the Hdc 5'-UTR and 3'-UTR in regulating expression of a reporter gene, eGFP, in histaminergic cells. Previous results demonstrated that a 4.3 kb region, 5' to the ORF of the Hdc gene, was necessary for expression in the central brain and photoreceptors (Burg and Pak, 1995). This 4.3 kb genomic region containing the Hdc promoter region was fused to eGFP in order to determine if this region is sufficient to drive a normal Hdc expression pattern. Results indicate that the 4.3 kb 5' region of the Hdc locus appears to be sufficient to direct expression in cells that normally express the Hdc gene, determined through histamine immunocytochemistry. Burg, M.G. et. al. (1993) EMBO J. 12(3): 911-919.Burg, M.G. and Pak, W.L. (1995) Invest. Ophthal. and Vis. Sci. 36(4): 1979.Hong et al. (2006) J Neuroscience 26(27): 7245.

108. Ben Konynenbelt, Calvin College **Organism Biology / Physiology**

(Co-Author: Dan Mlnarik, and Dr. John Ubels)

Cytotoxicity Testing of Contact Lenses and Multipurpose Contact Lens Solutions Using Monolayer and Stratified Cell Models

This study examines the effect of contact lenses soaked in MPS on the viability of cells. Monolayer and multilayer cells exposed to Acuvue Oasys lenses soaked contact lens care solutions were subjected to the live/dead cell viability assay and were observed using fluorescence microscopy. The percent viability of monolayer cells exposed to MPS was measured using the live/dead cell viability assay and flow cytometry. A cell adherence assay was developed determine whether cells were attaching to the contact lens upon removal from the cells. This assay examined the adhesion of both monolayer and multilayer cells to either Acuvue Oasys, O_2 Optix , or PureVision lenses soaked in MPS. Three MPS were tested : OPTI-FREE Express, ReNu MultiPlus, and Complete Easy Rub. It was expected that tests using multilayer cells would more accurately predict the response of the intact human corneal epithelium than tests on monolayer cells.

109. Dan Mlnarik, Calvin College **Organism Biology / Physiology**

(Co-Authors: Ben Konynenbelt, and Dr. John Ubels)

Cytotoxicity Testing of Contact Lenses and Multipurpose Contact Lens Solutions Using Monolayer and Stratified Cell Models

Recently there has been a shift in ocular cytotoxicity testing from the use of in vivo studies on animals to in vitro tests. In vivo testing has been criticized because of a lack of correlation with clinical response and for ethical reasons involving animal testing. In vitro methods on cells in culture, such as the human corneal-limbal epithelial cell line (HCLE), are now being evaluated because of the need for improvements in the use of cell lines to replicate in vivo conditions. Traditional tests on cells grown in monolayer culture are sometimes highly sensitive, producing results that are not predictive of the intact corneal response. Moreover, testing of multilayer cells more accurately models the intact human corneal epithelium. Lim et al. (2009) tested the in vitro response of HCLE cells exposed directly to multipurpose contact lens care solutions (MPS)1. MPS contain anti-microbial agents, preservatives, and surfactants that clean by simply soaking the lens. All of these components must therefore go through various forms of testing in order to ensure the safety of the consumer, since these agents are potentially toxic to the cornea.This study was conducted to develop a model that more closely mimics in vivo conditions for the cytoxicity testing of MPS and to determine if MPS have adverse effects on HCLE cells, when applied to the cells by means of a contact lens.

110. Melissa Bobowski, Grand Valley State University **Organism Biology / Physiology**

Nest Site Characteristics and Reproductive Success in Tree Swallows

If nest site characteristics impart benefits to tree swallows (Tachyncineta bicolor), then individuals should prefer nest sites that have features that have a positive influence on reproductive success. A survey of the literature on tree swallows nesting in both artificial and natural nest sites showed a common trend in the qualities of sites that are regularly used; swallows preferred nests that were away from wooded areas and faced south-southeast. I used data collected from tree swallows nesting in nest boxes from 1996-2005 at GVSU to examine the fine-scale geographic patterns of nest site use and reproductive success using Geographic Information System (GIS) and spatial statistics. Nest site use was measured by the occupancy rate in individual boxes and reproductive success by the total number of young fledged from each box from 1996-2005. Results showed that tree swallows preferred to nest in some areas of the site over others and those that occupied the preferred area had the greatest reproductive success.

111. Steve Gauthier, Grand Valley State University **Organism Biology / Physiology**

(Co-Author: Dr. Dan Bergman)

Sublethal exposure to two alkylphenolic compounds and their influence on development, growth and reproductive behavior of crayfish

Invertebrates make up much of the world's biological diversity. Their survival is fundamental to the maintenance of all life, and their ubiquitous distribution is useful when using them as biological indicators of pollution. Many invertebrate species are under threat of extinction due to exposure to various chemical pollutants. Crayfish are an important invertebrate that is affected by chemical pollutants, such as pesticide/herbicide runoff and industrial waste effluents. Crayfish are considered keystone species because they are an important resource for other species and consequently influence diversity and abundance. For these reasons, crayfish are important in terms of better understanding the effects of pollution on their behavior and ultimate survival. Alkylphenols are a group of chemicals often concentrated in the tissues of crayfish, fish, and birds when released into nature. They are used in various detergents and pesticide formulations, which makes them very common pollutants. Exposure can lead to contamination levels between ten to several thousand times greater than in the surrounding environment. They have notably adverse effects in fish and likely have similar harmful impacts for crayfish. We examined the effect of exposure to two alkylphenol pollutants (nonlyphenol and octylphenol) on development, growth, reproductive behavior, and success finding food at sublethal levels. We found numerous significant impacts on crayfish when exposed to alkylphenols

112. Susan Bardolph, Calvin College **Organism Biology / Physiology**

(Co-Authors: Leah Koetje, Mark Schotanus, John Ubels, and Loren Haarsma)

Inhibition of UV-B Induced Apoptosis in Corneal Epithelial Cells by K+ Modulators

The goal of this study was to determine whether prevention of K+ loss can protect human corneal-limbal epithelial (HCLE) cells from UV-B induced apoptosis. Caspase-8 activity induced by exposure to UV-B at 150 mJ/cm2 was significantly reduced when the cells were incubated in 0.3 mM BDS-I or 0.05-1 mM quinidine. Caspase-3 was also activated by UV-B and a reduction in activity was observed after incubation in 0.1-0.3 mM BDS-I and 0.1-1mM quinidine. Induction of DNA fragmentation, as measured by the TUNEL assay, was decreased by treatment with 0.3 mM BDS-I and 0.01-0.05 mM quinidine. Patch-clamp recording showed activation of K+ channels after exposure to UV-B and a decrease in outward K+ current was observed following application of BDS-I. Quinidine did not block K+ currents in HCLE cells, suggesting that the protective effect of quinidine occurs by a mechanism other than via K+ channels. The effect of the K+ channel blocker BDS-1 on HCLE cells exposed to UV-B confirms that preventing K+ efflux protects corneal epithelial cells from apoptosis. This suggests the elevated [K+] in tears may protect the corneal epithelium from effects of ambient UV-B.

113. Benjamin Keen, Grand Valley State University **Physics**

Numerical Simulation of the Dynamics of Many-Body Physical Systems

Standard Newtonian mechanics can be used to study the motion of objects moving at non-relativistic speeds. Newton's laws of motion are relatively simple to apply to physical systems containing a limited number of objects that have uncomplicated interactions. For systems which contain many objects or whose objects have complex interactions, such as celestial bodies or atoms/molecules, the standard equations of motion become analytically un-solvable. These complicated systems can, however, be modeled using a variety of computational methods in modern computer systems. Towards this purpose a modeling program was constructed to simulate the resultant motion of interacting many-bodied particle systems. Using the Lennard Jones potential to approximate the interaction between atoms it was possible to simulate the motion of collections of particles under a variety of initial conditions. Using the microscopic data from these simulations it was then possible to extrapolate macroscopic characteristics, such as temperature, pressure, speed distribution, and spatial distribution function for the system. This process allowed us to see what effects the small scale interactions between particles have on the macroscopic properties of the system as a whole.

114. Charlotte Du Laney, Calvin College **Physics**

(Co-Authors: Dr. Loren Haarsma and Dr. Paul Moes)

Electrophysiological Properties of Probst's Bundles

In a normal brain, the Corpus Callosum (CC) serves as a intermediary between the two hemispheres, allowing for the sharing of information and coordination. We have begun electrophysiology experiments in mouse brain slices to study synaptic transmission from CC fibres to Layer V neurons in normal mice. Our goal is to perform the same experiments in mice with congenital malformations of the CC which form Probst's Bundles (PB) instead of functional CC

115. Candace Goodson, Hope College **Physics**

Doping Dependent Microwave Nonlinearity of Tl2Ba2CaCu2O8-x Superconductor

The carrier doping of the Tl2Ba2CaCu2O8-x (TBCCO-2212) superconductor is a potential tool for modifying the nonlinearity of the superconductor's microwave response. The properties that respond to carrier doping level include the surface resistance (RS) and critical temperature (TC) of the TBCCO-2212 superconductor. The effect of nitrogen annealing on RS and critical temperature was demonstrated. A sapphire/superconducting dielectric resonator housed in a liquid nitrogen cryostat was tested with a vector network analyzer in order to determine RS and TC. The influence of the induced surface current on RS, called nonlinearity, was found to depend on the doping level, as was the TC. This, in turn, provides a useful correlation of doping level to the temperature of the nitrogen anneal. Nitrogen annealing has thus been shown to provide a calibrated method to select a nonlinearity regime of the superconductor.

116. Christopher Ploch, Hope College **Physics**

(Co-Author: Cameron Recknagel)

Collisional-to-Collisionless Transition of a Microwave Induced Plasma

The microwave electric field required to induce dielectric breakdown of a gas exhibits a minimum at the boundary between pressure regions of plasma dynamics. The plasma produced by breakdown is separated into two regimes by this Paschen minimum: collisional plasma, which contains particles having frequent low-energy collisions resulting from the short mean free path of a high pressure gas, and collisionless plasma, which contains particles having infrequent high-energy collisions resulting from the long mean free path of a low pressure gas. The breakdown electric field was measured for several gases, revealing the minimum point and allowing the breakdown kinetics to be examined by relating the average electron kinetic energy to the mean free path. A change in mean free path dependence at the minimum indicates that a transition between plasma conditions indeed occurs at this minimum. Spectroscopic measurements of a helium plasma glow reveal a rise in relative intensity of the lower energy (1s2p→1s3s) emission line and a sudden drop in the higher energy (1s2p→1s3d) line at pressures above the minimum, indicating that at lower pressures the low frequency of collisions sends electrons into higher orbital states.

117. Katie Shomsky, Calvin College **Physics**

(Co-Authors: S.L. Haan, Z.S. Smith, P.W. Plantinga, and T.L. Atallah)

Anticorrelated Electrons from High-Intensity Non-Sequential Double Ionization of Atoms

Non-Sequential Double Ionization yield and final e-e correlation – or anticorrelation – are examined for laser wavelength 800 nm over a wide range of laser intensities, using 3d fully classical models. It is shown that in the transition region between NSDI and sequential ionization, turn-on stage recollisions can lead to having a majority of anticorrelated (back-to-back) electron pairs.

118. Nathan Meyers, Calvin College **Physics**

(Co-Author: Paul Harper)

Nonlinear Effects of Sucrose on Lipid Kinetics

This poster explores the effects of sucrose on the phase transition kinetics for PE lipids, but specifically SOPE. We explore the phase transition from the liquid lamellar to inverse hexagonal for SOPE. In just nanopure water, the equilibrium phase transition temperature occurs around 57 degrees Celsius. This poster explores the effect of various concentrations of sucrose in nanopure water on that phase transition temperature. We found a linear dependence between concentration and equilibrium phase transition temperature. We also explore the effect of sucrose concentrations on the coefficient and exponent in the power law relationship exhibited between hysteresis and ramp rate. We found that for both the coefficient and the exponent in this relationship, the changes are nonlinear with respect to changing sucrose concentrations.

119. Joshua Krueger, Calvin College **Psychology**

Psychological Treatment of Adult Sex Offenders

This independent study addresses the issues of psychological treatment of adult sex offenders. This issue has been controversial and many have questioned the efficacy of treatment for this population. The general consensus is that treatment of adult sex offenders has been of limited value. The community consensus of a very high recidivism rate among these offenders has led to serious concerns about the safety of communities pertaining to where these offenders live, the mandatory registration, and the punishment of these offenders. The chief concern is whether treatment actually reduces victimization and, if so, by how much?

120. Zach Mills, Grand Valley State University **Ecology and Evolution**

(Co-Author: Dr. James Dunn)

Factors that Determine the Distribution of Butterflies within Complex Prairie Habitats

Spatial distribution of native lepidopteron species was examined in correlation with various environmental components of restored prairie habitats in Barry County, Michigan. We examined the influence of host plant species and nectaring species on distribution. By using simple mark and recaptures methods assess individual movement patterns could be assessed in relationship with environmental quality. By assessing the relative altitude of capture locations, we were able to hypothesize that breeding populations of butterflies, specifically Euphydryas phaeton, prefer to aggregate in areas higher in elevation than the surrounding environment. From this we can deduce that areas of high vegetative quality are not always indicative of high butterfly concentration. Species were catalogued and capture data were used in the development of an approximate flight period log per species.

121. Kirsten Borek, Aquinas College **Cell and Molecular Biology/Genetics**

DNA Barcoding of Quercus sp. at Pierce Cedar Creek Institute Using the matK Gene

When identifying different species in the field or in a laboratory, morphological characteristics are often used. These distinguishable characteristics can be very similar among different species which can make the identification process very difficult. Another way to denote different species is through a DNA barcoding method. Similar to items in a store that have a universal product code (UPC), DNA barcoding is a short genetic sequence that identifies an individual organism as a member of a particular species. The species examined were *Quercus* sp. (oaks) and 71 samples of the 8 different species growing at Pierce Cedar Creek were collected for DNA extraction. The samples were all made into herbarium specimens and DNA was extracted from all of them. The extracted DNA was then amplified using PCR and gel electrophoresis. The successful amplified DNA was then sequenced using the gel slab method and the capillary method. Successful sequences came from the capillary method of sequencing and these samples were then analyzed using computer software to obtain a contig. The seven sequences that were analyzed had no variations in their base pairs confirming the fact that they are of the same species, *Quercus rubra.*

122. Arcelia S. Ortega, Hope College **Chemistry**

(Co-Author: Amy L. Speelman, David A. Paul, Bryan A. Leland, and Brent P. Krueger)

Modeling Fluorescently Tagged DNA and RNA Oligonucleotides for Direct Comparison to Fluorescence-detected Resonance Energy Transfer (FRET) Experiments

We are developing a method for studying the structural dynamics of biological systems which brings together fluorescence spectroscopy and computational modeling, providing a more complete understanding than is possible with either technique individually. Before beginning molecular dynamics simulations, force field parameters were developed for the fluorescent probes to be used in experimental studies. This was carried out using quantum mechanical calculations to determine low-energy probe conformations and electrostatic potentials, deriving charges using the RESP charge fitting procedure, and setting force field parameters by analogy to pre-existing parameters. Several DNA– and RNA–fluorescent probe systems were created and explicitly solvated in water. These systems were then minimized and equilibrated at 298 K prior to beginning production molecular dynamics runs. In the future, these MD simulations will be used to calculate simulated fluorescence data which will be compared to experimental fluorescence data.