WM RUGS

WEST MICHIGAN REGIONAL UNDERGRADUATE SCIENCE RESEARCH CONFERENCE

Saturday, November 21, 2015

ABSTRACT BOOKLET

Organizing Institutions:

- Aquinas College
- Calvin College
- Grand Valley State University
- Hope College
- Van Andel Institute Graduate School

VAN ANDEL INSTITUTE

333 Bostwick Avenue, NE
Grand Rapids, MI 49503
www.vai.org

WEST MICHIGAN REGIONAL UNDERGRADUATE SCIENCE RESEARCH CONFERENCE

Saturday, November 21, 2015

SCHEDULE OF EVENTS

8:30 ARRIVAL AND POSTER SETUP *Cook-Hauenstein Hall*

9:00 WELCOME *Tomatis Auditorium*

Steve Triezenberg, Ph.D.
President and Dean of Van Andel Institute Graduate School

9:15 KEYNOTE ADDRESS *Tomatis Auditorium*

D. Marshall Porterfield, Ph.D.
Division Director
NASA Space Life and Physical Sciences
Human Exploration and Operations Mission Directorate (NASA Headquarters)
Professor of Agricultural and Biological Engineering at Purdue University
"The future of human space exploration, and the art of integrating science and engineering in designing bioregenerative life support for long duration missions"

10:00 POSTER SESSION I *Cook-Hauenstein Hall*

Presenters at even-numbered posters
Refreshments served

11:15 FACULTY TALKS *Tomatis Auditorium*

Scott Rothbart, Ph.D.
Assistant Professor
Center for Epigenetics
Van Andel Research Institute
"Decoding the language of chromatin modifications"

Jennifer Hampton, Ph.D.
Associate Professor
Department of Physics
Hope College
"New Materials for Batteries: Nickel Hexacyanoferrate Thin Films"

12:00 LUNCH *Cook-Hauenstein Hall*

1:00 POSTER SESSION II *Cook-Hauenstein Hall*

Presenters at odd-numbered posters

2:15 FACULTY TALKS *Tomatis Auditorium*

Peter Wampler, Ph.D.
Associate Professor
Geology Department
Grand Valley State University
"Wrestling with Wells and Water in Haiti"

David Warners, Ph.D.
Professor
Biology Department
Calvin College
"Helping to Heal a Creek with Undergraduate Research"

3:00 CONCLUSION

WEST MICHIGAN REGIONAL UNDERGRADUATE SCIENCE RESEARCH CONFERENCE

ACKNOWLEDGEMENTS

Costs for the 2015 West Michigan Regional Undergraduate Science Research Conference are underwritten by keynote sponsor AT&T, supporting sponsors Western Michigan University and Grand Rapids Community College, and also by the following organizing institutions: Aquinas College, Calvin College, Grand Valley State University, Hope College, and Van Andel Institute Graduate School.

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Dr. Greg Fraley, Hope College
Dr. Nick Duesbery, Van Andel Research Institute

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KEYNOTE SPEAKER

D. Marshall Porterfield, Ph.D.
Division Director, NASA Space Life and Physical Sciences
Human Exploration and Operations Mission Directorate (NASA Headquarters)
Professor of Agricultural and Biological Engineering at Purdue University

"The future of human space exploration, and the art of integrating science and engineering in designing bioregenerative life support for long duration missions"

Now that the National Aeronautics and Space Administration (NASA) had developed it's roadmap to Mars the future needs for long-duration missions has started to be defined. As we move further away from missions in low-earth orbit aboard the International Space Station the cost and risks are both increased dramatically. The challenge for further expanded missions that create more permanent outposts will increasingly be associated the logistics of providing the necessities of life to the crew. Today aboard the international Space Station we are doing research to develop biomedical countermeasures for humans in space, developing and testing space-systems technologies, and doing research on biological systems that would contribute to the development of bioregenerative systems to support long duration exploration. This seminar will review various efforts in these areas and outline how they contribute to the ambitions of humanity to explore further out into the solar system, but also to create new sustainable systems that will help us protect our environment back on earth.

ABSTRACTS OF FACULTY RESEARCH TALKS

Scott Rothbart, Ph.D.
Assistant Professor
Center for Epigenetics
Van Andel Research Institute

"Decoding the language of chromatin modifications"

Two major epigenetic signals regulating the structure and function of eukaryotic chromatin are methylation of DNA and post-translational modifications of histone proteins. Fundamental breakthroughs in our understanding of chromatin function have been made through the identification of protein machineries that incorporate (write), remove (erase), and bind (read) these epigenetic marks. Chromatin modification and remodeling shape cellular identity, and it is becoming increasingly apparent that deregulation of epigenetic signaling contributes to, and may cause, the initiation and progression of cancer and other human diseases. Unlike genetic abnormalities, chromatin modifications are reversible, making the writers, erasers, and readers of these marks attractive therapeutic targets. The goal of our research is to define molecular details of chromatin accessibility, interaction, and function. We are particularly interested in understanding how DNA and histone modifications work together as a language or "code" that is read and interpreted by specialized proteins to orchestrate the dynamic functions associated with chromatin. We hope our studies will lead to a better understanding of the etiology of disease and will contribute to the discovery of effective therapeutic approaches targeting the epigenetic machinery.

Jennifer Hampton, Ph.D.
Associate Professor
Department of Physics
Hope College

"New Materials for Batteries: Nickel Hexacyanoferrate Thin Films"

As the world transitions more and more to intermittent sources of energy, such as solar and wind, there is an increasing need for a variety of energy storage solutions. Metal hexacyanoferrate (HCF) compounds are attractive for battery and supercapacitor applications because of their high energy density combined with long cycle life. HCF materials store and release energy as a result of the redox behavior of the incorporated transition metals as well as the insertion and extraction of cations in the open-framework lattice structure. In this talk, I will describe the electrochemical formation process for HCF thin films on nickel substrates and the characterization of the charge transport and charge storage properties for these materials.

ABSTRACTS OF FACULTY RESEARCH TALKS

Peter Wampler, Ph.D.
Associate Professor
Geology Department
Grand Valley State University

"Wrestling with Wells and Water in Haiti"

Since 2007 I have been travelling to Haiti to learn about groundwater and safe and sustainable solutions to ground water contamination with undergraduate and graduate students (www.gvsu.edu/haitiwater). This research has revealed widespread contamination with fecal coliform bacteria in shallow karst aquifers. Water interventions such as biosand filters and chlorination work, but their implementation and sustained use by rural Haitians has been problematic. Hand-dug wells are common in many developed communities, but are uncommon in the rural mountainous areas of Haiti where natural springs are abundant. Rural Haitians typically send family members, usually women and children, to fetch water at springs 2-3 times daily using a combination of buckets and plastic containers. Bacterial contamination is common in natural springs in Haiti due to surface contamination, vulnerable karst aquifers, and inadequate sanitation. A common practice has been to install concrete structures to protect the area where the spring emerges, however water testing shows that both protected and unprotected springs are contaminated with bacteria. In June 2013 an alternative approach, referred to as in-situ filtration (ISF) wells, was tested on two pilot wells. An ISF well combines hand-construction techniques compatible with remote locations, simple and inexpensive hardware and maintenance, and the convenience and protection provided by a drilled well at a fraction of the cost. Since 2013 6 ISF wells have been installed in Haiti and monitoring indicates they are successfully reducing E. coli levels.

David Warners, Ph.D.
Professor
Biology Department
Calvin College

"Helping to Heal a Creek with Undergraduate Research"

Plaster Creek flows for approximately 14 miles from agricultural lands in Southern Kent County through suburban, commercial, industrial and then low-income urban areas before emptying into the Grand River just south of downtown Grand Rapids. Plaster Creek is known as the most degraded waterway in West Michigan due to the large volume of stormwater runoff it carries, along with excess nutrients and sediment, as well as dangerously high levels of bacteria. Plaster Creek Stewards, a Calvin College based watershed group, was formed in 2009 in an attempt to address these problems by focusing on 1) education and outreach; 2) on-the-ground restoration work; and 3) research. This talk will highlight recent research projects including *E. coli* sourcing, habitat restoration, and hydrologic modeling that are providing Plaster Creek Stewards with valuable information as they work to restore this much maligned local stream.

2015 RECRUITER CONTACT INFORMATION

BINGHAMTON UNIVERSITY
http://www.binghamton.edu/grad-school/

The Graduate School
Binghamton University
PO Box 6000
Binghamton, NY 13902

Justin Pierce, Graduate Admissions and Recruitment Advisor
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Binghamton recruiters/representatives will be available from 9:00 AM to 3:00 PM during the conference/grad fair.

CENTRAL MICHIGAN UNIVERSITY – DEPARTMENT OF PHYSICS
https://www.cmich.edu/colleges/cst/physics/Pages/default.aspx

Department of Physics
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Central Michigan University recruiters/representatives will be available from 9:00 AM to 2:15 PM during the conference/grad fair.

FERRIS STATE UNIVERSITY – COLLEGE OF PHARMACY
http://www.ferris.edu/colleges/pharmacy

College of Pharmacy
Ferris State University
Pharmacy Building
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Big Rapids, MI 49307

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College of Pharmacy recruiters/representatives with Ferris State University recruiters/representatives will be available from 9:00 AM to 2:15 PM during the conference/grad fair.

2015 RECRUITER CONTACT INFORMATION

FERRIS STATE UNIVERSITY – COLLEGE OF HEALTH PROFESSIONS
http://ferris.edu/HTMLS/colleges/alliedhe/PublicHealth/Public-Health.htm

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GRAND VALLEY STATE UNIVERSITY
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Grand Valley State University - Professional Science Master's (PSM)
301 W. Fulton Street
Grand Rapids, MI 49504
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GVSU recruiters/representatives will be available from 9:00 AM to 3:00 PM during the conference/grad fair.

INDIANA UNIVERSITY SCHOOL OF MEDICINE
http://grad.medicine.iu.edu

Indiana University School of Medicine
Graduate Division
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IUSM Graduate Division recruiters/representatives will be available from 9:00 AM to 3:00 PM during the conference/grad fair.

2015 RECRUITER CONTACT INFORMATION

OHIO STATE UNIVERSITY, THE
http://lsn.osu.edu/

Interdisciplinary Graduate Programs
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Columbus, OH 43210

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PURDUE UNIVERSITY
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The Graduate School
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West Lafayette, IN 47907

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Purdue University recruiters/representatives will be available from 9:00 AM to 2:15 PM during the conference/grad fair.

UNIVERSITY OF MICHIGAN
http://www.kines.umich.edu/

School of Kinesiology
University of Michigan
1402 Washington Heights
Ann Arbor, MI 48109

Charlene Ruloff, Graduate Program Coordinator
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School of Kinesiology recruiters/representatives will be available from 9:00 AM to 2:00 PM during the conference/grad fair.

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UNIVERSITY OF MICHIGAN
http://sph.umich.edu/

School of Public Health
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Ann Arbor, MI 48109

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School of Public Health recruiters/representatives will be available from 9:00 AM to 2:30 PM during the conference/grad fair.

UNIVERSITY OF NOTRE DAME
http://graduateschool.nd.edu

Graduate School
University of Notre Dame
502 Main Building
Notre Dame, IN 46556

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University of Notre Dame recruiters/representatives will be available from 9:00 AM to 2:15 PM during the conference/grad fair.

VAN ANDEL INSTITUTE GRADUATE SCHOOL
http://vaei.vai.org/grad-school/

Van Andel Institute Graduate School
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Grand Rapids, MI 49503

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VAI Grad School recruiters/representatives will be available from 9:00 AM to 2:15 PM during the conference/grad fair.

2015 RECRUITER CONTACT INFORMATION

WAYNE STATE UNIVERSITY
http://engineering.wayne.edu

College of Engineering
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Biological Sciences Department
- www.grcc.edu/biologicalsciences

Physical Sciences Department
- www.grcc.edu/physicalscience

PURPLE COMMUNITY CONTACT INFORMATION

Purple Community
http://purplecommunity.vai.org/

Purple Community
Van Andel Institute
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Grand Rapids, MI 49503

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Stop by the Purple Community table between 9:00 AM and 2:15 PM to learn about our upcoming events, how to become a volunteer and how to create your own fundraising event to support research and science education at Van Andel Institute.

2015 POSTER PRESENTATIONS

1. Alex Boomsma, Calvin College **Biochemistry**

(Co-Authors: Robbie Hohlman, Sherrice Zhang)

"The Bromocyclocarbamation and Iodocyclocarbamation Reactions of N-Allyl-N-arylcarbamates and N-Homoallyl-N-arylcarbamates"

The 5-substituted 3-aryl-2-oxazolidinone ring system can be considered a privileged chemical scaffold by virtue of its being a core structural feature of marketed therapeutic agents such as linezolid (antibacterial agent), rivaroxaban (anticoagulant) and toloxatone (antidepressant), amongst others. The iodocyclocarbamation reaction of allylated N-arylcarbamates, available in two steps from commercially available aromatic amine precursors, provides ready access to racemic 5-(iodomethyl)-3-aryl-2-oxazolidinones. These advanced intermediates should have utility in allowing synthetic access to the aforementioned privileged substances. This poster highlights 1) optimization of the iodocyclocarbamation reaction conditions in the N-allyl series, 2) our initial investigations into the corresponding bromocyclocarbamation reaction, and 3) exploration on an extension of this chemistry to N-homoallyl-N-arylcarbamates. The racemic six-membered cyclic carbamate products obtained should have utility as chemical building blocks suitable for further synthetic modification.

2. Garrett Bazany, Calvin College **Biochemistry**

(Co-Authors: Duanghathai Wiwatratana, William D. Atchison)

"Investigating the role of dimethyl fumarate in activating Nrf2 pathway associated genes and in the survival of motor neurons following MeHg-toxicity"

The pathogenic mechanisms by which MeHg-induced toxicity occurs include perturbation of membrane receptor functions, intracellular calcium homeostasis, mitochondrial functions, and neurotransmitter release. This multi-cascade toxicity, in turn, generates excessive reactive oxygen species; subsequently, oxidative stress occurs. A cytoprotective agent dimethyl fumarate (DMF) has been used successfully to treat relapsing multiple sclerosis. DMF exerts neuroprotection by activating the Nrf2 pathway. We tested if DMF treatment will induce upregulation of antioxidant genes in NSC34 cells. We also tested if DMF treatment is able to protect primary spinal cord cell cultures from MeHg-induced toxicity. Quantitative PCR was applied to assess Nqo1 and Txnrd1 expression in cells treated with different DMF concentration and vehicle alone (DMSO). While, NSC34 cells treated with 0, 7, 21 and 42 µM DMF for 24 h demonstrated equivalent changes in Nqo1 and Txnrd1 levels relative to control (Gapdh), upregulation of Txnrd1 is significantly higher than Nqo1 in all DMF concentrations. However, DMF treatment prior to MeHg exposure did not protect cell death. Several factors such as the half-life of DMF and its concentration, and the overly high toxicity of this MeHg concentration which caused 75% cell death could contribute to this non-protective result.

3. Brianna Busscher, Calvin College **Biochemistry**

(Co-Authors: John T. Wertz)

"Characterizing Commas: Discovery and exploration of a novel family of pleomorphic Rhizobiales bacteria isolated from herbivorous ants"

Ants are one of the most abundant, diverse, and ecologically important insects on the planet. Interestingly, it was the evolution of herbivory in ants that led to this extensive diversification (Hansen et al., 2014), a surprise given that an herbivorous diet is typically nitrogen- and vitamin-poor. To study this enigma we are using the model genus Cephalotes (turtle ants). We hypothesize that in the case of the Cephalotes ants, bacterial provisioning of nutrients allows an herbivorous lifestyle and is a significant factor in ant diversification, allowing the ant to move into new niches and habitats where speciation can occur. Of the five orders of bacteria conserved in the guts of all Cephalotes ants, bacteria in the order Rhizobiales are also found among many other genera of herbivorous ants and hence are thought to be critical to this lifestyle (Russell et al., 2009). Feeding studies have shown that when Cephalotes varians is fed a diet of pollen (a common food source for Cephalotes ants), the number of Rhizobiales increases significantly, highlighting the importance of this group in ant nutrient degradation and provisioning (Hu et al., 2014). Our research also lays the groundwork for the comparison of Rhizobiales isolated from Cephalotes varians with Rhizobiales isolated from other Cephalotes species. These comparisons may shed light on metabolic differences that could have been important factors in ant speciation. To better understand the role of Rhizobiales bacteria in ant guts, we isolated several novel Rhizobiales from Cephalotes varians ants throughout the Florida Keys and characterized key metabolic features of one strain in particular – JR021-5. The substrate utilization profile of JR021-5 clearly distinguishes it from other members of the Rhizobiaceae and gives a glimpse into its in situ environment and metabolic role primarily as a mono- and disaccharide degrader. However, it can also utilize other non-sugar compounds such as L-lactic acid, citric acid, D-glucuronic acid, L-malic acid, α-hydroxybutyric acid, α-keto-glutaric acid, glucuronamide, pyruvic acid methyl ester, and esculin ferric citrate, which suggests nutritional versatility, a possible benefit to the ant should it need to switch diets. In particular, JR021-5's use of esculin may indicate an ability to degrade plant toxin, which would benefit both the bacterium and the ant host. Studies of bacterial growth suggest that 3% CO2 yields significantly faster growth ($p<0.05$) than 0% CO2. Growth rates at 0% O2 and 20% O2 are not significantly different, suggesting a facultatively aerobic lifestyle that may allow JR021-5 to thrive in the varying conditions of the ant gut as the ant develops from larvae to adult. Growth at 0% O2 suggests a need for further studies focused on the ability of JR021-5 to perform anaerobic respiration as well as characterization of fermentation end products that may be important to ant nutrition. Interestingly, preliminary DNA sequencing of the Rhizobiales isolates suggests that they may be members of a novel family of bacteria. We use their metabolic characteristics and morphology to validate their placement within a new family of bacteria, as well as name and validly publish them as such.

4. Lydia DeJonge, Calvin College **Biochemistry**

(Co-Authors: Nicole L. Michmerhuizen, Maggie A. Van Winkle, Amanda B. Witte, Kylin Hamann, and Kumar Sinniah)

"A Thermodynamic Study of the Interaction between Insulin and Insulin-Linked Polymorphic Region DNA"

The binding of insulin to the G-Quadruplexes formed in four distinct repeats found in the insulin-linked polymorphic region (ILPR) was investigated with isothermal titration calorimetry (ITC). This provided the thermodynamic parameters (Kd,ΔH, ΔG and -TΔS) of the insulin-G-quadruplex binding over a range of temperatures. At higher temperatures, the ILPR b and c sequences were found to be enthalpically driven while the ILPR b and c variants were found to be entropically driven.

5. Leesha Gunnink, Calvin College **Biochemistry**

(Co-Authors: Dr. Larry Louters)

"The Mechanism of Curcumin Inhibition on GluT1"

Curcumin, a small molecule found in turmeric, has been shown to be an anti-inflammatory, anti-hyperglycemic and anti-cancer agent. Previous work in our lab has shown that curcumin inhibits GluT1 activity. This study further documents curcumin's effect and investigates the physiology of its inhibition of GluT1. We studied various aspects of curcumin's effect, including kinetics, residual effect, recovery of GluT1, and binding location. Glucose uptake assays were performed on L929 fibroblasts, a cell line which only uses GluT1 to transport glucose. Kinetics experiments show that increasing 2-deoxyglucose cannot negate curcumin inhibition on GluT1, implying that it is not a competitive inhibitor. After varying the period at which 50 uM curcumin is applied, it appears that two-thirds of inhibition is primary while one-third is residual. Residual effects of curcumin were also seen in experiments varying recovery time; these effects indicate a secondary method of inhibition on GluT1. The lack of synergistic inhibition of curcumin with cytochalasin B may indicate that the two compounds may have overlapping binding sites on GluT1. It appears from this study that curcumin's inhibition on Glut1 is mediated in two methods and involves non-competitive binding.

6. Brian Heidmann, Calvin College **Biochemistry**

(Co-Authors: Dr. Carolyn Anderson)

"Efforts towards the synthesis of β- and γ-amino acids containing N-alkyl pyridones"

N-alkyl pyridones are an interesting functional group found in a series of pharmacologically active and naturally occurring compounds. Due to their medicinal potential, incorporation of N-alkyl pyridones into interesting chemical motifs, such as unnatural β- and γ-amino acids, is an important synthetic goal. Utilizing a β-iodo N-alkenyl pyridone intermediate that was discovered in our laboratory, preparation of these unnatural amino acids is underway. Evaluation of a number of different protected propargylic amino alcohols in route to the required substrates will be presented, as will efforts to optimize the formation of the required nitrogen containing β-iodo N-alkenyl pyridones.

7. Susan Hromada, Calvin College **Biochemistry**

(Co-Authors: Dr. David E Benson)

"Investigation of Tyrosine-Cysteine Crosslinks in a Model Protein"

Proteins undergo various modifications after translation. One post-translational modification is bond formation between tyrosine and cysteine amino acids. This covalent bond has been recognized to have active functions inside its parent protein. In galactose oxidase, the Tyr-Cys crosslink is a co-oxidant in redox chemistry. In cysteine-dioxygenase, Tyr-Cys is proposed to contribute rigid hydrogen bond donation. The Tyr-Cys crosslink also may act as an antioxidant in the protein, as seen in cytochrome c oxidase where His-Tyr, an analogous crosslink, reduces reactivity of the heme site.
In light of this bond's significance, the mechanistic details of Tyr-Cys crosslink formation have been examined using an orphan protein from Bacteroides fragilus, BF4112, as a model. BF4112 has a tyrosine and cysteine side chain geometrically predisposed for Tyr-Cys crosslink formation adjacent to a His2Glu coordinated metal binding site. This project has investigated previously reported copper mediated Tyr-Cys formation as well as iron and non-metal conditions. Preliminary oxidative screening results are presented.
New detection methods are needed to study this crosslink as current methods of Gel Electrophoresis and Proteolytic mass spectrometry coupled with X-ray crystallography are unable to provide precise quantitative measurements of amount of crosslink in solution. A new detection assay for Tyr-Cys crosslink using fluorescence spectrophotometry of the tyrosine residue is presented.

8. Stephen Lander, Calvin College **Biochemistry**

(Co-Authors: Kylee Rosette, Calvin Van Opstall, Brendan Looyenga, PhD)

"Deciphering the Role of LRRK2 in the Cell Migration"

Cellular migration is an important facet of cancer, as it allows tumor cells to move away from their original source into adjacent normal tissue (invasion) and to distant locations through the vascular system (metastasis). Leucine-Rich Repeat Kinase 2 (LRRK2) is involved in endosomal sorting, and is implicated in Parkinsons's disease as well as being overexpressed in various types of cancer. Previous research has shown knockdown of LRRK2 in A549 cells inhibits cellular migration. Knockdown of LRRK2 influences activation/deactivation of Epidermal Growth Factor Receptor (EGFR) minimally with only a slight lag in the deactivation phase, and appears to have little impact on the internalization of EGFR. In the presence of FBS, EGF and the LRRK2 inhibitor PFE-475, Focal Adhesion Kinase (FAK) appears to remain phosphorylated which might indicate a turnover rate of FAK which is critically important for cell migration. Future investigation into the roles of LRRK2's influence on the turnover of FAK may prove useful into further understanding and inhibition of the invasion and metastasis of cancer.

9. Karine Rose, Calvin College **Biochemistry**

(Co-Authors: Dr. Carolyn Anderson)

"Efforts Towards the Synthesis of N-Alkyl 2-Pyridone Containing Isoquinoline Alkaloids"

Isoquinoline alkaloids are naturally occurring bicyclic aromatic species containing a pyridine or pyridone ring. Many isoquinoline alkaloids have potential as antimicrobial pharmacological agents. While many isoquinoline alkaloids have been isolated or prepared synthetically, those with substitution on their backbones, such as N-Alkyl 2-Pyridone containing target, are relatively rare, and offer access to a new region of chemical space.

10. Kylee Rosette, Calvin College **Biochemistry**

(Co-Authors: Stephen Lander, Calvin Van Opstall, and Brendan Looyenga, PhD.)

"The Role of MET in the Proliferation of Papillary Renal Cell Carcinoma"

It has been found that papillary renal cell carcinoma contains an overexpression for the receptor tyrosine kinase known as MET. After inhibiting the function of MET through both RNA interference and pharmacologic inhibition, it was determined that only the chronic shRNA knockdown actually slowed cell proliferation in papillary renal cell carcinoma cell lines. Western blotting was used to validate that both conditions did indeed inhibit MET activity to the same degree. Pharmacological inhibition, using the inhibitor INCB028060, was tested in a variety of conditions to determine if the acute inhibition of MET could produce the same decrease in cell proliferation as the chronic shRNA knockdown. Only the soft agar assay, representing cell proliferation in three dimensions, showed promise of slowed cell proliferation and tumor growth in the presence of the pharmacological inhibitor INCB028060. This may suggest that MET is involved in three-dimensional proliferation in papillary renal cell carcinoma.

11. Lauren Strohbehn, Calvin College **Biochemistry**

(Co-Authors: Dr. Larry Louters)

"The Correlation of GluT1 Translocation to Lipid Rafts with its Activity"

Glucose is a preferred fuel and proper regulation of uptake is critical for cellular health. Abnormal glucose regulation is linked to serious diseases, including cancer and diabetes. GluT1 is a widely expressed glucose transporter, whose acute regulation is not clearly understood. A deeper understanding of GluT1 regulation is essential for developing therapeutic strategies to treat glucose imbalance-linked disorders. Previous findings suggest that activation of GluT1 occurs when the transporter is integrated into lipid rafts. In this study we isolated lipid raft proteins, both pre and post activation of uptake by glucose deprivation, from L929 fibroblast cells that expressed native GluT1 and a GluT1-GFP (green fluorescent protein) fusion protein. We utilized a mechanical disruption and a detergent resistant method to isolate low-density lipid raft proteins by ultracentrifugation. Western blot analysis indicated that both methods isolated 'lipid raft' proteins as marked by caveolin. Little GluT1 was isolated within the lipid raft fraction by the detergent resistant method; in contrast, when membrane fragments were mechanically generated, we observed a 20%-25% shift of GluT1 to low-density membranes. This pattern was observed for both the native GluT1 and GluT1-GFP fusion protein. More research is needed to determine the origins of the differences in low-density membranes isolated by these two methods as well as effects of other activators on GluT1 translocation.

12. Kayla Vander Stel, Calvin College **Biochemistry**

(Co-Authors: Abigail Leistra, Kumar Sinniah)

"A Single Molecule Force Spectroscopy Study of the Insulin-G-Quadruplex Interaction"

A single molecule force spectroscopy study was performed by atomic force microscopy (AFM) to examine the binding interaction between insulin and the G-quadruplex formed by the insulin linked polymorphic region consensus DNA sequence. Two approaches were used to study this interaction. In the first approach, the G-quadruplex was tethered to the AFM tip while insulin was immobilized on an ultra-flat gold surface. However, this limited the binding orientation of insulin. In the second approach, the G-quadruplex was tethered at one end of the DNA sequence to an ultra-flat gold surface, leaving the other end free to associate with the AFM tip. Free insulin was present in the buffer. The experiments were performed at various pulling speeds and analyzed by the Bell-Evans and the Dudko-Hummer models. Using these models, the lifetime of the ILPR-insulin association was determined to be ~0.2 seconds and the effects of insulin on ILPR DNA observed.

13. Lucas VanLaar, Calvin College **Biochemistry**

(Co-Authors: Roger L. DeKock)

"Effective Atomic Size Concept: A Dilemma"

Based on a pair of papers published by Slater and Zener in 1930, it can be shown that the effective size of an atom varies as the square root of the inverse average valence ionization energy. There is a strong correlation on a row-by-row basis in the periodic table, but the effective size values become far too large as one progresses to rows 3, 4, and 5. The correction for this is shown to lie in how the core-valence electron-electron repulsion energies are accounted for in the ionization process. From Hartree-Fock theoretical studies we show that if roughly 90% of these core-valence electron-electron repulsion energies, rather than 100%, are assigned to the valence electrons, the poor effective size values can be easily corrected.

14. Jeremy Wodarek, Calvin College **Biochemistry**

(Co-Authors: Eric Arnoys, PhD, Brendan Looyenga, PhD, Larry Louters, PhD)

"Building a GluT-1 Knockout"

While a fair amount is known about the transport of glucose into the cell, there has been little research into the deletion of the GluT-1 transport protein. Previously, our lab has illustrated the interactions and acute activation of GluT-1. In this study, we investigated the mechanisms of knocking out this protein, with the future intention of investigating the extent to which the cell reacts to such a change. It is the hope that an enhanced understanding of cells with the deletion of GluT-1 may lead to advancements in strategies that fight cancer and diabetes in a clinical setting.

15. Shiyuan Zhang, Calvin College **Biochemistry**

(Co-Authors: Dr. Michael Barbachyn, Dr. Ronald Blankespoor)

"The Iodocyclocarbamation Reaction of N-Allyl-N-arylcarbamates and N-Dienylmethyl-N-arylcarbamates"

The 5-substituted 3-aryl-2-oxazolidinone ring system can be considered a privileged chemical scaffold by virtue of its being a core structural feature of marketed therapeutic agents such as linezolid (antibacterial agent), rivaroxaban (anticoagulant) and toloxatone (antidepressant), amongst others. The iodocyclocarbamation reaction of allylated N-arylcarbamates, available in two steps from commercially available aromatic amine precursors, provides ready access to racemic 5-(iodomethyl)-3-aryl-2-oxazolidinones. These advanced intermediates should have utility in allowing synthetic access to the aforementioned privileged substances. This poster highlights some optimization chemistry in the N-allyl series but the principal focus of the described research is on the extension of this chemistry to N-(1,3-butadien-1-yl)methyl-N-arylcarbamates. The racemic oxazolidinone products incorporate an interesting (3-iodopropen-1-yl) C-5 substituent that should be amenable to further synthetic elaboration.

16. Hannah Foley, Central Michigan University **Biochemistry**

(Co-Authors: Jessica A. Stewart, Herbert W. Kavunja, Sarah R. Rundell, and Benjamin M. Swarts)

"Bioorthogonal Chemical Reporters for Selective In Situ Probing of Mycomembrane Components in Mycobacteria"

The global pathogen Mycobacterium tuberculosis and other species in the suborder Corynebacterineae possess a distinctive outer membrane called the mycomembrane (MM). The MM is composed of mycolic acids, which are either covalently linked to an underlying arabinogalactan layer or incorporated into trehalose glycolipids that associate with the MM non-covalently. These structures are generated through a process called mycolylation, which is central to mycobacterial physiology and pathogenesis and is an important target for tuberculosis drug development. Current approaches to investigating mycolylation rely on arduous analytical methods that occur outside the context of a whole cell. Here, we describe mycobacteria-specific chemical reporters that can selectively probe either covalent arabinogalactan mycolates or non-covalent trehalose mycolates in live mycobacteria. Specifically, alkyne-modified versions of the mycolyl donor trehalose monomycolate were designed to target MM metabolic pathways and incorporate into these MM components. These probes, in conjunction with bioorthogonal chemistry, enable selective in situ detection of the major MM components.

17. Daniel Kesterson, Central Michigan University **Biochemistry**

(Co-Authors: Avery Ward, Chia-Heng Hsiung, Vasudeva Kamath, Edward McKee)

"NRTI Treatment Alters mRNA Tissue Specific Expression of Enzymes of Deoxynucleoside Salvage and Synthesis in a Neonatal Rat Model"

Nucleoside analogs are important drugs in the treatment of many viral conditions and cancers. Those that are nucleoside reverse transcriptase inhibitors, (NRTIs) were first used primarily to treat HIV infections, but some have been found to be useful in treating chronic Hepatitis B and C also. The primary focus of our work for the past eight years has been on 3'-Azido-3'-Thymidine (AZT), one of the first NRTIs, and, until recently the WHO-recommended drug for prevention of mother-to-child transmission of HIV. More recently, we began studying Entecavir (ETV), another NRTI that is instead used to treat Chronic Hepatitis B in adults and children. While AZT and ETV are very effective in treating and preventing viral conditions in children and adults, there has been very little research regarding their toxicity in the children treated with them. Our study focuses on the effects of these NRTIs on major organ tissues in neonatal rats in their first 3 weeks post-birth. We hypothesize that these drugs are inhibiting enzymes involved in dNTP salvage and de novo pathways, particularly in the hyperplastic growth period. We began treatment at birth for both ETV and AZT treated group pups with a daily oral gavage of ETV or AZT. Pups were sacrificed on designated days post-gestation two hours post-treatment and their major organ tissues collected and snap frozen before processing for assays. In AZT-treated tissue, we found that levels of mRNA encoding for enzymes involved in the dNTP salvage and de novo pathways in heart tissue were expressed at significantly higher levels than controls, whereas AZT had the opposite effect; in liver, it showed a trend of lower expression of those same enzymes versus controls. In ETV-treated tissues, we observed a lesser but similar effect in heart, where mRNA levels were elevated, but saw a large, significant increase of expression in liver in stark contrast to the AZT-treated group. Additionally, we observed an overall increase of total mRNA levels in the NRTI-treated tissues on all days. We also saw that in AZT-treated tissue, the overexpression of mRNA was seen beginning on day 1, while in ETV-treated tissue we generally did not observe any major effect until day 7. Finally, we observed that in heart tissue most of the mRNA levels in both AZT and ETV treated tissues normalized to the controls by day 21, with the exception of a small group that remained elevated. This study demonstrates a clear and significant change in tissue specific expression of mRNA levels in ETV and AZT treated tissues of the dNTP salvage and de novo pathways in neonatal organ tissue. These data suggest that the potential toxic effects of NRTIs are likely to be tissue specific and are not generalizable. Work continues to understand the mechanism(s) of this tissue specificity.

18. Brent Piligian, Central Michigan University **Biochemistry**

(Co-Authors: Jessica Alyse Stewart, Sarah Rose Rundell, Benjamin Michael Swarts)

"A Trifunctional Cyclooctyne for Modifying Azide-Labeled Biomolecules with Photocrosslinking and Affinity Tags"

In recent years, increasing attention has been focused on the development of techniques directed toward studying interactions between biomolecules in living systems. Advances in biomolecular labeling and photocrosslinking technologies have provided powerful tools to study such interactions, even when they are weak and/or short-lived. However, this area still faces significant challenges, including the incorporation of photocrosslinking tags into specific biomolecules and the detection/purification of crosslinked complexes. Here, a bicyclo[6.1.0]nonyne (BCN)-based cyclooctyne reagent bearing a photocrosslinking diazirine (DAz) group and a biotin affinity handle, named BCN-DAz-Biotin, is reported. This trifunctional probe capitalizes on bioorthogonal chemistry and is the first reagent capable of simultaneously delivering photocrosslinking and affinity functionalities to azide-labeled biomolecules in living cells. Photocrosslinking and affinity functionalities allow for the photoactivated covalent capture and enrichment/detection of interacting species, respectively. Thus, for biomolecules that can be azide-labeled for bioorthogonal chemistry applications, BCN-DAz-Biotin can facilitate the study of their interactions in native settings.

19. Sarah Rundell, Central Michigan University **Biochemistry**

(Co-Authors: Zachary L. Wager, Lisa M. Meints, Anne W. Poston, Brent F. Piligian, Claire D. Olson and Benjamin M. Swarts)

"Fluorine-Modified Trehalose Analogues as Possible PET Probes for Mycobacterial Infection: Rapid Synthesis, Conformational Analysis, and Uptake by Mycobacteria"

Mycobacterium tuberculosis, the etiological agent of human tuberculosis, requires the non-mammalian disaccharide trehalose for growth and virulence. Detectable trehalose analogues have gained interest as probes to study trehalose metabolism and as potential diagnostic tools for the tuberculosis infection. Here, we report our progress toward the synthesis and conformational analysis of four 19F-deoxyfluoro trehalose (FluoroTre) analogues, along with the assessment of their uptake by the model organism, M. smegmatis. Using a one-step chemoenzymatic method, several of the FluoroTre analogues were rapidly synthesized and purified within 1 hour in high yield. One FluoroTre analogue, which could not be accessed chemoenzymatically, was chemically synthesized using a trehalose desymmetrization strategy. NMR and molecular modeling techniques were used for conformational analysis of the FluorotTre analogues, and a GC-MS assay was used to show investigate uptake by M. smegmatis. The efficiency of 19F-FluoroTre synthesis, purification, and administration to M. smegmatis described here may support future applications in using short-lived 18F-deoxyfluoro trehalose analogues as positron emission tomography (PET) probes for in vivo imaging of M. tuberculosis infection.

20. Avery Ward, Central Michigan University **Biochemistry**

(Co-Authors: Chia-Heng Hsiung, Daniel G. Kesterson, Vasudeva G. Kamath, Edward E. McKee)

"Deoxyguanosine Kinase, an Enzyme in the Mitochondrial Purine Nucleoside Salvage Pathway: A Target of Entecavir Drug Toxicity"

Deoxyguanosine kinase (DGK) is an important enzyme in the mitochondrial purine deoxynucleoside salvage pathway. Mutations in this enzyme have been found to deplete mitochondrial dNTP pools leading to mitochondrial DNA (mtDNA) depletion syndrome (MDS). Mutations in the DGUOK, such as 204delA, have an early onset of liver dysfunction accompanied with hypotonia and muscle weakness. Children aged from 2-11 suffering from chronic hepatitis B (CHB) are prescribed Entecavir (ETV), a nucleoside reverse transcriptase inhibitor (NRTI) and deoxyguanosine analogue. In non-replicating tissues when the salvage pathway is the primary mechanism for dNTP synthesis, such as the liver, ETV must be phosphorylated through DGK then further to its active form (ETV-TP) in order to repress viral replication. However, binding of ETV to DGK could have a competitive inhibitory effect on binding the natural substrates (dA and dG). The aim of this investigation is to characterize the enzyme kinetics of DGK with regard to for the substrates dG, dA, and ETV as well as combinations of substrates. Enzyme kinetics were studied using freshly isolated rat liver mitochondria incubated with each of three substrates at various concentrations respectively. Immucillin-H (2 μM) and EHNA (5 μM) were added to the incubation mixture to prevent the breakdown of substrate by purine nucleoside phosphorylase (PNP) and adenosine deaminase (ADA) activity. The metabolites were collected after 2 hours of incubation at 30° C and processed for UPLC analysis. Results obtained from the study suggested that dG is the preferred substrate phosphorylated by DGK followed by ETV and dA. Given the structural similarities between ETV and dG it is was not surprising that ETV competitively inhibited dG phosphorylation, however, it was surprising that ETV and dG were both potent non-competitive inhibitors of dA phosphorylation. This suggested a second binding site on the DGK enzyme. In summary, these data provide important insight into the role of DGK in intact liver mitochondria in which the phosphorylation of dG may be its primary role. Further, ETV inhibition of deoxypurine phosphorylation may in turn cause imbalanced dNTP pools leading to a potential decrease in mtDNA copy number and mitochondrial toxicity in tissues of patients treated with ETV.

21. Lauren Kennington, Hope College **Biochemistry**

"Mutation of Putative Neddylation Site in VACM-1/Cul5 Attenuates its Effect on Proliferation and MAPK Phosphorylation"

VACM-1 (Vasopressin-Activated Calcium -Mobilizing) protein expression has been shown to inhibit cellular proliferation. These effects may depend on VACM-1 modification by NEDD8. The consensus sites for the neddylation of the VACM-1 protein have been identified. Thus, the aim of this study was to examine the effect of mutating the neddylation site on the VACM-1 and the subsequent effects on the phosphorylation of MAPK. COS-1 cells were grown that had been previously transfected with mutated cDNAse. Immunostaining and In-Cell Western assays were performed on these cells to study the effects of mutation on the neddylation of VACM-1 and MAPK P. Our results indicate that the cells transfected with VACM-1 show an increase in neddylation and when the NEDD8 site is mutated, an increase in MAPK phosphorylation.

22. Sarah Glass, Kalamazoo College **Biochemistry**

(Co-Authors: Laura Lowe Furge)

"Activity and Kinetic Characterization of Four Human CYP2D6 Polymorphisms using the Substrates Bufuralol and Dextromethorphan"

Human cytochrome P450 enzymes (CYPs) are a heme-containing enzyme superfamily that have a major role in the metabolism of drugs along with other endogenous and exogenous chemicals. Human CYP2D6 is responsible for approximately 12% of CYP-mediated drug metabolism. There are over 100 different allelic variants of CYP2D6 with metabolic profiles ranging from poor to ultra-rapid. Four CYP2D6 allelic variants, three with a small series of distal mutations (*34, *17-2, *17-3) and one possible ultra-metabolizer (*53), were expressed and purified in E. coli to further characterize their interactions with the substrates bufuralol and dextromethorphan using HPLC with UV detection. Km and vmax values were measured for comparison between variants and the reference *1. Previous molecular dynamics simulations of these allelic variants with and without a ligand bound suggested that varied flexibility and active site accessibility altered interaction with substrates. The current metabolic and kinetic studies are compared to these molecular dynamics models to broaden the understanding of substrate interactions for CYP2D6 variants with local and distal mutations relative to the active site (Support: NIH 1R15-GM086767-02).

23. Natalie Dunn, Aquinas College **Biology**

(Co-Authors: Frank Vogt)

"Spectroscopic Monitoring of Nutrient Competition between Dunaliella salina and Nannochloropsis oculata"

Increased levels of anthropogenic CO2, a greenhouse gas, is a growing global problem that effects environment stability and human health. However, algae act as a sink for atmospheric CO2 which generates nutrients the cells use for biomass production. In order to gain a more detailed understanding of the algae's sequestration capabilities, the complex interactions between chemosphere and cell species must be investigated. This study focuses on the nutrient competition among different species because this is hypothesized to be an important factor determining sequestered CO2 quantities. In order to investigate competition impacts on biomass, two algae species, Dunaliella parva and Nannochloropsis oculata, were cultured under a constant CO2 supply. All samples' chemical signature have been acquired by means of attenuated total reflection FTIR spectroscopy. In order to extract the spectroscopic signature changes induced competition, the species were analyzed individually and in mixture. Spectroscopic differences found between individuals and mixture are attributed to competition effects. Species separate in mixture based on differences in buoyancy, while D. parva settles within the evanescent field, N. oculata stays afloat yet chemically interacts with D. parva. Future studies will derive a relation between biomass signature and consumed CO2.

24. Jordan Jones, Aquinas College **Biology**

(Co-Authors: Jamaal Tarpeh, Kendra Garcia, Kevin Stille, Emerald Butko, Natasha DelCid and L. Rob Peters, Ph.D.)

"Subcloning of zebrafish (Danio rerio) NOD1 and NOD2 mutants into a Gateway pENTR vector"

Previous research revealed the utility of using zebrafish (Danio rerio) as a model organism in the study of the genes, NOD1 and NOD2, in the etiology of inflammatory bowel disease (IBD). An objective of the Aquinas College research team is to ultimately generate a tool, the Tol2 transposon, which will enable the further study of these zebrafish genes. With our work, we attempted to ligate mutant NOD genes into the plasmid, pENTR1ADS. We did so by growing E. coli cultures containing inserted NOD genes in the plasmid, pCS2+, isolating the plasmid DNA via midipreps, isolating the mutant NOD genes via restriction enzyme digest followed by gel extraction, performing ligation reactions in an effort to ligate the mutant NOD genes into pENTR1ADS, transforming competent E. coli cells with the newly ligated DNA, growing those E. coli cells, isolating their DNA via a miniprep, and performing agarose gel electrophoresis to analyze that DNA. The results of our analytical gel indicate that one of the ligations was successful; therefore, we have made progress toward our goal. Logical steps to be taken in the future include sequencing the DNA from the apparently successful ligation, growing up other colonies from attempted ligation reactions, and retrying the ligation reactions that failed. Ultimately, if ligation reactions are successful, we will be able to utilize the NOD genes inserted in the plasmid, pENTR1ADS, to generate Tol2 transposons via the gateway cloning reaction. Thus, the Aquinas College research team has the potential to further the understanding of the NOD genes and their role in innate immunity.

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25. Ashley Powers, Aquinas College **Biology**

(Co-Authors: Dr. Clark A. Danderson)

"An Examination of the Plant Species Diversity at the Karner Blue Nature Sanctuary"

We sought to study the plant diversity and community composition of dry sand prairie habitat at the Karner Blue Nature Sanctuary in Newaygo, Michigan. Data was collected from each community in terms of percent cover and species present. Meander surveys were taken to determine the butterfly diversity at this site. The following data will be sent to the Michigan Nature Association to aid in future management plans.

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26. Lauren Anderson, Calvin College **Biology**

(Co-Authors: Amy M. Wilstermann, PhD)

"CancerEd: Creating Tools for Teaching Children About Cancer"

Cancer is undeniably prevalent. The estimated number of new cases exceeded 1.6 million in 2013, and in some way, cancer will affect more than 1 in 3 Americans in their lifetime. Studies have shown that when children are impacted by cancer—either by their own diagnosis or that of a friend or relative—they are likely to experience anxiety, misconceptions, and uncertainty. CancerEd's objective is alleviate their anxiety by educating students on the biology of cancer in an age appropriate manner that encourages open, honest discussions. A survey of current cancer curriculum found that there is a significant gap in science education for children about cancer; CancerEd's goal is to fill that gap. To date, CancerEd's efforts have been towards: (1) creating lesson plans containing educator background information, supplementary materials for lessons, education standards, and recommended assessment strategies; (2) developing a website to easily disseminate educational materials, receive feedback, and provide links to other resources; (3) creating two surveys—one for teachers and one for parents—to provide feedback about where the CancerEd team should focus their efforts. Outcomes are: (1) three lesson plans are completely finished while ten are in draft form, (2) CancerEd.org is now an active website, and (3) surveys have been disseminated. CancerEd will then analyze surveys once they are complete.

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27. David Bouma, Calvin College **Biology**

(Co-Authors: Jenna Van Bruggen and Alaina Mahn)

"Great Lakes Restoration Initiative: Reassessment of Wildlife Reproduction and Health Impairments in the Saginaw Bay and River Raisin Areas of Concern and Grand Traverse Bay"

Polychlorinated Biphenyls (PCBs) have been known to cause adverse health effects on waterbirds since the 1950s (Grasman et al., 1998). Areas of Concern (AOCs) have since been designated by the Great Lakes Restoration Initiative as places particularly prone to environmental problems. This study reassessed the state of two AOCs, River Raisin and Saginaw Bay, as well as Grand Traverse Bay, another contaminated site. It focused on impairments in reproduction and population health of herring gulls, Caspian terns, and black-crowned night herons. Beneficial Use Impairments were evaluated using endpoints of embryonic nonviability, deformities, reproductive success, chick growth, T cell-mediated immune function (phytohemagglutinin (PHA) skin response), and antibody response (sheep red blood cell (SRBC) titers). Embryonic nonviability rates in herring gull eggs were elevated in the River Raisin AOC (8.4%) and in the Saginaw Bay AOC (SBCDF: 5.3%, Little Charity Island: 7.4%) as compared to the reference site at the Pipe Island Twins (3.3%). Nonviability at the reference site was primarily due to infertility while at contaminated sites infertility was even higher and embryonic mortality played a larger role. The PHA skin test showed doubled responses at reference colonies compared to contaminated sites. Total antibody and IgG responses were significantly higher at the herring gull reference site. These results indicate that Beneficial Use Impairments still occur at these AOCs.

28. Jeremy Brands, Calvin College **Biology**

"Wildflower Bloom Times at Flat Iron Lake Preserve"

Wildflowers are a key contributor to and indicator of an ecosystem's health. This makes the connection between changes in climate and yearly weather patterns and the bloom times of wildflowers very important. This study is part of a long-term research project designed to elucidate the relationship between the two and took place at Calvin College's Flat Iron Lake Preserve in Greenville, Michigan. Weather and climate data were recorded along with blooming periods of wildflowers on the premises for ten weeks from June to August. This past summer, over 200 species of wildflowers were analyzed. Lower average rainfall and soil moisture accompanied slightly later bloom times than were recorded in 2013 and 2014. The study will continue into the foreseeable future.

29. Joey Budi, Calvin College **Biology**

(Co-Authors: Thomas Sokolowski, Dominic Wong, Hannah Burrows, Fred Van Dyke, Benjamin Van Ee)

"Spatial Distribution and Identification of the Mottled Sculpin (Cottus Bairdii) for Stream Quality Analysis in the Manistee River Watershed, Michigan USA"

In 2013, the Huron-Manistee National Forest designated the mottled sculpin as a management indicator species (MIS). We assessed the effectiveness of the mottled sculpin as an indicator of overall stream quality by examining aspects of its distribution and abundance, reliable identification, association with high water quality, and comparison to other integrated biological indices. Sites (12) were sampled throughout the upper Manistee River watershed for mottled sculpin and slimy sculpin (Cottus cognatus), a morphologically similar species, with concurrent measurement of pH, turbidity, dissolved oxygen, temperature, and conductivity at each site. Macroinvertebrates were also sampled and the presence and abundance of macroinvertebrate orders was used to determine an integrated biological index (IBI) for each site. Extraction and amplification of DNA from the fish and subsequent sequencing was used for precise genetic identification. Mottled sculpin abundance was highest near the headwaters of the watershed and decreased downstream. Mottled sculpin exhibited sympatry with slimy sculpin only in a narrow range of the watershed and were otherwise allopatric in distribution. Abundance of mottled sculpin, indexed by catch per unit effort, was not correlated with abiotic variables or IBI score. We conclude that the mottled sculpin may be ineffective as an MIS.

30. Stephan Buiter, Calvin College **Biology**

(Co-Authors: Katie E. Homa, Jenna R. Christensen)

"Profilin and its effects on cytokinesis in fission yeast"

The fission yeast Schizosaccharomyces pombe has three actin cytoskeleton structures: actin patches, cables, and contractile rings. Actin is distributed to these three structures from one common pool in the cell. One of the proteins involved in regulating this distribution is the actin binding protein profilin. Profilin activates the production of rings and cables while inhibiting patch formation. This protein is the focus of the project. To study profilin's roles in fission yeast cytokinesis, a strain that endogenous profilin can be depleted in is imaged with microscopy. This strain is also used to incorporate different profilin constructs: WT profilin and two mutant profilins (Y5D and K81E) to see different effects of these on cytokinesis in the cells when endogenous profilin is depleted. This summer I worked with strains with all three constructs incorporated and expressed at the weakest level. By utilizing epifluorescent microscopy, I was able to analyze the strains and saw that when endogenous profilin is depleted and the constructs are expressed, most cells have two or more nuclei and abnormal septa, indicating defects in cytokinesis. These results show that profilin's function is vital for contractile ring formation allowing proper cytokinesis to occur in fission yeast.

31. Leanna DeJong, Calvin College **Biology**

"Restoring Native Prairie Habitat in a Suburban Campus Landscape"

Increased human development has led to a loss of native landscapes and native biodiversity. In urban areas this loss can be abated with the establishment of green spaces that include native plants, trees, and restored habitats. Incorporating local flora into urban landscapes can elicit multiple benefits, including decreased use of fossil fuels and pesticides, biodiversity enhancement, stormwater absorption and erosion control, increased genetic diversity, and pollination attraction. We evaluated different approaches of installing prairie habitat in a suburban landscape. The first phase of Prince Prairie was initiated on Calvin College's campus in 2013. Replicated quadrats were embedded into the restored prairie, each with the same five species (Carex brevior, Coreopsis lanceolata, Liatris scariosa, Rosa carolina, and Schizachyrium scoparium) planted into six different soil treatments (10 replicates for each treatment; 60 total quadrats). These treatments consisted of combinations of rototilled or non-rototilled plots and three different sand:organic soil compositions. Our three years of data show that results are species dependent, both with regard to tilling and soil composition. Significant differences were also more frequent in the first, compared to the second year of data collection. This is an ongoing project with expanded plantings and more results coming in the future.

32. Wesley Dykstra, Calvin College **Biology**

(Co-Authors: Dena DeKryger)

"Installation of Rain Gardens in the Alger Heights Community"

This poster outlines the installation of rain gardens in Alger Heights in the summer of 2015. Rain gardens are one way to naturalize developed areas. In urban settings, impervious surfaces such as streets, parking lots, and buildings dominate the landscape. These cityscapes disrupt the natural path of water through the water cycle; water is collected from impervious surfaces and piped directly into streams. Unfortunately, the runoff entering streams is often polluted chemically, thermally, and physically. Rain gardens work to reduce stress on streams since they prevent potentially harmful water from reaching the stream. In Alger Heights we employed the use of "curb cut" rain gardens where a portion of roadside curb is cut away to divert water into a rain garden from the street. This water is then used by native plants and any excess is filtered through loamy sand and returned to the water table. Another purpose of these rain gardens is to restore natural habitat and food source for native fauna. The features of a rain garden and process of installation are also summarized on this poster.

33. Kathryn Gerber, Calvin College **Biology**

(Co-Authors: Paul Schramm)

"Worldwide meta-analysis of the relationship between allergenic pollen seasons and climate change"

Pollen, as an environmental trigger for diseases such as seasonal allergic rhinitis, allergic airways disease, and asthma, poses a serious public health risk to much of the world's population. Recent studies evaluating pollen levels and public health outcomes suggest that increasing season duration and pollen quantity are correlated with higher allergic illness levels and fewer productive work and school days, disproportionately affecting vulnerable groups such as children, elderly, uninsured, and urban dwellers. Bearing this public health significance in mind, recent research has sought to evaluate the possible correlation between pollen production and increasing temperatures, hypothesizing that climate change is increasing duration and intensity of pollen seasons across the globe. This study seeks to identify the body of published and peer-edited literature which evaluate this connection, and collect data from identified articles to illustrate the observed patterns. The further exploration and understanding of this connection will aid Centers for Disease Control and Prevention's public health program development for pollen-vulnerable populations in the future.

34. Courtney Glupker, Calvin College **Biology**

(Co-Authors: Peter M. Boersma, Mark P. Schotanus, Loren D. Haarsma, John L. Ubels)

"Effects of Ba2+ on ultraviolet B–induced activation of K+ channels and apoptotic signaling pathways in corneal epithelial cells"

Purpose: The goal of this study was elucidate the ability of Ba2+ to block UVB- induced K+ channel activation, as well as investigate possible protective effects of Ba2+ against UVB-induced activation of apoptotic signaling pathways in human corneal limbal epithelial (HCLE) cells. The overall goal of this study, in conjunction with previous studies, was to investigate the effects of UVB-exposure on corneal epithelial cells, and investigate how high K+ in tears may protect the cornea against UVB-induced apoptosis. Methods: HCLE cells were exposed to UVB at doses relevant to ambient outdoor exposure. Patch-clamp recording was used to measure effects of Ba2+ on UVB- induced K+ currents in HCLE cells. Cells were also exposed to UVB followed by incubation with 5 mM Ba2+ for 4-6 hr. Caspase-activity assays and TUNEL assay were used to determine whether Ba2+ inhibits activation of UVB-induced apoptotic pathways. Results: K+ currents in HCLE cells increased with UVB-exposure, and decreased following addition of Ba2+. When UVB-exposed HCLE cells were incubated with Ba2+, caspases-9, -8, and -3 showed significant decreases in activation as compared to control cells not exposed to Ba2+. Following exposure of HCLE cells to UVB in the presence of Ba2+ apoptosis was also inhibited, as evidenced by a decrease in DNA fragmentation and the number of apoptotic cells.Conclusions: Results indicate that exposure of HCLE cells to UVB activates K+ currents, leading to activation of the caspase cascade and apoptosis due to loss of intracellular K+. This UVB-induced activation is inhibited by Ba2+, giving evidence that Ba2+, a known K+ channel blocker, has effects similar to high extracellular K+, protecting the corneal epithelium from UVB-induced apoptosis. This supports our overall hypothesis that the high K+ in tears, which constantly bathe the cornea, is a protective mechanism against UVB-induced apoptosis in the corneal epithelium.

35. Alexandra Kuipers, Calvin College **Biology**

(Co-Authors: Ryan Bebej, PhD)

"Evaluating Change in Hip and Hind Limb Form and Function to Assess Evolution of Swimming Mode in Early Cetaceans"

The fossil record demonstrates that early cetaceans once lived on land. Our research aimed to study their evolution from a locomotion method suited to land to one suited for water.

36. YeaEun Lee and Thuy-Tien Nguyen, Calvin College **Biology**

(Co-Authors: Andre Otte and Randall DeJong)

"Tracking Geographic and Taxonomic Sources of Fecal Microbes in Plaster Creek Tributaries"

Plaster Creek drains a 58 square mile area within the Lower Grand River watershed in south-central Kent County, Michigan. Plaster Creek and its tributaries receive runoff from much of southern Grand Rapids, parts of the suburbs of Kentwood and Caledonia, and rural southern lands. One of the most significant impairments of Plaster Creek is apparent fecal contamination. High levels of E. coli, a fecal indicator, are frequently detected - up to 50X higher than what is considered safe for partial body contact. Neither the precise geographic locations nor the animal sources of the fecal contamination are known. Levels of E. coli are easily detected by culture-based methods, but no differentiation is possible among animal sources (cow vs. human, for instance). We utilized a DNA-based technique called quantitative PCR (qPCR) and genetic markers that have been developed for various Bacteroides spp. that are specific to different animal guts. Our results identify human contamination in at least two tributaries, and ruminant, most likely bovine, contamination in two southern tributaries. Further investigation is needed to identify the specific geographic sources.

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37. John Leerar, Calvin College **Biology**

(Co-Authors: Mark Schotanus, John Ubels)

"Effect of UVB Radiation on Na+-K+ ATPase Activity in the Corneal Epithelium"

Purpose: Exposure to ultraviolet B (UVB) radiation causes K+ efflux from corneal epithelial cells due to activation of K+ channels. This loss of intracellular K+ is an early step in UVB-induced apoptosis, and inhibition of K+ efflux results in decreased rates of apoptosis in corneal epithelial cells following UVB exposure. When corneal epithelial cells are exposed to UVB, intracellular K+ is lost, then rapidly gained again. Additionally, after treatment with UVB exposure of cells to ouabain, a Na+-K+ ATPase inhibitor, cells are inhibited from regaining K+. This suggests that the Na+-K+ ATPase serves as a mechanism in the recovery of K+ and protection of the corneal epithelial cells from UVB-induced apoptosis. Methods: Human corneal-limbal epithelial (HCLE) cells were exposed to 150 mJ/cm2 UVB radiation and then incubated for time intervals from 10 minutes to 4 hours at 37o C. Cells were lysed in deionized water and homogenized. Following this, Na+-K+ ATPase activity was measured. Results: Exposure of HCLE cells to UVB radiation caused no significant change in Na+-K+ ATPase activity in the cells. Conclusion: The data support the hypothesis that Na+-K+ ATPase in HCLE cells is not inhibited when exposed to UVB radiation. This is in contrast to lymphocytes in which the Na+-K+ ATPase is inhibited when exposed. The data suggest that the Na+-K+ ATPase may play a role in the recovery of K+ after exposure to UVB and protection of the cells from apoptosis.

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38. Jon Lensing, Calvin College **Biology**

(Co-Authors: Cassandra Diegel-Zylstra, Dr. Bart Williams)

"Conditional Knockdown of Wnt3a Using the CRISPR/Cas9 System"

Utilizing the cre-lox bacterial recombinase system, two LoxP recognition sequences were inserted flanking the first exon of the gene Wnt3a - a protein ligand that plays a significant role in embryonic development. In order to insert the two flanking recognition sequences, the CRISPR/cas9 genomic editing system was used to introduce double-strand DNA breaks in the insertion sites.The correct founder population was then crossed with a mice strain containing the tissue-specific cre gene creating offspring lacking the Wnt3a gene.

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39. Matthew Schepers, Calvin College **Biology**

(Co-Authors: Darren Proppe)

"Mitigating the negative effects of road noise on songbird abundance with conspecific playback"

Noise from human activity is known to reduce diversity and abundance in many animal species. Songbirds are especially susceptible because of their reliance on vocal communication. Many songbirds are declining in areas with high levels of noise. While chronic noise clearly disrupts acoustic communication under conditions such as a high-use highway, songbird abundance is also reduced in locations exposed to intermittent noise. In this case, reduced abundance may be due to fear of novel stimuli rather than a true reduction to fitness. Playback of conspecific bird song is a signal of high-quality habitat for many songbird species. If fear is inhibiting establishment in noisy areas, playback of multiple species' songs may help reestablish songbird communities. We investigated whether playback of six migratory species near moderate-use roads increased songbird territory establishment and community diversity in playback areas. To evaluate the effect on the broader community, we also measured twenty-four non-focal species. When combined for all species, playback sites had significantly higher territory density per hectare. Focal species were more diverse at playback sites, and four of six focal species were more common, although density increases were not significant. Non-focal species increased density at playback sites, but were no more diverse. Our results suggest conspecific song playback may be a viable tool to mitigate effects of anthropogenic noise for some songbird species, although future studies are needed to assess songbird fitness in these areas.

40. Jacob Swineford, Calvin College **Biology**

"The Effects of Prairie Burning on insect populations at Flat Iron Lake"

Prairies burning is a generally accepted practice for ecosystem management. It is generally beneficial, however the impact on arthropod communities is relatively unknown. This study is part of an ongoing yearly investigation looking into the effects of prairie burns on arthropod communities at a western Michigan prairie. Pitfall traps were placed along 4 transects on a burned and unburned section. Collected specimens fell into the traps and were categorized by family. Ground cover was also measured with quadrat data. Initial results showed a wide gap in abundance and diversity favoring the burned half of the prairie. There were over 700 specimens collected on the burned half and only about 350 collected on the unburned half. In addition, there were roughly twice as many families identified on the burned half than the unburned half. Ongoing data analysis of the second snapshot week may reveal new trends.

41. Philip Tubergen, Calvin College **Biology**

(Co-Authors: Kara Smit; David Dornbos, PhD)

"Influence of Autumn Olive on Plant Community and Soil Composition"

The non-native, invasive shrub Elaeagnus umbellata, common in the northeast US and in Canada, outcompetes native neighbors by growing faster and using a more light, water, and minerals due to faster photosynthesis rates. E. umbellata is a nitrogen fixer that may nurse co-habiting plants, but it is unclear whether it makes biologically available nitrogen accessible to plants around it. Studies hint that E. umbellata may be allelopathic which may pose a challenge to native species. Change in soil chemistry and species composition can represent how E. umbellata reduces species richness. Our hypothesis was that E. umbellata changes the chemistry of its rhizosphere by increasing nitrogen and reducing anions in its rhizosphere. We assessed this by comparing ions from soils, leaf chlorophyll, and protein content of cohabiting plant species. Less total protein and more chlorophyll content was found in neighboring species. Biodiversity was not affected E. umbellata. Lower ions concentrations were found in E. umbellata soils, likely because fast-growing plants extract large water volumes and minerals from soils. The germination study revealed E. umbellata inhibits seeds when extracts were made from frozen leaves, compared with minor effects using extracts from fresh leaves or roots; so allelopathy may be triggered by frost. While we did support the hypothesis that E. umbellata changed soil fertility, we did not see a corresponding change in biodiversity.

42. Megan Van Baren, Calvin College **Biology**

(Co-Authors: Kellie Sisson, Matt Kortus, Jeff MacKeigan)

"When Broken Brakes are a Problem: Developing a TSC Cell-Based Screen for Compound Sensitivity"

Tuberous Sclerosis Complex, or TSC, is a genetic autosomal dominant disorder characterized by non-malignant tumors in multiple organ systems including the heart, brain, lungs, and kidneys. TSC affects 1 in 6,000 people, and there are approximately one million people worldwide who suffer from the disease. TSC is caused by mutations in the TSC1 or TSC2 genes which lead to aberrant mTOR signaling and uncontrolled cell growth. Although interventions, such as mTOR inhibitors or surgical resection of tumors, are possible for some aspects of the disease, no cure for TSC currently exists. To better understand the disease and increase potential treatment options, we aim to develop a cell-based screen in order to test compounds for use in treating TSC. The patient-derived renal angiomyolipoma (AML) cell line, TRI102, which lacks TSC2, and its TSC2-rescued counterpart cell line, TRI103, were chosen to develop the cell-based screen. To better simulate the tumor environment in the physiological conditions of the body, a gradient of growth serums was tested to determine the amount of growth serum needed to allow the TSC null (disease relevant) cells, but not the TSC wildtype cells to grow. Once developed, this cell-based screen will be used to test a variety of compounds that potentially could be used to treat TSC.

43. Emily Van Staalduinen, Calvin College **Biology**

(Co-Authors: Dorthea Liesman, Dr. Garret Crow, Dr. David Warners)

"A Reassessment of the Grand Rapid Region's Flora After 100 Years of Development"

(presenting with co-author) In the late 1800s, botanist Emma Cole, a teacher at Grand Rapids High School and Kent Scientific Institute, assessed the plant diversity growing throughout much of Kent County, collecting specimens and eventually publishing Grand Rapids Flora (1901), a catalogue of all plants growing in the Grand Rapids area. Despite considerable urban development in the past 100 years, this remains the most comprehensive study of the area's plants to date. Over the course of ten weeks, thirteen different locations throughout Kent County that Emma Cole had included in Grand Rapids Flora were visited, surveyed, and herbarium specimens were collected. Three of the largest areas, Lamberton Lake Fen, Clear Bottom Lake, and Saul Lake Bog, were visited on a weekly or biweekly basis throughout the summer. These locations experienced less disturbance than most and so were predicted to have higher diversity of native species, fewer invasive species, and an overall higher Floristic Quality Index value (FQI), an index used to determine the overall health and quality of an ecosystem. As predicted Saul Lake Bog, Clear Bottom Lake, and Lamberton Lake had the highest FQIs of the studied areas with indexes of 53.9, 50.5, and 36.75 respectively. These sites were also home to several rare and threatened plants such as Cypripedium candidum (White-lady slipper) and Myrica pensylvanica (Northern bayberry). Further analysis of this reassessment could inform future conservation decisions in Kent County.

44. Whitney Lambert and Darien Lozon, Cornerstone University **Biology**

(Co-Authors: Rob Keys - Faculty Advisor)

"The influence of habitat and landscape associations on breeding birds in managed grasslands of Southwest Michigan"

Grassland birds are nationally experiencing a significant population decline primarily due to conversion of habitat to agricultural and industrial uses. Pierce Cedar Creek Institute stewardship managers hoped that the removal of hedgerows in their prairies would increase grassland bird biodiversity. We conducted 7 weeks of point count surveys, vegetation surveys, and surrounding landscape analyses to determine what habitat characteristics, landscape features, and management practices act as attractors or detriments to grassland birds. Four management types were analyzed for their effect on grassland bird diversity: restored prairie, mixed management, Conservation Reserve Program (CRP), and mowed fields. We specifically surveyed the presence of Henslow's Sparrows, Grasshopper Sparrows, Bobolinks, Song Sparrows, Field Sparrows, Eastern Meadowlarks, and Savannah Sparrows. Mowed airport fields had the greatest mean diversity (H' = 1.436) with CRP fields the second greatest (H' = 0.474). Restored prairies and mixed management sites had the smallest mean diversity (H' = 0.068 and 0, respectively). Among the dominant vegetation types found, fescue grasses (Festuca spp.) had the highest correlation with diversity at a magnitude 78.4% greater than goldenrods (Solidago spp.) and 123.8% greater than Big Blue Stem (Andropogon gerardi). Edge effect was an important indicator of species found during point counts. Our models showed urban areas have a high correlation with diversity, including both fields surrounded by urban areas (1-km radius from center of each field) and fields directly adjacent to urban areas (R2=0.868 and R2=0.699, respectively).

45. Rachel Kempisty, Ferris State University **Biology**

(Co-Authors: Mary Beth Zimmer)

"The Effects of Spinal Cord Injury on Learning and Memory"

Spinal cord injuries (SCI) result in the damage of nerves extending from the brain to all areas of the body, leading to disturbances in sensory and motor signals below the injury site. This study hypothesizes that the hippocampus, the region of the brain involved in learning and memory, undergoes neurochemical changes after an SCI. Learning and memory was assessed in SHAM (control) and SCI Sprague-Dawley rats through the use of the Morris Water Maze. Results obtained were analyzed and compared to a similar study involving SHAM and SCI Long Evans rats.
The mechanisms by which animals retain memories and acquire new information are still unknown. In order to gain a better understanding of these processes, we have begun investigating varying levels of specific proteins found in the hippocampus of SHAM rats compared to SCI rats. We are in the process of examining Brain-Derived Neurotrophic Factor (BDNF) levels, known to be involved in learning and formation of new synapses, by implementing the Western Blot analysis, an immunostaining technique, on the hippocampal tissues. Analyzing BDNF levels in the upcoming weeks may help to explain differences in learning and memory in SCI and provide insight into the mechanics of learning.

46. Hunter Brunges, Grand Valley State University **Biology**

(Co-Authors: James Dunn)

"The Effects of Invasive Earthworm Species on Salamanders in the Grand Valley State University Ravine Ecosystem"

Earthworms are an invasive species that are causing ecological damage to northern forest ecosystems. The disruption to soil nutrient cycling and litter decomposition can negatively impact organisms that live within the leaf litter, such as salamanders. To test this hypothesis, we sampled earthworms within three ravines at thirty-six sites using the mustard extraction method. We surveyed salamander populations on two dates in 2015 at each site using cover boards. We also collected data on slope aspect, altitude, soil moisture, leaf litter coverage, canopy cover, and coarse woody debris at each site to determine their effects on earthworm and salamander populations. Unexpectedly, our results show that total earthworm populations did not decrease salamander abundance. However, epigeic earthworms in north facing, low elevation sites did have a negative effect on salamanders. We also found that anecic earthworm species had a negative impact on leaf litter in south facing, low elevation sites. Using a GLIMMIX model, we found that epigeic earthworms had a negative effect on salamander populations, while anecic earthworms had a positive effect on salamander populations.

47. Macy Doster, Grand Valley State University **Biology**

(Co-Authors: Anthony Weinke, Dirk Koopmans, Bopi Biddanda)

"Analyzing Drivers of and Linkages Between Hypoxia and Algal Blooms in a Great Lakes Estuary Using Time-Series Observations"

Lakes are sentinels of change in their watersheds. In 2014, the city of Toledo was forced to shut down their water supply due to a toxic algal bloom in Lake Erie. The cause of this crisis was microcystin, a toxin produced by the cyanobacteria Microcystis. Cyanobacteria bloom rapidly under optimum conditions such as a warm, stratified water column, but roles of multiple environmental drivers are not well understood. Most studies tend to cover only the fair weather periods and have large breaks in data collection, but the Muskegon Lake Observatory has provided a continuous time-series data set from 2011-2015 giving the opportunity to study fine-scale changes occurring in Muskegon Lake (http://www.gvsu.edu/wri/buoy/). By analyzing temperature change and dissolved oxygen levels, we determined the onset and departure of stratification. Fueled by excess productivity from surface waters sinking to bottom waters and enhanced by thermal stratification, hypoxic bottom waters have the potential to contribute to algal blooms by releasing sediment—bound phosphorous. Our study looks at possible drivers of hypoxia and algal blooms, such as mixing events in Muskegon Lake, MI for 2015. A thorough explanation of the daily, seasonal, and yearly patterns will contribute to a better understanding of the ongoing ecosystem changes in the Great Lakes and elsewhere.

48. Brianna Powell, Grand Valley State University **Biology**

(Co-Authors: Cynthia Thompson, Chris Vinyard, Rebecca Britain)

"Behavioral thermoregulation during winter in Japanese macaques (Macaca fuscata)"

Mammals use thermoregulatory behaviors to maintain optimal body temperatures when facing variable weather conditions. During cold temperatures, these behaviors can serve as an energetically inexpensive way to modulate heat loss. We assessed the use of thermoregulatory behaviors in a semi free-ranging group of Japanese macaques (Macaca fuscata) in Inuyama, Japan during winter. We recorded activity, body postures, and sun exposure for five animals (N=443 observation hrs) exposed to natural thermal variation (-2.9°C to 10.8°C). Air temperature and solar radiation were recorded via an on-site weather station. At colder temperatures, macaques utilized heat-conserving body postures more frequently, engaged in longer periods of physical contact, and spent less time moving. Additionally, when daytime solar radiation was high, macaques rested in sunny locations more frequently than shady locations. These results are consistent with a strategy to behaviorally conserve heat loss. Decreases in movement at cold temperatures further suggest that animals are attempting to reduce energy expenditure when thermoregulatory costs are highest. In sum, these results indicate that Japanese macaques utilize heat- and energy-conserving behaviors as part of their thermoregulatory repertoire when experiencing cold temperatures in winter.

49. Erin Alenciks, Hope College **Biology**

(Co-Authors: G. S. Fraley, S.L. Meddle, and K. Frazier)

"Immunolesions of melanopsin receptive neurons in the adult Pekin drake attenuates the hormonal reproductive axis"

Several light sensitive receptors have been described in the avian brain that are thought to regulate the reproductive axis independently from the eyes and pineal gland. Recently, our lab has described the presence of 3 of these photoneuroendocrine systems in the Pekin duck: opsin, opsin 5, & melanopsin. We set out to test the hypothesis that melanopsin receptive neurons are necessary to maintain seasonal reproductive status along with growth and development in the Pekin drake. To accomplish these goals we first investigated 50-week-old Pekin drakes that were housed in the aviary at Hope College under long day length (18 hrs lights on) conditions in floor pens. To specifically lesion melanopsin-receptive neurons, 3 µl of an anti-melanopsin-saporin conjugate (MSAP, 100 ng/ul) was injected into the lateral ventricle (n = 10). Control drakes were injected with 3 ul of equimolar unconjugated anti-melanopsin and saporin (SAP, n = 10). The drakes were returned to the aviary after complete recovery. Reproductive behaviors were analyzed weekly in a test pen with adult hens. After 4 weeks, birds were euthanized and body weights were measured, and brains, pituitaries, and testes collected and stored for analyses. To test melanopsin's effect on immature ducks the same surgery was performed on a group of 10 day old ducks (n= 10). Ducks were weighed weekly starting at 3 days of age. After a final weight was obtained at 50 days of age, ducks were euthanized and a blood sample was collected and sent out for an avian panel. Mature MSAP-treated drakes had significantly ($p < 0.001$) reduced relative teste weights compared to SAP controls. qRT-PCR analyses (n = 3 per treatment) of anterior pituitary showed a significant reduction ($p < 0.001$) in both LH-beta and FSH mRNA's. Immunoctyochemical analyses (n = 3 per treatment) showed a significant reduction in melanopsin and GnRH-immunoreactivities. Immature drake BW did not differ significantly between MSAP and SAP animals at any of the measured days. The data appeared to drift toward significance near the end of the sampling period ($p = 0.297$). Blood panel results revealed no significant differences between MSAP and SAP animals in any CBC component. Serum glutamic-oxaloacetic transaminase (SGOT) ($p = 0.022$) and creatine phosphokinase (CPK) values were significantly elevated ($p = 0.006$) in MSAP animals compared to controls. Although melanopsin neurons in the PMM appear to have an important role in adult drakes, their importance in the growth of immature ducks is still unclear. However, these data underscore the importance of the photoneuroendocrine system in maintaining the reproductive axis along with growth and development in seasonally breeding birds.

50. Brandon Ellsworth, Hope College **Biology**

(Co-Authors: Aaron O'Meara, Gerald G. Griffin)

"The 1-42 isoform of amyloid beta reduces cell viability of Salmonella. enterica"

Alzheimer's disease (AD) is the sixth leading cause of death in the United States. In fact, one out of every eight americans age sixty-five and older will develop the disease. One pathological hallmark associated with AD and other forms of dementia is the over-accumulation of the amyloid beta peptide. While amyloid beta is present at low levels in all humans, its function is a source of great debate. Reducing the viability of microbes that have invaded the central nervous system is one reported function of the peptide. However, this work has been demonstrated only once so far. To further test, if amyloid beta reduces cell viability of microbes, we tested the hypothesis that amyloid beta exerts antimicrobial resistance against Salmonella enterica (S. enterica). After treating S. enterica with a range of concentrations (1pM-1microM) of both major isoforms of amyloid beta (1-40 and 1-42), we measured bacterial cell viability with the alamar blue assay. Our results revealed that the 1-42 isoform, but not the 1-40 isoform of amyloid beta, had an effect on bacterial growth. More specifically, administration of 10pM of amyloid beta (1-42 isoform) reduced cell viability over 20 percent (compared to vehicle control; $F=32.91$, $p<0.0001$). This piece of data extends the finding that amyloid beta has a anti-microbial function. Moreover, our results indicate that the 1-42 isoform, enriched in amyloid beta plaques associated with dementia, has unique properties that allow it reduce the growth of S. enterica. These data also demonstrate that the peptide exerts its antimicrobial effects at a concentration (10pM) lower than that associated with protein misfolding and the plaque formation associated with AD and other dementia. While ongoing work is being performed to dissect the mechanisms underlying these findings, our data lend support to the hypothesis that amyloid beta release in vivo is prompted by microbial infection of the central nervous system.

51. Elizabeth Ensink, Hope College **Biology**

(Co-Authors: Morgan Ricker, Carrie Dummer, Vanessa Muilenburg, Justin M. Shorb)

"Design and Evaluation of Day1 Peer Partnership Learning Course Materials for General Chemistry and General Biology"

First-year college students encounter a multitude of obstacles ranging from acclimating to living away from home to adapting to a higher level of course rigor. In Fall 2015, Hope College launched "Day1", a program designed to promote retention and performance of first year students in STEM fields through interdisciplinary research projects. In addition to shared residence halls and coursework, students enrolled in Day1 participate in Peer Partnership Learning (PPL) activities on a weekly basis. PPL Leaders will attend all lectures for a given section and lead one or two PPL sessions per week for approximately 10 students. The design for these sessions has been built from a literature review of best practices for problem solving in STEM fields, the information processing model of learning, and integrated learning of study skills. Worksheets for the first semester of introductory biology and chemistry have been created in partnership with lecture professors in order to train this first generation of PPL Leaders and promote collaborative learning. Goals for their implementation, a template for their generation, and a plan for evaluation will be presented.

52. Sarah Faith Kim, Hope College **Biology**

(Co-Authors: Lydia Pagel)

"Loline biosynthesis gene expression by Epichloe fungi grown under in vivo and in vitro conditions"

It is know that the fungus, Epichloë coenophiala, produces alkaloids, such as lolines, in response to physical damage to its host. I explored presence of the lol-cluster genes (Lol A1, A2, C2, D2, E2, F2, O2, T2, P2, U2) in cultured Epichloë isolates and the inducibility of lol cluster gene expression within Tall Fescue grass (Schedonorus arundinaceus). Isolated cultures of the fungus were procured from Rutgers University and University of Kentucky (UK); additionally, cultures were isolated at Hope College (HC) to be used in the on-site study. RNA was extracted using the Quiagen RNeasy kit following the manufacturer's protocol. Samples were analyzed using qPCR, to test for expression of specific lol-cluster genes, as well as B-tubulin as a control. Previous studies had only looked for the expression of Lol C in vitro, and had not shown positive results. Ours is the first study to show expression in vitro of lol-cluster genes. Lol A2, E2 and T2 expressed in samples from HC and UK cultures as well as samples drawn in vivo from Tall Fescue grass. Samples from Tall Fescue were collected before it was physically damaged, and then again one week after physical damage. The in vivo Tall Fescue grass samples indicated the inducibility of A2 and O2 (up regulation) and E2 and T2 (down regulation). These indications of inducibility merit further study as lolines can influence preference and performance of herbivores of Tall Fescue.

53. Lindsey Porter, Hope College **Biology**

(Co-Authors: Fraley, G.S, L., E. Alenciks, M. Shannon, and H. Potter)

"Gonadal regression elicited in Pekin duck drakes and hens associated with a drop in light intensity"

Many studies have focused on the neural mechanisms associated with seasonal reproduction in birds and the light intensity necessary to initiate gonadal recrudescence. However, few studies have examined the drop in light intensity that initiates gonadal regression. The Pekin duck is an excellent model for the study of seasonal reproduction. The question regarding the neurobiology of gonadal regression is important in the US duck poultry industry. To more fully understand the relationship between light intensity and gonadal regression, we housed adult (45 week old) drakes and hens in the Hope College aviary as 4 drakes:20 hens in each of 3 floor pens (density = 0.24 m2 per duck). Light conditions were divided into the following: 1) to simulate summer, 14 hrs 60 Lux with 10 hrs 1 lux; 2) to simulate winter, 8 hrs 60 lux with 16 hours 1 lux; 3) winter augmented, 8 hrs 60 lux with 16 hours with 15 lux. Daily the total number of eggs laid was tallied and a daily average of eggs laid was calculated for each week of the study. Weekly, eggs were weighed and the perivitilline membrane was assayed for the number of sperm holes as an indirect measure of drake fertility. As expected, winter conditions caused a significant ($p < 0.01$) reduction in the percent of eggs laid and a significant ($p < 0.001$) reduction in the number of fertilized eggs compared to the summer light conditions. The augmented winter light conditions prevented the loss in the percent eggs laid and fertilized eggs. Surprisingly, even after 4 weeks of the study, the winter conditions did not cause a complete loss of fertility in the Pekin ducks. Although a minimum (1 lux) of light is capable of maintaining some fertility, commercial Pekin duck barns might want to increase the augmented light to 15 lux in order to maintain fertility during winter months. Furthermore, it appears that the drakes may be more sensitive to environmental light conditions than the hens are.

54. Hannah Potter and Mackenzie Shannon, Hope College and Grand Valley State University **Biology**

(Co-Authors: Gregory S. Fraley)

"Increased hypothalamic GnIH-ir and decreased reproductive behaviors in an inbred line of Single comb white Leghorn egg-layers, GHs6"

An inbred line of White Leghorn chickens has been housed at the University of Wisconsin for decades. This line of birds could only be propagated by artificial insemination despite that researchers in the past demonstrated that the hens laid eggs at a typical leghorn rate, and the roosters produced good quality semen, though of slightly, but significantly lower sperm count compared to controls. Thus we hypothesized that the lack of fertility in these birds was due to deficits in reproductive behaviors. To test this hypothesis, a remote surveillance system was set up over the floor pens (n = 3) that contained roosters and hens (1:4 ratio) housed on 18 hrs of daylight. Constant remote monitoring continued for 6 months, and reproductive and aggressive behaviors were assayed once per week for 3 hours after lights-on. Controls were standard white leghorns (SWLR) housed in a similar fashion with remote surveillance in the Hope College aviary (n = 3 pens). We focused on the roosters' behaviors and found no differences in thrusts or pecks between the inbred and standard leghorns. However, unlike the SWLR the GHs6 roosters showed zero courtship or mating behaviors. Gonadotropin inhibitory hormone has been described in birds to stimulate food intake, and to inhibit both the HPG axis and reproductive behaviors. Thus we hypothesized that the lack of reproductive behaviors in GHs6 roosters may be due to an overexpression of GnIH. To test this hypothesis, 45 week old GHs6 and SWLR (n = 4 per strain) roosters were euthanized and pericardially transfused with 4% paraformaldehyde. Brains were processed for immunocytochemical analyses of GnIH-immunoreactivity (ir). A significant ($p < 0.05$) increase in the number of GnIH-ir perikarya were observed in the paraventricular nucleus of the hypothalamus in GHs6 roosters compared to SWLR controls. The increased GnIH protein expression may be related to the loss of reproductive behaviors in the Single comb white Leghorn roosters.

55. Kayla Schipper, Hope College **Biology**

"Localization of Host Phospholipids in Comparison to Sties of Genome Replication in Flock House Virus"

The majority of human viral pathogens are positive-strand RNA [(+)RNA] viruses. All (+)RNA viruses replicate their genome in association with host intracellular membranes. This similarity in genome replication has led to the hypothesis that this association may be a target for broad spectrum antivirals against (+)RNA viruses. It is also why lipids and phospholipids associated with viral genome replication are of particular interest in looking for potential targets for broad spectrum antivirals. In this study, the localization of two host phospholipids, phosphatidylethanolamine (PE) and phosphatidylserine (PS), were compared to sites of genome replication of the (+)RNA virus Flock House Virus (FHV). FHV RNA replication takes place in virus-induced spherules on the outer membrane of mitochondria. Fluorescent duramycin was used to label Drosophila cells replicating FHV RNA to look at the localization of PE. Duramycin is known to bind PE with high specificity at a 1:1 ratio. The presence of protein A was used to indicate sites of FHV RNA replication since it is the only viral protein necessary for RNA replication. Protein A was detected using an anti-FHV protein A antibody and a fluorescent secondary antibody. Cells were imaged using a confocal microscope. We observed no significant enrichment of PE at sites of FHV replication. To examine the location of PS relative to viral replication sites, we used a GFP fusion with the C2 domain of lactadherin (LACT-C2) that had previously been shown to bind PS. We cloned GFP-LACT-C2 into a Drosophila expression vector and infected cells with FHV. Phosophatidylserine was not enriched at sites of FHV replication. Ongoing studies are examining the localization of other phospholipids.

56. Michael VanWyngarden, Hope College **Biology**

"Role of Membrane Rearrangement in Positive-strand RNA Virus Immune Evasion"

Positive-strand RNA [(+)RNA] viruses are serious threats to human health and include emerging pathogens such as the Middle-East Respiratory Syndrome (MERS) coronavirus and West Nile virus. A universal feature of (+)RNA virus genome replication is its association with host intracellular membranes. To study (+)RNA virus genome replication we used the alphanodavirus, Flock House Virus (FHV). FHV has a 4.5 kb bipartite positive-sense RNA genome and normally infects insect cells, but will also replicate in mammalian, plant, and yeast cells. The larger of the genomic segments, RNA1, encodes the viral replicase protein A and the smaller genomic RNA2 encodes the capsid protein. During replication of RNA1, a subgenomic RNA3 is produced that encodes the RNA interference (RNAi) suppressor protein B2. When Drosophila S2 cells are infected with FHV, 50 nm membranous spherules form on the outer mitochondrial membrane, which are the sites of viral genome replication. Since protein B2 is produced after RNA replication has begun, and presumably after the formation of double-stranded RNA replication intermediates, we hypothesized that the spherules may provide an initial barrier against host RNA interference (RNAi). Therefore, we localized protein B2, the RNAi protein Dcr-2, and viral dsRNA to test the possible roles of virus-induced membranous replication compartments in immune evasion. Drosophila S2 cells were infected with FHV, and 16 hours post-infection stained with primary and secondary fluorescent antibodies and analyzed by confocal microscopy. Our results found that dsRNA co-localized with the sites of viral RNA replication. Protein B2 did not co-localize with dsRNA at FHV RNA replication sites, a surprising result given protein B2's documented ability to bind dsRNA. At later stages of infection, Dcr-2 was found at sites of FHV genome replication. On going studies will continue to elucidate the role of virus-induced membrane compartments in viral replication and immune evasion.

57. Carter Wolff, Hope College **Biology**

(Co-Authors: Santiago E. Rios)

"Endophytic Fungi Affects Insect Abundance and Reduces Plant Damage From Sucking Insects"

Endophytes are microbial species, often bacteria or fungi, that live within a plant asymptomatically. Some fungal endophytes have developed a symbiotic relationship with cool-season grasses. It has been suggested that these symbiotic fungi act in a defensive mutualism with their host grasses. Endophytes can produce alkaloids that deter various types of herbivores. We examined the effect these endophytic fungi have on insect abundance, insect herbivory, and plant growth in Canada Wild Rye (Elymus canadensis), a native grass of North America. Grasses that were naturally uninfected, naturally infected with Epichloë canadensis, and artificially disinfected were studied in outdoor and laboratory trials. Bird-cherry Oat Aphids (Rhopalosiphum padi) were used as a bioassay. Our field experiment showed that endophyte infection resulted in a reduction in plant damage due to sucking insects. Our laboratory experiment corroborated this result, showing fewer apterous aphids on grasses with endophyte presence.

58. Reid Blanchett, Kalamazoo College **Biology**

(Co-Authors: Nikki Thellman, DVM; Carolyn Botting; Steve Triezenberg, PhD)

"Establishment of latency in human immortalized dorsal root ganglia with the neurotropic 17syn+ strain of herpes simplex virus type 1"

Herpes simplex virus type 1 is present in approximately 80% of the American population and is the causative agent of herpetic keratitis, viral encephalitis, and labial lesions. An HSV-1 infection is characterized by its three-stage lifecycle: the initial lytic infection, the establishment of latency, and the reactivation of the virus. Though lytic infections are quite well understood, much less is known about HSV-1 latency and reactivation. This disparity is partially due to a lack of adequate models to study the processes. The current in vivo and in vitro systems that exist are either inefficient, or inapplicable to human physiology. This study investigated the efficacy of establishing a latency-model in HD10.6 cells with the neurotropic HSV-1 17syn+ strain. The hallmarks of in vitro latency were demonstrated with viral plaque assays for infectious virus release and quantitative real time PCR for viral genome detection in cells. X-gal staining of neurons latently infected with a 17syn+-based LAT promoter-βgal reporter virus validated that viral genomes present in cells were functional and capable of LAT expression. The results indicate that the presented model for establishing latency is efficacious, and can be used as a model system for investigations of HSV-1 latency and reactivation mechanisms that are physiologically relevant to humans.

59. Marko Ivancich, Calvin College **Biomedical Sciences**

(Co-Authors: Neelu Puri, Ph.D, Perlina Fortinberry, Gagan Chhabra, Ph.D, Douglas Chan)

"Mechanism of Action of Oligonucleotides Homologous to the Telomere Overhang and Development of a Nano-Delivery Vehicle for Melanoma to Increase its Efficacy"

In recent years, telomeres have become an attractive target for anticancer therapeutics due to the near-universal over-expression of telomerase in tumors. Telomere homolog oligonucleotides, commonly known as T-oligos, are known to have potent anti-cancer effects when administered to several malignant cell types, both in vitro and in vivo. Our research centers around one particular eleven-base oligonucleotide (5'-dGTTAGGGTTAG-3'), called T11, that is homologous to the 3' telomere overhang sequence, induces potent DNA damage responses (DDRs) in several cancers, and has minimal or no toxicity on normal cells. Our earlier studies indicate that DDRs initiated by T11 lead to senescence and apoptosis in cancer cells. However, T11 is sensitive to nuclease degradation and its mechanism is poorly understood. We postulate that T11 functions by recruiting the shelterin complex, a group of regulatory proteins that protects and maintains telomeric DNA, away from the telomere, thus uncapping the 3' overhang and causing DDRs. Additionally, the telomeric DNA on the 3' overhang is known to form G-quadruplexes (G4), a secondary structure that is facilitated by the folding of single stranded DNA around a tetrad of hydrogen bonded guanine residues. It was recently discovered that T-oligos are also able to form G4 when they are incubated in KCl solution. We hypothesize that the additional secondary structure of G4 configured T11 may confer increased stability and resistance to nucleases in serum, thus increasing the amount of T11 that accumulates in the nuclease and initiates DDRs. To compare the stability of SS- and G4-T-oligo, we performed nuclease digestion experiments at different time-points after incubation with mouse serum. It appears that G4-T-oligo remained more intact in serum than SS-T-oligo after two hours. Anti-proliferative activity of SS- and G4-T-oligo on melanoma cells was determined using an MTT assay. The results show that SS-T11 alone inhibited growth by 38.4-51.1%, while G4-T11 inhibited cell growth by 20.8-33%. To elucidate T11's mechanism of action, immunoblotting was performed to study apoptosis and telomere dysfunction related proteins in vitro. Western blot results showed upregulation of both p-JNK and total JNK by 4.0- and 2.0-fold respectively, at 24 hr after T-oligo treatment. T-oligo treatment also upregulated TRF2 by 2.0-fold indicating that T-oligo may cause telomere dysfunction.

60. Zachary Bassler, Grand Valley State University **Biomedical Sciences**

(Co-Authors: Dawn M. Clifford Hart)

"The membrane anchored protein Mac1 facilitates Mid1 localization to interphase nodes"

Cell division is a fundamental component in the life of an organism. It is important to study the various mechanisms involved with cell division in order to better understand diseases such as cancer in which cells divide uncontrollably. A model organism for the study of eukaryotic cell division is the fission yeast Schizosaccharomyces pombe. Fission yeast elongate at the cell tips and divide medially through the formation of an acto-myosin ring. Formation of this ring is dependent on the proper timing and positioning of two types of interphase nodes to the division site, both of which contain an array of proteins. Mid1 is an anillin-like protein present in all nodes that determines the placement of the cytokinetic ring by anchoring to the cell membrane and recruiting additional cytokinetic proteins. In the absence of Mid1, nodes do not form, resulting in defects during acto-myosin ring formation and cytokinesis. Investigation of an under characterized protein, Mac1, reveals that it plays a role in the association between Mid1 and interphase nodes. Visualization of a mac1Δ mid1-GFP strain displays reduced Mid1 localization at nodes during interphase. To further investigate the role of Mac1 in Mid1 localization to interphase nodes, mac1Δ cells expressing fluorescently tagged cytokinetic node proteins will be visualized. In the absence of mac1, cells experience cytokinetic defects at higher temperatures. Cells lacking Mid1 localization to nodes have similar phenotypes. The correlation in cytokinetic defects in both types of cells warrants further investigation into the relationship between Mid1 and Mac1. Failure of tagged node proteins to localize to nodes is expected and will show Mid1 node localization is impaired when ,mac1 is absent.
This research is supported by National Science Foundation RUI Award #1157997.

61. Jessica Fritzler, Grand Valley State University **Biomedical Sciences**

(Co-Authors: Timothy M. Evans)

"A Molecular Phylogeny of the African Plant Genus Palisota (family Commelinaceae)"

The plant family Commelinaceae displays a range of variation in vegetative, floral and inflorescence morphology. This variation, particularly among the reproductive parts, makes assessment of homology among morphological characters difficult. Recent molecular data have revealed that the African genus Palisota occupies a position near the base of Commelinaceae, indicating an early divergence from most of the family. The primary goal of this study is to use DNA sequence data from three chloroplast (matK, rbcL, and RPS16) and one nuclear (AT103) gene to evaluate phylogenetic relationships among Palisota species and related genera. Specifically, we wish to: 1) determine whether Palisota is a monophyletic ("natural") group; 2) assess its position within the family Commelinaceae; and 3) resolve phylogenetic relationships among Palisota species. Preliminary data indicate that Palisota is monophyletic, and they place it sister to tribes Commelineae and Tradescantieae, supporting earlier work. Palisota bracteosa is sister to the remaining Palisota species included in this study.

62. Basma Khudhur, Grand Valley State University **Biomedical Sciences**

(Co-Authors: Katie Uhl)

"Biological Testing of Novel Telomerase Inhibitiors"

As of 2011, cancer was the leading cause of death in the United States, second only to heart disease. Cancer is often referred to as being "immortal", because of its ability to divide a seemingly infinite amount of times. Normal cells are limited in the number of times they can divide by the caps on the ends of their chromosomes, called telomeres. Two series of compounds were synthesized with the goal of creating novel telomerase inhibitors. The first series was derived from the structure of BIBR 1532, and the second series was based on an ester linkage. The efficacy of these compounds were compared against that of BIBR 1532 at similar concentrations, in order to determine if these novel compounds would prove to be adequate cancer treatments. The compounds were tested against metastatic cancer cells at varying concentrations, and then a Telomerase Repeat Amplification Protocol assay was performed. The results show that all of the compounds show anti-proliferative qualities, and also demonstrate telomerase inhibition.

63. Lindsey Schroedter, Grand Valley State University **Biomedical Sciences**

(Co-Authors: Grace Peterson, Justin Bria, David Linn PhD)

"Characterization of a drug for Alzheimer's disease in a 'retina in a dish' culture system for glaucoma"

Characterization of a drug for Alzheimer's disease in a 'retina in a dish' culture system for glaucoma.
Lindsey Schroedter, Grace Peterson, Justin Bria and David Linn, PhD
Grand Valley State University, Department of Biomedical Sciences, Allendale MI
Glaucoma, a neurodegenerative disease, is a leading cause of blindness. It is known that activation of nicotinic ACh receptors (nAChRs) on retinal ganglion cells (RGCs) can provide neuroprotection. Theoretically, if one could increase the amount of ACh released, then more nAChRs should be activated and more neuroprotection observed. DMP 543 was originally developed to treat Alzheimer's disease by increasing the release of ACh in the brain. Previously, we examined if the release of labeled ACh in the intact porcine eye-cup could be increased with DMP 543. DMP-543 was determined to evoke a dose-dependent release of ACh from the pig retina. Also, an increase in the release of ACh evoked by individual high potassium pulses was observed during continuous exposure to DMP 543. This is consistent with reports examining ACh release from rat hippocampal slices. More recently, we wanted to determine if a dissociated retinal cell culture (including cholinergic amacrine cells and RGCs) could indirectly demonstrate the release of ACh as measured by increased cell survival (neuroprotection). DMP 543 has a similar dose-dependent effect on retinal cell survival in our dissociated mixed retinal cell culture ('retina in a dish'). Currently, we are testing the effects of selective nAChRs modulators to confirm a direct effect upon nAChRs on RGCs. These modulators have no effect on their own, but only enhance the response of an activated nAChR. Collectively, these results could be used to indicate which nAChRs (alpha7, alpha4beta2, etc.) are activated by the ACh released due to DMP 543. To our knowledge, this is the first time a drug originally developed to treat Alzheimer's disease provides promise as a novel therapeutic approach for treating glaucoma.

64. Leah Starks, Grand Valley State University **Biomedical Sciences**

(Co-Authors: Bradley Ophoff)

"The Impact of Perfusion on Stored Blood Vessel Function"

The goal of the experiment is to study the impact of different storage methods for arteries on vascular reactivity. Commonly, blood vessels are refrigerated prior to experimentation. During storage, the blood vessels are maintained in a buffer solution at low temperature and are not perfused with blood. In vivo, blood vessels constrict or dilate in response to various stimuli as a means to control blood flow. We hypothesize that adding a perfusion protocol to traditional blood vessel storage methods will improve subsequent vascular responses. To test this hypothesis, the left anterior descending (LAD) artery was dissected from a porcine heart. Next, segments of the LAD were stored in Krebs buffer solution in the refrigerator, at body temperature, and at body temperature while being perfused; all segments were stored for 30 minutes. Five millimeter sections from each storage method were then connected to a force transducer to record the changes in arterial tension in response to different agonists: potassium chloride (15-60 millimolar), a vasoconstrictor, and sodium nitroprusside (10-7-10-4 Molar), a vasodilator. Preliminary data suggest that perfused vessels do respond appropriately to agonists. This is an ongoing experiment to determine if the perfused blood vessels are more reactive than blood vessels stored using traditional methods.

65. John Wesley, Grand Valley State University **Biomedical Sciences**

(Co-Authors: Michela Kastura)

"Impact of Acute Hyperbaric Oxygen Treatment on Gut Motility"

The purpose of this study is to determine the effect of hyperbaric oxygen therapy on gut motility. Our laboratory has observed changes in the physiological responses of mesenteric arteries following acute exposure to hyperbaric oxygen. As such, the smooth muscle of the intestinal wall may also be affected by acute exposure to hyperbaric oxygen. Approximately 1.0cm segments of porcine small intestine were placed in a hyperbaric chamber at 1.75 atmospheres with either 100% oxygen or room air. The intestinal segments were mounted in isolated organ baths coupled to force transducers at 5.0 grams passive tension. Serial doses of potassium chloride, acetylcholine and phenylephrine were independently added to the organ baths and the subsequent changes in contractile tension were then recorded. Preliminary findings indicate that the intestines are responsive to each of the agonists. Further studies will be performed to determine potential differences in gut motility upon exposure to hyperbaric treatments.

66. Salma Mumuni, Western Michigan University **Biomedical Sciences**

(Co-Authors: Roderick Davis, Pamela Clarke, Bernard Kwabi-Addo1)

"Effect of sex steroid hormones, circumin, LPS, and retinoic acid on PTEN and p53 expression in prostate cancer cells"

Background: Prostate cancer (PCa) is the most frequent type of cancer in men, with over 220,800 new cases diagnosed and 27,540 American men dying each year. That is equivalent to 1 out of 7 American men developing prostate cancer in their lifetime. Mutations or alterations in p53, a tumor suppressor gene,is frequent in prostate cancer cases. Therefore, the expression of p53 plays an important role in PCa etiology and/or progression.
Aim: The aim in this study is to investigate the effect of sex steroid hormones on the expression of p53.
Methods: The androgen dependent LNCaP and the androgen-independent PC3 cells were each treated with estradiol, progesterone, R1881, curcumin, LPS, and retinoic acid. Quantitative reverse-transcribed PCR (qRT-PCR) was used to quantify the effects of the drugs on p53 gene expression. Crystal violet assay was used to determine cell proliferation.
Results: We observed induction in p53 expression in both the LNCaP and PC3 cells in response to treatment with curcumin, retinoic acid, and R1881. In contrast, treatment of PC3 cells treated with estradiol and progesterone showed a decrease in p53 expression. LNCaP cells also showed a decrease in p53 expression in response to estradiol treatment, however progesterone did not have any effect on p53 expression in LNCaP cells.
Conclusion: Our preliminary observation demonstrates that estradiol induces proliferation of LNCaP and PC3 prostate cancer cell lines by decreasing expression of the p53 tumor supressor gene. However, curcumin, R1881, and retinoic acid inhibit the proliferation of LNCaP and PC3 cells by increasing expression of the P53 tumor suppressor gene.

67. Joshua Favorite, Ferris State University **Biotechnology**

(Co-Authors: Calvin Hancock)

"Acoustic Larvacide Effectiveness on Different Mosquito Developmental Stages"

Acoustic Larvacide© is a chemical free, environmentally friendly method of exterminating mosquito larvae. By using sound waves in water, it ruptures the larvae tracheal tube by resonating with the small amount of air inside. The larvasonic device uses a range of frequencies within the octave of 18-36 kHz, since the resonating frequency may vary slightly due to size and species of mosquito. This damage can cause both instant death and future defects in the mosquito throughout its lifecycle that would prevent it from becoming a viable adult.
Although the main target of acoustic larvacide is just the larvae, the manufacturer of the larvasonic device (New Mountain Innovations) claims it can also be used to treat mosquito pupae as well. The pupae stage has numerous physical differences such as its fused head and thorax called the cephalothorax, the trumpet breathing tube instead of the larvae's siphon, and many more as the pupae prepares its transition into an adult. It is because of these physical differences that we hypothesize that acoustic larvacide will not be nearly as effective on pupae as on larvae.

68. Shaughna Langerak, Ferris State University **Biotechnology**

(Co-Authors: PhD Changqi Zhu)

"Functional Study of Drosophila Activin Signaling in Aging Regulation in Fruit Flies"

Drosophila Activin signaling is a branch of Transforming Growth Factor β (TGF-β) signaling in fruit flies. This signaling pathway is well conserved from fruit flies to vertebrate animal species and is known to play a large role during development. Previous published work has implicated this signaling pathway in regulation of cell proliferation, apoptosis, larval axon guidance, photoreceptor axon targeting, and neuromuscular junction development. Our study shows that down regulation of various signaling components of Drosophila Activin signaling pathway in the whole body or muscle tissues of adult fruit flies shortened life span. Preliminary results also indicate that over expression of some components of this pathway extend life span. In addition this study reveles that manipulation of Activin in muscle tissue effects overall muscle health in aged fruit flies. Because the signaling components and events from Drosophila Activin signaling are highly conserved throughout the animal kingdom, we believe that a thorough study of the function of Drosophila Activin signaling in aging regulation in fruit flies can shed light on the roles that the vertebrate TGF-β signaling plays in aging regulation and diseases that develop during the aging process such as Sarcopenia, Cardiovascular disease, Neurodegeneration, and Cancer. Activin may also control factors related to the general loss of the ability to maintain homeostasis in aged individuals, and accelerated aging caused by genetic disorders.

69. **Abstract removed at the request of presenter.**

70. Matthew Oram, Calvin College **Cell and Molecular Biology**

(Co-Authors: Hiroyuki Mori, Ormond MacDougald)

"Wnt3a increases β-oxidation in adipocytes"

While the behavioral factors leading to obesity are well known, the physiology of adipose tissue and adipocytes – the most prevalent cell in fat depots – is not clearly understood. Understanding the tissue that defines obesity is essential for treatment. Mesenchymal precursors expand and differentiate into adipose tissue in a tightly regulated process. Wnt is a secreted glycoprotein whose family members have been found to both inhibit and promote adipogenesis. The effect of Wnt signaling on mature adipocytes is less well known, but holds great potential for increased understanding of the regulation of adipocyte metabolism. Previous research conducted by Hiroyuki Mori in the MacDougald laboratory found increased levels of oxygen consumption in mature adipocytes treated with Wnt3a. This research explores metabolic changes in adipocytes in response to Wnt3a that may explain increased oxygen consumption. β-oxidation was found to significantly increase in both human and mouse adipocytes in response to Wnt3a treatment. At the protein level, hydroxyacyl-coenzyme A dehydrogenase activity increased in response to Wnt3a treatment, however carnitine palmitoyl transferase activity did not change, indicating that Wnt3a affects metabolism through increasing activity of enzymes specific to the oxidation of fatty acids.

71. Brooke Armistead, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Emma Hahs, Sapana Shinde, Sok Kean Khoo)

"Establishing a Feasible Experimental Design to Study MicroRNA Targets in SHSY-5Y Cells"

Parkinson's disease (PD) is a neurodegenerative disorder with no cure. The pathological hallmark of PD is the aggregation of alpha synuclein (aSyn) proteins in the neurons in the form of Lewy neurites and Lewy Bodies. Thus, developing new drug therapies that block or reduce aSyn aggregation could potentially stop or slow the disease progression. MicroRNAs (miRNAs) are small, conserved RNAs that regulate gene expression and are involved in many important biological processes. Here, we aim to establish a feasible study to evaluate the expression of miRNA-34b and miRNA-34c in a differentiated SH-SY5Y cell line induced with rotenone that replicates PD phenotype. miRNA-34b/c are predicted targets for aSyn and are shown to be downregulated in PD brain specimens. First, we will study the growth curves of undifferentiated and differentiated (with retinoic acid and brain-derived neurotrophic factor) SH-SY5Y cells to define the log growth phase. The cell population is at its most viable at the log growth phase and thus it is important to identify this optimal phase for cellular function studies. Once the log growth phase of differentiated SH-SY5Y is determined, cell viability will be evaluated with trypan blue in rotenone treated and untreated differentiated cells. A rotenone model is known to replicate many pathological aspects of PD, including aSyn aggregation in dopaminergic neurons. Dopaminergic phenotypes will be assessed and confirmed with tyrosine hydroxylase. The expression of miR-34b/c and aSyn will be evaluated using quantitative real time PCR. Once the feasibility of this study is established, we can apply miRNA mimics or inhibitors to this cell model to investigate their effects on aSyn aggregation. miRNA mimics or inhibitors can increase or reduce the expression of a targeted gene and are potential novel drug agents to improve treatments including PD.

72. Anna Barry, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Eric Moore, Dawn Clifford-Hart)

"Analyzing a role for the PP1 phosphatase Dis2 on Mid1 localization in fission yeast cell division"

Schizosaccharomyces pombe is a family of fission yeast that divide by medial fission and is a good model to study human cell division. In S. pombe, the scaffolding protein Mid1 is required for proper placement of the actomyosin ring, which determines where the cell will divide. Mid1 localization to the cell cortex is regulated through phosphorylation and the kinases involved have been identified. However, a phosphatase that reverses the phosphorylation has not yet been reported. Previous experiments from our lab determined that Mid1 is a substrate of the serine/threonine phosphatase Dis2. In order to further explore the relationship between Dis2 and Mid1 in vivo, we created a phosphatase dead version of Dis2. Mutation of histidine 125 in the mammalian PP1 abolishes catalytic activity (Yamano et al., 2012). We created a mutation at the conserved position in Dis2 (H124A) to observe the consequence of inactive Dis2 on Mid1. In comparing wild type Dis2 to the phosphatase dead version, Mid1-GFP localization is altered. When Dis2 is present, Mid1 localizes to the nucleus, cortical nodes and division site as expected. The phosphatase dead version of Dis2 shows dispersed Mid1-GFP across the cytoplasm. Our results suggest that Mid1 localization during interphase and mitosis is specifically regulated by Dis2 phosphatase activity.
This research is supported by National Science Foundation RUI Award #1157997.

73. Daniel Doyle, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Nicholas Huisingh, Steven Durham, Merritt Taylor)

"Nato3 Overexpression in the Midbrain Induces Ectopic Expression of Floor Plate Cell Markers"

Nato3 is a bHLH transcription factor endogenously expressed in the floor plate region of the developing spinal cord and midbrain. We studied the effects of the overexpression of the Nato3 transcription factor from Mus musculus in the developing chick embryo using in ovo electroporation. Through the use of cryosections and immunohistochemistry, we tested if the overexpression of Nato3 from Mus musculus induced ectopic expression of the floor plate markers such as sonic hedgehog (Shh) and Foxa2/HNF3β. The overexpression of Nato3 yielded a significant increase in the expression of the floor plate markers in the midbrain of the developing chick embryo, but did not induce ectopic expression in the spinal cord. We are currently performing work in order to test results from Nato3 from Homo sapiens, and Nato3 from Gallus gallus.

74. Elliot Ensink, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Jessica Sinha, Arkadeep Sinha, Huiyuan Tang, Heather M. Calderone, Galen Hostetter, Jordan Winter, David Cherba, Randall E. Brand, Peter J. Allen, Lorenzo F. Sempere, and Brian B. Haab)

"Segment and Fit Thresholding: A New Method for Image Analysis Applied to Immunofluorescence Data"

Certain experiments involve the high-throughput quantification of image data, thus requiring algorithms for automation. A challenge in the development of such algorithms is to properly interpret signals over a broad range of image characteristics, without the need for manual adjustment of parameters. Here we present a new approach for locating signals in image data, called Segment and Fit Thresholding (SFT). The method assesses statistical characteristics of small segments of the image and determines the best-fit trends between the statistics. Based on the relationships, SFT identifies segments belonging to background regions; analyzes the background to determine optimal thresholds; and analyzes all segments to identify signal pixels. We optimized the initial settings for locating background and signal in antibody microarray and immunofluorescence data and found that SFT performed well over multiple, diverse image characteristics without readjustment of settings. When used for the automated analysis of multi-color, tissue-microarray images, SFT correctly found the overlap of markers with known subcellular localization, and it performed better than a fixed threshold and Otsu's method for selected images. SFT promises to advance the goal of full automation in image analysis.

75. Gabrielle Foxa, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Patrick Schneider, Ashley DeWitt, Dawn M. Clifford Hart)

"Nuclear transport of Anillin-related Mid1 requires the importin alpha Imp1 and influences fission yeast cell polarity"

Fission yeast duplicate by lengthening cell tips followed by medial division. During interphase, protein complexes assemble into medial nodes and coalesce to form an actomyosin ring. Actomyosin ring location determines where the cell separates and cell wall material develops. In fission yeast, Mid1 controls ring placement and recruits other cytokinetic proteins. Consequently, localization of Mid1 between the nucleus and cytoplasm during the cell cycle is crucial. Investigation of importin alpha proteins reveals that Imp1 is required for Mid1 nuclear localization. When Imp1 is absent, Mid1 fails to localize in the nucleus. Mid1 nuclear localization is also influenced by phosphorylation via the Septation Initiation Network (SIN). The SIN is a protein cascade that initiates ring constriction and septum formation. In vitro studies show that the final SIN kinase, Sid2, phosphorylates four Mid1 residues. In the absence of Sid2 phosphorylation, Mid1 remains cytoplasmic. To further examine the Mid1 nuclear localization mechanism, we visualized the Mid1 phosphosite mutant in a strain lacking imp1. In the absence of Imp1 transport, the Mid1 phosphosite mutant is primarily dispersed across the cytoplasm. When the double mutant is arrested in late anaphase, when Mid1 should remain nuclear, cells experience severe polarity defects. Further examination of the actin cytoskeleton in these cells uncovers abnormal actin patterns, which are hypothesized to contribute to the aberrant polarity.

76. Timothy Gilbert, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Eric Moore, Dawn Clifford-Hart)

"Discovery of Cell Cycle Protein Binding Events and Their Role In Fission Yeast Cytokinesis"

Protein phosphatases are widely characterized regulatory proteins of dynamic function. Of present interest are the protein phosphatase 1's, a specialized variant with understood roles in mitosis, cytokinesis, and protein synthesis. This class of protein demonstrates substantial eukaryotic homology. Within Schizosaccharomyces pombe is Dis2, a catalytic PP1 subunit. The cytokinetic precursor Mid1, which recruits contractile ring components, has atypical localization patterns in Dis2's absence. Current work establishes Mid1 as a substrate of Dis2. Western blot analysis indicates direct binding between Dis2-GFP and GST-Mid1. This binding event was visualized using fluorescent antibodies. Both termini of Mid1 bind independently to Dis2-GFP. Specific phenylalanine residues within identified PP1-binding motifs along Mid1 are currently being mutated in an attempt to abolish Dis2's affinity. The details of this Mid1/Dis2 interaction must be further understood if we are to know all the complexities of cell proliferation within eukaryotic systems.

77. Zachary Klamer, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Dr. Agnieszka Szarecka)

"Functional Dynamics of OXA-51 Beta-Lactamase"

Antibiotics are a crucial clinical tool that has saved countless lives. Thus the growth and worldwide spread of resistance to antibiotics is a great public health concern. Bacteria primarily resist β-lactam antibiotics by expressing β-lactamases, a large family of hydrolytic enzymes which is divided into four groups: A, B, C, and D. Class D is a diverse and quickly growing group which has recently evolved considerable activity against cephalosporins as well as carbapenems. The latter is particularly threatening as carbapenems are used for saving lives of patients with complicated nosocomial infections. Among the several subfamilies of carbapenemases within the class D, the OXA-51 subgroup is the least studied. Previous studies of β-lactamases have shown that protein dynamics plays an important role in ligand binding and catalysis. Therefore, to gain a better understanding of the internal motions in the OXA-51 enzyme, we performed a 100-nanosecond Molecular Dynamics simulation of fully solvated OXA-51. Analysis of the Cα-root mean squared deviation (of secondary structure elements) indicates that OXA-51 is a relatively rigid protein, especially compared to another representative of class D carbapenemases, OXA-24. All-Cα root mean squared fluctuations indicate that conformational changes in the OXA-51 structure are rather small and occur predominantly in the major loop areas, particularly the loop connecting β7 and the C-terminal α-helix (loop β7- α10). In order to characterize the essential dynamics of the protein, we have carried out a Principal Component Analysis and found that at least the first 5 principal components are likely to have impact on the active site, involving motions of the α-helix 10 and loops P and β7- α10 while the Ω loop is not involved. This work indicates that the OXA-51 protein is very stable, which may make it relatively resistant to the destabilizing effects of mutations and thus explain the OXA-51 subgroup's potential to evolve.

78. Barrett Kyle, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Dr. Mark Staves)

"Blue Light Yields Clues to the Mechanism of Plant Gravity Sensing"

Since 1900 the most widely-accepted model for plant gravity sensing has been the starch-statolith model which proposes that sedimenting intracellular particles are the gravity sensors. A shortcoming of the model is that there are examples of gravity-responsive plants and plant tissues which do not contain sedimenting statoliths. We proposed an alternative model for plant gravity sensing (the gravitational pressure model) in which the entire protoplast is suggested to be the plant gravity sensor and that the gravity signal is perceived by sensing differential pressure between the protoplast and the extracellular matrix at the top and the bottom of the cell. To test between these models we grew rice roots in media of different densities and monitored gravity-induced curvature. If the protoplast were the gravity sensor, we would predict that increasing the density of the external medium would decrease gravity-induced curvature. Conversely, if sedimenting intracellular particles were responsible for gravity sensing, we expect that changing the external medium with an impermeant solute would have no effect on the gravity response. Consistent with the gravitational pressure model, we find that increasing the density of the external medium does indeed inhibit gravity-induced curvature.

However, since increasing the density of the external medium also decreases the growth rate of roots, it is possible that the inhibition of gravity-induced curvature reflects an inhibition of growth rather than an inhibition of gravity sensing. To test this we took advantage of the negative phototropism of rice roots exposed to blue light. Vertically-grown (parallel to the vector of gravity) rice roots were illuminated with blue light perpendicular to the vector of gravity such that the tendency for positively-gravitropic growth was antagonistic to the tendency of negatively-phototropic growth. Thus, the starch-statolith model would predict that changing the density of the external medium would have no effect on the negative phototropic curvature, while the gravitational pressure model predicts that increasing the density of the external medium will inhibit the gravity response and increase the negative phototropic curvature. We find that, with increasing density of the external medium, negative phototropic curvature is increased. These results are consistent with the gravitational pressure model for plant gravity sensing and not consistent with the starch-statolith model .

79. Luke Pardy, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Chelsea Reiber, Robert Smart, William Schroeder, Osman V. Patel)

"Neoadjuvant therapy with BIBR 1532 Accelerates Senescence in Triple-Negative Breast Cancer Cells"

Triple-Negative Breast Cancer (TNBC), which is the most aggressive form of breast cancer, represents about 15% of all breast cancer cases worldwide. There is no tailored therapy available for TNBC and prognosis post-metastasis is very poor. Recently, interest in inhibition of the enzyme called telomerase, in the management of TNBC has increased. Therefore, we evaluated the Adjuvant and Neoadjuvant effects of the anti-telomerase BIBR 1532 with the anthracycline Doxorubicin. In the initial (Neoadjuvant) experiment, MDA-MB-231 (TNBC) cells were supplemented with BIBR 1532 (n=4) for 14 days, then exposed to Doxorubicin (n=4) for 7 days. In the second (Adjuvant) experiment, cells were primed with Doxorubicin for 7 days (n=4) prior to 14 days of BIBR 1532 (n=4) therapy. The Trypan Blue (Gibco) exclusion and Senescence-Associated β-galactosidase assays were used to assess cell viability and senescence, respectively. Cell densities decreased by 41% ($p<0.05$) and the number of senescent cells increased by several folds ($p<0.05$) after 14 days of Neoadjuvant treatment with BIBR1532. In the adjuvant setting, a limited effect on cell density was observed following supplementation with BIBR 1532. Our result demonstrates that neoadjuvant therapy with BIBR 1532 does significantly increase the rate of senescence in TNBC cells.

80. Brooke Prieskorn, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Margaret Dietrich)

"A disruption in repeated sequence may be responsible for a P. patens mutant phenotype"

The moss, Physcomitrella patens, is a model plant species for tip growth studies because of its simple developmental pattern which relies on tip growth. In higher plants, tip growth is critical for nutrient and water uptake via root hairs and for pollen tube growth in sexual reproduction. A P. patens insertional mutant has been identified which, in its filamentous tissue, produces initial cells but does not respond to cytokinin and, therefore, rarely produces the leafy gametophyte. The disrupted locus was found to contain both retrotransposon sequence and a region of 11 bp tandem repeats. Sequencing also revealed that in addition to the insertion, approximately 350 base pairs of genomic sequence, including a portion of the 11 bp tandem repeats, was deleted. It does not appear that any coding sequence was disrupted. A search with the Repbase CENSOR software confirmed the locus to be composed almost entirely of retrotransposon sequence. Two P. patens retrotransposons belonging to the Gypsy family complete with their flanking long terminal repeats (LTRs) were found side by side. The insertion/deletion site lies in a portion identified as a nonautonomous retrotransposon LTR. Retrotransposons have been reported to produce small RNAs that may regulate surrounding genes, and in addition, repeated retrotransposons are known to be one of many centromeric markers. Taken together, this suggests that the mutant phenotype is the result of a disruption in gene regulation.

81. Kali Smolen, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: R. A. Powers, F. Prati, E. Caselli, C. Romangoli, H. C. Swanson, A. Bouza, R. A. Bonomo, B. J. Wallar)

"Structure-function analysis of R2 substituents in boronic acid inhibitors of Acinetobacter-derived cephalosporinase (ADC-7)"

Background: Much of β-lactam mediated resistance in Acinetobacter baumannii derives from expression of class C β-lactamases, known as Acinetobacter-Derived Cephalosporinases (ADCs). Identifying inhibitors for these enzymes is challenging, given that current inhibitors are not effective against class C enzymes. Boronic acid transition state inhibitors (BATSIs) offer a novel way to inhibit ADC enzymes. BATSIs that display various functionalities at the R2 position were explored for their ability to inhibit ADC-7. Methods: A series of BATSIs were designed and synthesized to explore the R2 side chain binding site, and Ki values were determined via steady state kinetics. The X-ray crystal structures of ADC-7 in complex with three inhibitors were determined.Results:These BATSIs bind with high affinity to ADC-7 (Ki as low as 21 nM). All contain the R1 side chain found in the β-lactam cephalothin and a carboxylate group believed to mimic the C3/C4 carboxylate of β-lactams. Each contained a different R2 group that varied in size and flexibility. To determine the structural basis for their inhibition, the structures of ADC-7 in complex with three R2 BATSIs were determined at resolutions ranging from 1.84 – 1.95 Å. In all of the complexes, the boronic acid is covalently attached to S64, the O1 oxygen is bound in the oxyanion hole, and the R1 amide group makes interactions with conserved residues N152 and Q120. On the other side of the molecule, the carboxylate group makes interactions with specific residues on the enzyme, which include S315, R340, and N343. Of particular interest are the interactions with R340, a residue that distinguishes ADC-7 from related class C enzymes. R340 interacts with this carboxylate via an ionic interaction in one complex, a water-mediated interaction in another, and cation-pi interactions in the third. Conclusions: The ADC-7/boronic acid complexes provide insight into recognition of non-β-lactam inhibitors by ADC enzymes, specifically highlighting the contribution of the R2 group. These structures may aid in the optimization of this series of β-lactamase inhibitors against a clinically relevant resistance target.

82. Kyle Sugg, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Cynthia June, Rachel Powers, Dave Leonard)

"Structure of OXA-51, the native carbapenemase of Acinetobacter baumannii, reveals insights into gain-of-function clinical variants"

The Gram-negative pathogen Acinetobacter baumannii has become a public health menace due to the rising incidence of resistance to carbapenems, the potent "last-resort" class of β-lactam antibiotics. Plasmid-borne class D β-lactamases such as OXA-23, OXA-24 and OXA-58 have been the focus of intense study because of their contribution to elevated resistance levels. The native A.baumannii β-lactamase OXA-51 has received less attention because of its low hydrolytic activity against all classes of β-lactams. This has recently begun to change with the discovery that some OXA-51 clinical mutants display increased activity against carbapenems. In this study, we show that a clinical variant of OXA-51 with three active-site substitutions (OXA-173) shows increased activity toward all four classes of β-lactam antibiotics (carbapenems, penicillins, cephalosporins and monobactams). We used X-ray crystallography to determine the structure of OXA-51 at 1.6 Å. The overall fold of this enzyme is very similar to that of OXA-23 and OXA-24, and the active site residues responsible for catalysis are also positioned as in those enzymes. The structure provides simple explanations for why each of the three mutations found in OXA-173 yield increased activity for a variety of substrates.

83. Matthew Wieckhorst, Grand Valley State University **Cell and Molecular Biology**

(Co-Authors: Dr. Matthew Christians)

"Investigating the role of EER5 in ethylene signaling by protein interaction studies with EIN2"

Ethylene is a major phytohormone that controls numerous developmental processes in plants, most notably fruit ripening and pathogen defense. Ethylene Insensitive2 (EIN2) is a central component of the ethylene signaling pathway. Upon ethylene stimulus, the C-terminal portion of EIN2 is dephosphorylated, which results in it's cleavage from the N-terminal end and translocation into the nucleus. However, the exact mechanisms involved in cleavage of EIN2 are not well understood. The C-terminal end of EIN2 has been shown to interact with Enhanced Ethylene Response 5 (EER5), a negative regulator of the ethylene response. In addition EER5 is known to interact with COP9 signalosome (CSN), which functions to cleave proteins off of larger complexes. This suggests EER5 and the CSN may play a role in the separation of the C-terminal portion from the rest of EIN2. To investigate whether EER5 binds preferentially with one phosphorylated form of EIN2, we tested the interaction between wild-type EER5 and EIN2 phosphorylation mutant proteins in S. cerevisiae via a yeast two-hybrid assay. We found that phosphorylation of EIN2 may weaken the interaction with EER5. One potential theory is that EER5 may protect EIN2 cleavage by sequestering the CSN away from EIN2 when ethylene is not present, thus preventing EIN2 cleavage. Future work will focus on the interaction between EIN2 and the CSN, as well as how EER5 exactly regulates the function of the CSN.

84. Andrew Neevel, Hope College **Cell and Molecular Biology**

(Co-Authors: Gloria Chang, Wessel VandenBergh, Joseph Stukey, Virginia McDonough)

"Investigating Mycobacteriophage-Host Protein Interactions"

Mycobacteriophages are viruses that infect bacterial cells of the genus Mycobacterium. With more than 400 mycobacteriophage genomes sequenced, they represent the largest collection of sequenced phages that infect a single host (Mycobacterium smegmatis). They possess multiple unfamiliar or novel genes which encode protein products that do not resemble any previously studied proteins. We hypothesized that some of those genes encode products that interfere with the normal metabolism of the host cell, possibly through specific phage-host protein-protein interactions, enabling phage infection. Further, we predicted that those gene products would still be toxic and impair cell growth when expressed alone in host cells. We have investigated two genetically distinct mycobacteriophages, Pumpkin and Vix, and have identified 4 single genes and several small genomic regions that are cytotoxic to M. smegmatis. We are taking a multi-prong approach to further identify the specific functions and roles in the infection process associated with these gene products: 1) identification of resistant M. smegmatis mutants, 2) expression of phage genes to screen for interacting host proteins, 3) collection of microscopy data of host cells expressing the genes, and 4) deletion of these genes from the phage genome to determine the effect on infection. 24-hour expression of individual cytotoxic phage genes in M. smegmatis resulted in a significant increase in mean host cell length and some subtle effects on cell shape. Ongoing analysis of the mutants has identified a common mechanism of resistance to distinct phage gene expression, while protein-protein interaction studies have not yet identified a potential host target involved in translation.

85. Alexander Swain, Hope College **Cell and Molecular Biology**

(Co-Authors: Kyle J Hill, Margaret J Lange, and Donald H Burke)

"Aptamers and HIV: A Story of Evolution"

Approximately 35 million individuals are infected with Human Immunodefficiency Virus (HIV) globally. Novel nucleic acid-based compounds are being studied involving small RNA molecules, known as aptamers, which can selectively bind specific proteins, in this case, HIV proteins. A conserved retroviral target is Reverse Transcriptase (RT), an enzyme that converts HIV's RNA genome into dsDNA, which subsequently integrates into the infected host's genome. The Burke lab has developed anti-RT aptamer libraries via SELEX (Systematic Evolution of Ligands by Exponential Enrichment) that selectively bind and inhibit HIV-RT. Inhibition is achieved by the aptamer competitively binding the active site of RT, thereby preventing the genomic template from binding. However, the aptamers have not been optimized for packaging into developing virus to overcome stoichiometric constraints, and this is a key event for increased therapeutic functionality. We are currently exploring additional rounds of in vivo cellular SELEX to select for the enhanced packaging of the aptamer libraries into budding viruses. By co-expressing the aptamer libraries with the proviral plasmids, we can harvest the virus and isolate the aptamers using the cellular environment to perform the selection for us. Subsequently, by reverse transcribing into cDNA and re-cloning the aptamer into our expression plasmid, we will be selecting for aptamers that are enriched for packaging into the virus while maintaining the anti-RT functionalities. Ultimately, High Throughput Sequencing will reveal the sequences of thousands to millions of individual aptamers. This will allow us to identify the common sequences that have been conserved via selection, which we hope to implement to increase the functionality of aptamer therapeutics in HIV.

86. Evan Romero, Calvin College **Cell and Molecular Biology / Genetics**

(Co-Authors: Dr. Carolyn Anderson)

"Asymmetric Gold(III)-Catalyzed Rearrangement of N-Propargyloxypyridines"

We show attempts to develop a method for the synthesis of chiral N-substituted pyridones; an interesting functional group found in a series of pharmacologically interesting compounds. To date, we
have developed a gold(III)-catalyzed method for accessing this motif by rearranging a related system in a racemic fashion. We seek to induce chirality with the addition of chiral ligands.

87. Sarah Brown, Grand Valley State University **Cell and Molecular Biology / Genetics**

(Co-Authors: William Thompson, Derrick Kroodsma, Aik Choon Tan, Stephen K. Obaro, Sok Kean Khoo)

"Gene Expression Changes in Blood Can Reflect Infection Stages of Typhoid Fever in Children"

Typhoid fever is caused by Salmonella enterica serovar Typhi (S. Typhi), a human-restricted pathogenic bacteria. Though typhoid fever is not common in the United States, it is recognized by The World Health Organization (WHO) as a global health problem. There are over 21 million cases and 200,000 to 600,000 deaths annually, mainly in under-developed countries of Africa and South Asia. Current diagnostics can be invasive, expensive, and time-consuming with detection sensitivity of 40-70%. As a result, first line of defense is usually the extensive use of broad spectrum antibiotics which causes antibiotic resistance for effective treatment. The aim of this project is to identify genetic signatures for early-diagnostic and stratification of children with typhoid fever. Total RNA extracted from blood at acute, convalescent and recovery phases of infection (patients age from 0 to 5 years old) were processed with gene expression microarrays. We found 179 and 175 differentially-expressed genes between acute / convalescent and acute / recovery, respectively. Using quantitative real-time PCR, our preliminary data show AIM2 (absent in melanoma 2) and CD274 (CD274 molecule) having the highest gene expression during acute phase and gradually decreased in convalescence and recovery phases. Both genes involve in the innate immune system and their gene expression reflects the host immune response according to its infectious stages. On the other hand, gene expression of IL5RA (interleukin 5 receptor, alpha) is lower in the acute phase and eventually increased in the convalescence and recovery phases. This further confirmed our suggestion that interleukin receptors such as IL5RA take longer time to response to typhoid fever infection in naïve patients with younger age (below 5 years old), most probably due to "first-time" infection without previous exposure.

88. Alexis Weber, Michigan State University **Cell and Molecular Biology / Genetics**

(Co-Authors: Laura Kirby, Donna Koslowsky)

"Understanding the Potential Coding Capacity of RNA Editing in Trypanosoma brucei"

Department of Microbiology and Molecular Genetics, Michigan State University
Trypanosoma brucei is the protozoan parasite that causes African Sleeping Sickness in humans, or Nagana in cattle. Nagana is capable of decimating 50-100% of a livestock population, which costs West and Central African economies an estimated 1.2 billion dollars annually. T.brucei is transmitted to a vertebrate host from its insect vector, the tsetse fly, during which it must change its metabolism to best utilize energy sources derived from the new vertebrate host. Shifts in metabolism are accompanied by RNA editing, a post-transcriptional RNA processing that involves uridine insertions and deletions in the mitochondrial mRNAs. These nucleotide changes are directed by small RNAs called guide RNAs (gRNAs), which are also encoded in the mitochondrion. The edited transcript is subsequently translated, generating a particular metabolic protein. Recently discovered mutated gRNAs are predicted to direct alternative editing patterns and consequently an alternatively edited transcript, potentially generating new mitochondrial proteins. Recent investigations have focused on non-canonical editing in NADH Dehydrogenase Subunit 9 (ND9) and Cytochrome C Oxidase Subunit 3 (COXIII) based on mutated ND9 and COXIII gRNA populations. Determination if these alternative gRNAs do generate new alternative mRNAs, and consequently new proteins, may provide more insight into the process by which RNA editing regulates the trypanosome life cycle.

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89. Nina Diklich, Aquinas College **Chemistry**

(Co-Authors: Brittany E. Givens & Vicki H. Grassian)

"Adsorption of BSA protein on SiO2 nanoparticles in aqueous solution: Impact of pH on size and zeta potential at the nanoparticle-protein interface"

With the growing use of nanomaterials in consumer products, it is prudent and necessary to fully understand how nanomaterials behave and interact with biological systems. When nanoparticles enter a biological system they are immediately coated by a layer of proteins, known as the corona. They are subsequently exposed to various pH environments. With both of these factors in mind, this study focused on understanding the dynamic relationship between the silica nanoparticle – Bovine Serum Albumin (BSA) interface as a function of pH. Dynamic light scattering (DLS), zeta potential, and attenuated total reflection- Fourier transform infrared spectroscopy were utilized to characterize the adsorption and desorption of BSA to and from the silica surface. The particle size and zeta potential data showed that charge stability occurred when there was a near-zero charge and large aggregations. The results also showed that the number of IR peaks, degree of desorption, absorbance intensity, and saturation time were all pH-dependent. Upon adsorption, it was also found that the IR peaks align with native BSA at neutral pH.

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90. Craig Jensen, Aquinas College **Chemistry**

(Co-Authors: Dr. Timothy Henshaw)

"Kinetic Analysis of OXA-24/40 Variants Against Aztreonam & Cephalothin"

We analyzed the kinetics of three variants of the carbapenem-hydrolyzing class D β-lactamases OXA-24/40 including the wild type (WT) variant, a G222A variant, and a G222V variant. The emergence of OXA-24/40 and other class D β-lactamases has resulted in an increase in β-lactam antibiotic resistance in the Acinetobacter genus. Hence this research is relevant in a medical setting.

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91. Nick Pierce, Aquinas College **Chemistry**

(Co-Authors: Tie-bo Zeng, Ji Liao, FuJung Chang, Piroska Szabó)

"Generating compound heterozygous mice to study the imprinting regulation at the H19/Igf2 cluster"

The H19/Igf2 imprinted cluster on distal chromosome 7 contains a maternally expressed long noncoding RNA gene H19, and a paternally expressed protein coding gene Igf2. An intergenic differentially methylated region is located ~2.4 kb upstream of H19 promoter, and functions as the imprinted control region (ICR). H19 ICR is unmethylated on the maternal allele, and methylated on the paternal allele. The Zinc finger protein CTCF binds to the maternal H19 ICR. When the four CTCF binding sites in the maternal H19 ICR were mutated, the Igf2 gene became biallelically expressed, and the H19 gene was silenced. These mice were overgrown. When the paternal H19 ICR was replaced with two copies of Chicken β-globin insulators, m(ChβGI)2, the H19 gene became biallelically expressed, and the Igf2 gene was repressed. This expression was lethal. In this study, we cross these two genetically modified mice to generate a mouse model with the four CTCF binding sites mutated in the maternal H19 ICR, and the paternal H19 ICR replaced with m(ChβGI)2, to investigate if the abnormal phenotypes can be rescued.

92. Robert Hohlman, Calvin College **Chemistry**

(Co-Authors: Sherrice Zhang, Alex Boomsma, Dr. Ronald Blankespoor, Dr. Michael Barbachyn)

"Iodocyclocarbamation Reaction of N-Allenylmethyl-N-arylcarbamates"

The focus of this summer project was to see if an N-allenylmethyl nitrogen substituent, in lieu of the usual N-allyl moiety, would allow facile access to oxazolidinones bearing a vinyl iodide group at the C-5 position.

93. Anna Michmerhuizen, Calvin College **Chemistry**

(Co-Authors: Dr. Douglas A. Vander Griend, Tasha Thong)

"The Binding Interactions of Triazolophane with Halides"

Triazolophane macrocycles have been the topic of extensive research in anion recognition and sensing. The molecular interactions between triazolophane and halides can be studied using spectrophotometric titrations and the techniques of global analysis. SIVVUTM is a global analysis program that breaks down absorbance data from spectrophotometric titrations into mathematical factors. These mathematical factors correspond to chemical species, which contribute to the absorbance of titration solutions. We performed titrations at four different temperatures in order to determine the binding constants and changes in Gibb's free energy values (ΔG°) for the equilibrium reactions forming each triazolophane-halide complex. We also determined the forces driving complexation with an Arrhenius plot. Finally, using the relationship between temperature and equilibrium binding constants, we estimated enthalpy and entropy parameters associated with a 1:1 complex, 2:1 triazolophane sandwich and a 1:1:1 complex incorporating the tetrabutylammonium counter ion.

94. Tasha Thong, Calvin College **Chemistry**

"Binding Interactions of Cu(I) with Phenanthroline Based Ligands"

The Cu(I)-phenanthroline linkage is commonly used in supramolecular chemistry, and the binding interactions of this system can be studied and characterized using spectrophotometric titrations and global analysis. The raw absorbance data generated through spectrophotometric titrations can be analyzed using the program SivvuTM. This program uses matrix algebra and Beer's law to break down the data into mathematical factors which correspond to the unique chemical species contributing to the overall absorbance of a solution. Titrations were run at four different temperatures in order to determine the binding constants and Gibb's free energy (ΔG°) values for the equilibrium reactions of each complex. The relationship between temperature and the binding constants was then used to estimate the thermodynamic parameters for the formation of the 1:1 and 1:2 Cu:phenanthroline complexes. This information was used to gain further insight into the system and to characterize the interactions between Cu(I) and phenanthroline based ligands.

95. Jared Weidman, Calvin College **Chemistry**

(Co-Authors: Roger DeKock)

"The Relationship Between Atomic Size, Charge, and Polarizability"

Central to an understanding of electronic behavior upon ionization in atoms is the concept of atomic and ionic size. This concept is qualitative, resulting in many different ways of calculating the "radius" of an atom. Our lab has utilized the quantum chemistry software GAMESS to model the electron densities of atoms and their ions in order to calculate theoretical radii. We are interested in two groups of these radii, those that align more closely with covalent radii and those that align with van der Waals radii, both of which are derived from experiment. Our results show that a single theoretical calculation method does not correlate with both experimentally-derived atomic and ionic radii. This work also has direct connections to atomic polarizability and can provide new insight into this property and its relationship to ionization energy.

96. Jeremy Cunningham, Grand Valley State University **Chemistry**

(Co-Authors: Shannon Biros)

"Synthesis and Characterization of cis-1,2-bis(diphenylphosphino)ethylene Diselenide for the Selective Extraction of Actinides in Aqueous Media"

Nuclear energy is one of the alternative resources to meet the ever-increasing demands for energy, because of its non-CO2-emitting property in combination with the limited reserves of fossil fuels. Currently, nuclear energy plants produce slightly less than 14% of the world's electricity and 5.7% of the total primary energy used worldwide. A total number of 441 nuclear reactors are working with a nuclear power capacity of 375 GW(e). In addition, 67 reactors are under construction. In the context of climate change concerns, as well as improved safety and performance records, some 65 countries are expressing interest in nuclear power. This, in turn, increases the amount of nuclear waste produced, in addition to the need for efficient waste management. More than 90% of fuel used after a typical nuclear reaction is reusable, so recycling spent nuclear fuel is an attractive way to increase energy production. Current nuclear waste remediation processes exist, using CMPO ligands to sequester the major actinide and lanthanide metals. Altering the design of their CMPO ligands could provide researchers with valuable insight about La3+/An3+ binding properties. This poster explains the synthesis and metal binding properties of a rigid, soft-donor ligand that was characterized using 31PNMR spectroscopy and X-Ray Crystallography. The La3+/An3+ selectivity and extraction efficiency was studied using UV-Vis spectroscopy and Arsenazo III studies. The results promise potential utility in nuclear waste remediation and/or other metal chelation processes.

97. Eva Gulotty, Grand Valley State University **Chemistry**

(Co-Authors: Randy Winchester)

"Synthesis of tris(trimethylsilyl)-((9H-fluoren-9-ylidene)methyl)silane - a sterically hindered alkene"

The silaallyl anion has two major contributing resonance structures. We are interested in determining the relative importance of the two resonance structures for the stability of this anion.
To do this we have synthesized precursors to the derivatives of the silaallyl anion, vinyltris(trimethylsilyl)silane, and tris(trimethylsilyl)-((9H-fluoren-9-ylidene)methyl)silane.
The synthesis of the fluorene derivative proved to be a thermodynamic process, and was attempted via multiple routes. The results of the routes studied will be presented, along with the products formed. The crystal structure of a novel dimer from the reaction of the (trimethylsilyl)silane anion and 9-(bromomethylene)-9H-fluorene was determined. Based on this structure, the adduct was reacted with potassium tert-butoxide to form a highly delocalized anion. We will present the synthesis of the dimer, its crystal structure, and a proposed mechanism for its formation. The discussion will include the conjugated anion that was formed by the dimer's reaction with potassium tert-butoxide, along with a proposed mechanism for the formation of the anion.

98. Erin Leach, Grand Valley State University **Chemistry**

(Co-Authors: Shannon M. Biros)

"The Sensitization of Lanthanide Luminescence Through Coordination of Carbamoylmethylphosphine Oxide Ligands"

A carbamoylmethylphosphine oxide (CMPO) ligand and three derivatives have been synthesized to study their ability to act as antennas for the sensitization of lanthanide luminescence. Lanthanide chemistry has previously been applied in the determination of protein structures and as major components of shift and contrast reagents for magnetic resonance spectroscopy and imaging. More recently, they are being considered in the composition of lanthanide-based luminescent probes for intracellular imaging. This class of metals is effective in these areas due to their unique photophysical and chemical coordination properties that allow for long emission lifetimes, which lead to easy application and measurement. Experimental data for this series of lanthanide-ligand complexes has shown that these CMPO ligands have been successful in sensitizing terbium, europium, dysprosium, and samarium. Metal-ligand complex synthesis and characterization, as well as luminescence data, quantum yields, and lifetime data will be presented.

99. Alan Lear, Grand Valley State University **Chemistry**

(Co-Authors: Shannon M. Biros)

"Synthesis, Characterization, and Extraction Studies of CMPO derivatives for f-Element Coordination Chemistry"

Rising energy demands and a high dependence on finite amounts of fossil fuels have been a major concern of the modern age. As a viable alternative to carbon based power sources, nuclear fuel generates vast amounts of energy and is becoming more widely utilized. However, the hazardous waste produced can have serious and long-lived environmental consequences. The goal of our research group is to design CMPO analogs for selective actinide extraction from high-level nuclear waste. Sequestration of these heavy metals will not only decrease the volume of nuclear waste, but will also allow for recycling of spent nuclear fuel. The synthesis of a new ligand coupled with ethylenediamine, containing two CMPO sites capable of selective extraction of f-elements from high-level nuclear waste has been successfully synthesized and characterized via X-ray crystallography. As a prediction of the efficacy of this ligand for nuclear waste remediation, the extraction efficiency has been determined using Arsenazo III assays.

100. Christopher Peruzzi, Grand Valley State University **Chemistry**

(Co-Authors: Scott N. Thorgaard)

"Detecting Single Platinum Nanoparticles Using Ultramicroelectrodes and Investigations of Modified Electrode Surfaces by Cyclic Voltammetry"

Understanding catalysis occurring at metal nanoparticles is critical for making use of these materials in applications such as energy devices and chemical sensors. The goal of this research project is to improve the understanding of catalysis at metal nanoparticles using experiments where individual nanoparticles are captured and characterized in an electrochemical cell. Single platinum nanoparticles were detected in our experiments by their ability to catalyze the oxidation of hydrazine as they collide with and stick to a micron-sized, inert electrode. The individual particle adsorption events are recognized by transients in plots of the electrode current vs. time, which can reveal their size and reactivity. The electrodes used for nanoparticle detection were characterized using cyclic voltammetry and chronoamperometry. As possible platforms for single nanoparticle detection, we also investigated procedures for forming thiol self-assembled monolayers (SAMs) on Au electrodes as well copper electrodeposition processes at multiple electrode materials.

101. Austin Ronspees, Grand Valley State University **Chemistry**

(Co-Authors: Scott N. Thorgaard)

"Detection and Fluorescence Imaging of Single Escherichia Coli and Bacillus Subtilis Bacteria at an Ultramicroelectrode"

In this work we report the electrochemical detection of single Escherichia coli and Bacillus subtilis bacteria at a Pt disk ultramicroelectrode (UME) with correlated optical observation using a fluorescence microscope. An applied potential to the electrode causes the bacteria, which have a slight negative charge and are present at fM concentrations in the solution, to arrive at the electrode surface by migration in a solution containing a supporting electrolyte and an electroactive species, ferrocene methanol (FcMeOH). Adsorption of the bacteria to the electrode surface cause measurable blocking of FcMeOH diffusion to the electrode. The arrival events of each bacterium result in a step shaped transient in a plot of the electrode current versus time. The incorporation of fluorescence microscopy to the method allows us to visually track the migration of fluorescently dyed bacteria as they impact the electrode surface.

102. Stacie Stuut, Grand Valley State University **Chemistry**

(Co-Authors: Dr. Matthew E. Hart)

"Design and Synthesis of Novel Analogues of the Antibiotic, Linezolid"

In recent years, the extensive use and misuse of antibiotics has led to high levels of antibiotic resistance in bacteria. Novel antibiotics are needed to combat this threat. Linezolid, one of the last approved antibiotics, kills bacteria by targeting the bacterial ribosome and preventing protein synthesis. Unfortunately, resistance to Linezolid has already been detected. This project focuses on the design and synthesis of novel analogues of Linezolid that optimize the interactions between the drug and the ribosome. The synthesis of a common intermediate will allow for functionalization of each end of the compound. Throughout the synthesis, NMR spectroscopy will be used to confirm the products of each step. Kirby-Bauer assays will be performed to determine the efficacy of the drugs.

103. Andrew VanderWeide, Grand Valley State University **Chemistry**

(Co-Authors: Shannon Biros)

"How do dipodal CMPO ligands bind to lanthanides? An experimental and computational study"

In the modern world the sustainability of energy resources is of paramount importance. One of the most important energy options is nuclear energy. In the process of producing electricity via nuclear fission, a vast array of chemically- and radioactively-toxic lanthanide and actinide metals are produced. Due to the chemical similarity of these metals selective separation of lanthanides and actinides presents a significant challenge. Our goal is to design ligands that selectively sequester lanthanide and actinide metals. Selective sequestration of fission products allows for recycling or responsible disposal of these wastes. A first step in the rational design of these sequestering ligands is to understand how they interact with a metal center. These interactions were studied using experimental techniques, and using DFT, the results will be presented.

104. Kimberly DeGlopper, Hope College **Chemistry**

(Co-Authors: Mason C. Yoder, Kyle G. Lindberg, Megan R. Kwiatkowski)

"Elucidating the Mechanism and Expanding the Scope of Organometallic Nucleophiles Utilized in the Nickel-Mediated Decarbonylative Cross-Coupling of Substituted Phthalimides"

A new method for synthesizing ortho-substituted benzamides has been developed through the nickel-mediated decarbonylative cross-coupling of substituted phthalimides with various diorganozinc reagents. This reaction demonstrates broad substrate scope, including both electron-rich and electron-poor aryl phthalimide substituents and a variety of commercially available and in situ generated diorganozinc reagents. However, this reaction suffers from two key limitations. First, it requires a stoichiometric equivalent of nickel, which limits its application in synthesis. Second, diorganozinc reagents are either pyrophoric or must be synthesized in situ. Efforts to promote catalysis include altering the phthalimide substituent, ligand, solvent, and catalyst used. Recent work has also focused on expanding the scope of nucleophiles to include boronic acids, which are safer and more commercially available, while optimizing reaction conditions of this new system.

105. Stanna Dorn, Hope College **Chemistry**

(Co-Authors: Chad T. Compagner, Joseph M. Dennis, Connor D. McNeely, Jeffrey B. Johnson)

"Incorporation of Boronic Acids in Cross-Coupling Reactions Proceeding through C-C Activation"

Carbon-carbon single bonds can be difficult to activate due to their nonpolar and covalent nature. In recent years, the use of appropriate directing groups and transition metal catalysts has led to the activation and functionalization of carbon-carbon single bonds. Using quinolinyl ketones, our group has demonstrated the successful rhodium-catalyzed exchange of ketone substitution with alkyl and aryl boronic acids. The reaction proceeds in good to excellent yields with a broad range of functionality on both the quinolinyl ketones and the boronic acids.

106. Kathryn Lee, Hope College **Chemistry**

(Co-Authors: Alexis Guttilla and Michael Pikaart*)

"Characterizing Escherichia coli in the Lake Macatawa Watershed and Testing Real-Time PCR Method for Monitoring Water Quality"

For the past several years, Lake Macatawa has exhibited unusually high levels of Escherichia coli, which is a fecal indicator bacterium associated with the presence of other potentially pathogenic microorganisms. This project aims to characterize and identify the sources of E. coli in the Lake Macatawa Watershed in order to improve the water quality of Lake Macatawa. Water samples were obtained from 10 different locations throughout the watershed. IDEXX Quanti-trays®, modified mTEC agar plates, and real-time PCR were used to calculate E. coli concentrations, and Biolog GN2 MicroPlates™ were used to characterize isolated strains. Bacterial colonies were isolated from human stool samples in order to investigate human fecal matter as a possible source of contamination in Lake Macatawa. In addition, Hope College is one of several labs that have been testing a new real-time PCR-based method for monitoring water quality at beaches throughout the state of Michigan. Initial data suggest that this method produces variable results due to high levels of inhibition. In the future, increased understanding of the microbial contamination in the Lake Macatawa Watershed and Lake Michigan will lead to cleaner waters for recreational use.

107. Kathryn Trentadue, Hope College **Chemistry**

(Co-Authors: Christian B. Otteman, Jessica Stachowski, Janelle K. Kirsch, Erik J.T. Phipps, Caroline E. Gregerson, Jeffrey B. Johnson)

"Carbon-Carbon Single Bond Activation Used for Coupling with Michael Acceptors"

Intramolecular alkene carboacylation has previously been achieved under rhodium
catalysis using quinolinyl ketones. Utilizing insight gained from mechanistic studies, new quinolinyl ketone substrates have been prepared and subjected to rhodium catalysis in the presence of an exogenous alkene. This poster provides an overview of the development of a new transition metal catalyzed reaction that yields an unexpected product—rather than the anticipated reaction sequence, substrates undergo carbon-carbon bond activation, and Heck-type reactivity is observed via oxidative nucleophilic addition to various Michael acceptors. The reaction proceeds in good to excellent yield with a broad range of functionality on both substrates.

108. Chris Dilley, Calvin College **Computer Science**

(Co-Authors: Joel Adams, Patrick Crain, Mark Vander Stel)

"TSGL: A Thread-Safe Graphics Library for teaching students about parallel computing"

Computer Science educators face the challenge of teaching their students about parallel computing. When a program solves a problem by breaking it into pieces and then solving those pieces in parallel, it can be hard for students to understand exactly what is happening behind the scenes.
TSGL is an open source, C++ graphics library created to help Computer Science educators better communicate the ideas of parallel computing to their students. It includes a variety of examples that educators can use in order to help their students understand the ideas of parallel computing.These ideas include: dividing a problem among multiple threads, livelock, deadlock, various parallel patterns, and others. By helping students visualize these abstract topics,TSGL has been shown to improve student learning.

109. Javin Unger, Calvin College **Computer Science**

(Co-Authors: Dr. Serita Nelesen)

"Educational Impacts in Computer Science"

Computer science changes quickly, so computer science pedagogy must also evolve. In these studies, we evaluate interventions that impact how introductory computer science students learn. We analyzed multiple forms of data and were able to observe trends. Through our analyses, we sought to:
-Determine the impact of the introductory computer science course language.
-Determine impact of a parallelism exercise in a data structures course.
-Determine the impact of a values affirmation intervention (2) in a computer science context.
To accomplish these goals, data from physical and digital copies of final exams, concept inventories, programming exercises, and values interventions were anonymized and encoded.

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110. Isaac Zylstra, Calvin College **Computer Science**

(Co-Authors: Victor Norman)

"SkelScratch: Scratch v. 2.0 with Kinect v. 2.0"

The Microsoft Kinect is an amazing device that is particularly good at tracking human bodies. Scratch is software developed by MIT that simplifies programming so that even kids can learn the beginnings of software development. When paired with a Kinect, students can create programs that react to and can be controlled by one or more bodies. This summer, we created the latest version of that software.

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111. Evans Lodge, Calvin College **Ecology and Evolution**

(Co-Authors: John M. Drake, PhD)

"Protective Population Behavior Change in Outbreaks of Emerging Infectious Disease"

In outbreaks of emerging infectious disease, public health interventions aim at increasing the speed with which infected individuals are removed from the susceptible population, limiting opportunities for secondary infection. Isolation, hospitalization, and barrier-nursing practices are crucial for controlling disease spread in these contexts. Ebola virus disease (EVD), Severe Acute Respiratory Syndrome (SARS), and Middle East Respiratory Syndrome (MERS) are all caused by zoonotic viruses that have spread in significant international outbreaks in the past, and we hypothesize that different geographies, political environments, and public health infrastructures will reveal distinct behavior development rates in different outbreaks. Here, we use patient-level data from the 2014-2015 Liberian Ebola epidemic, 2003 Hong Kong SARS epidemic, 2014 Saudi Arabia MERS outbreaks, and 2015 South Korea MERS outbreak to quantify changing removal rates, burial practices, contact tracing, and other measures of protective behavior change. Using the removal rate, γ, as a measure of protective behavior change allows direct comparison of health behavior development in different outbreaks and locations. Robust regression analysis and analyses of covariance are used to estimate the rate at which γ increases in each outbreak by epidemic week and serial interval. Measured interactions between models show that mean removal rates varied within a factor of three, falling between the 2003 Hong Kong SARS outbreak and the 2014-2015 Ebola epidemic in Liberia. This research is important for disease modelers and epidemiologists interested in social responses to emerging infections, where removal rates and public health behaviors change dramatically as disease prevalence increases throughout an epidemic. We hope to expand this analysis to include the 2003 SARS outbreak in Singapore in order to directly compare distinct locations of the worldwide SARS outbreak.

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112. Sheila Wald, Grand Valley State University **Ecology and Evolution**

"Site Comparison of Phenological Changes in Arctic White Heather (Cassiope Tetragona) in Response to Tundra Warming"

The implications of climate change are quickly being realized, and will greatly impact arctic climates. Understanding how vegetation like Arctic White Heather (Cassiope Tetragona) will be affected will allow for better future predictions of the impact climate change will have. I participated in the Grand Valley State University arctic ecology program in alliance with the International Tundra Experiment and gathered phenological data on the response of vegetation to artificially increased temperatures during the summer of 2015. The data was gathered in Barrow and Atqasuk, Alaska, and includes the dates of the appearance of the first green leaf, buds, flowers, seeds, and seed dispersal. Comparing this data with similarly collected data in a site with different environmental characteristics demonstrates the contrasting response C. Tetragona has across its range, and will have in the face of climate change. The phenological characteristics observed will likely be significantly earlier in Atqasuk than in Barrow for both the control and experimentally warmed plots, due to the more moderate climate.

113. Alexis Bonnema, Calvin College **Engineering**

(Co-Authors: Professor Yoon Kim)

"Development of Solar Simulator System with High-Power Multi-Array LEDs"

The research focused on developing a prototype model of a solar simulator that would take advantage of LED technology to match the spectral intensity of sunlight more closely and evenly than currently-available products. We were able to design, assemble, and test several integral parts of the prototype, particularly the power supply and the controller software.

114. David Dadzie, Calvin College **Engineering**

(Co-Authors: Professor Yoon Kim)

"Development of Constant-Current DC-DC Converter Modules for High-Power LEDs"

This project is to develop DC-DC switching power converter modules, which provide stable power to drive multiple high-power LEDs. LEDs have been widely accepted as light sources as they provide a light-weight and compact design, longer operating hours, and higher efficiency in electrical to optical power conversion. The constant-voltage DC-DC converters are simple and easy to adjust the voltage level required for various irradiation intensities emitted from LEDs. However, the voltage type converters often skew the intensities as the LED temperature and internal resistance vary. This results in uneven light intensities. In addition, due to the characteristics of LED I-V curves, the LED current would exponentially increase with a small increment in the LED voltage, making it difficult to accurately adjust the intensity of individual LEDs. Consequently, constant-current DC-DC converters have to be considered. The current-mode is more complicated to design than the constant-voltage version, but it has been gaining attention. The aim of this research project is to build a DC-DC switching power converter module. The module is designed to supply stable power by the means of a constant current to drive the high-power LEDs. We will need one hundred of these power converter modules since the proposed solar simulator will have an array consisting of consisting of one hundred high-power LEDs.

115. Ryan DeGroot, Calvin College **Engineering**

(Co-Authors: Robert Hoeksema, Julie Wildschut)

"Hydrologic Modeling of the Effects of Stormwater Runoff in Plaster Creek Watershed"

A major detriment to the health of Plaster Creek is stormwater that brings a large volume of warm, polluted water into the creek. Stormwater is water that runs off of impervious surfaces like pavement and rooftops. A significant amount of the Plaster Creek Watershed is urban with a lot of roads and parking lots which results in too much stormwater entering the creek at an unnatural speed. A common way to decrease the impact of stormwater is to install best management practices (BMPs) that capture the stormwater and give it a chance to percolate into the ground. A few examples of BMPs are:
Rain gardens
Detention basins
Planter boxes
To understand where and what types of BMPs are most needed, a hydrologic model is necessary. The model is also able to measure BMP effectivenesswhich aids in future BMP implementation.

116. Ha Ram Kang, Calvin College **Engineering**

"Green Roof: Impact and Sustainability"

Executive Summary (Abstract)
Green roof is a roof of a building that is partially or completely covered with vegetation and a growing medium planted over a waterproofing membrane. Green roof may also include additional layers such as a root barrier and drainage and irrigation systems depending on the weather.
Green roofs provide high sustainability in society. Sustainability is the quality of not being harmful to the environment or depleting natural resources, and thereby supporting long-term ecological balance. The green roof advantages provide sustainability in many different areas.

- Insulation
- Urban Heat Island Reduction
- Increased Roof Lifespan
- Rainwater Management
- Pollutant Filter
- Recovery of Biodiversity
- Education
- Aesthetics

Green roof is one of the options for renovating a roof or for building a new roof. Although green roof construction costs more than a normal roof, but in a long term investment that nearly halves the building's utility expenses. However, construction is not a simple task when a building requires additional support for the extra weight of the green roof. While the construction requires serious inspections from structural engineers. This research report provides the basic information related to green roofs which will be helpful for future green roof reference for Calvin College.
Moving forward, this project also proposes a demonstration facility on DeVries Hall for observing two different types of roof by measuring the temperature and precipitation. The demonstration facility will be a validation of green roof benefits. This research proposes a policy that would consider the scale of green roofs' benefits. The policy will assure that Calvin College structural engineers or architects always consider green roof when constructing or renovating a building. Lastly, as green roofs are considered, Calvin College will stand in a new phase on an improved sustainability.

117. Curtis Kortman, Calvin College **Engineering**

(Co-Authors: Matthew Kuperus Heun)

"Building Energy Efficiency Meets Internet of Things"

Buildings consume more than 40% of the energy needs of society in the developed world, and this number continues to grow[1]. As our world becomes increasingly connected, technology is added to every facet of our lives. The question arises whether this connected technology couldn't help reduce our energy consumption instead of add to it. A key aspect in determining improvement in energy consumption is to have data, meaning measurements must be taken. The goal this summer was to create a device that could take environmental measurements of different rooms on campus. This data would then be analyzed, and immediately accessible anywhere on campus through a web interface, with the hope that useful trends would become visible, and options for energy efficiency improvement could be found. The insights into the energy efficiency of buildings on campus could include inadequate building control systems, improperly set control systems, irresponsible occupant behavior, or other unexpected patterns in Calvin's energy usage.

The summer began with looking through literature regarding building energy efficiency and the internet of things. We wanted to become familiar with what had already been done, and successes and failures of previous research. Much of the previous research seemed to indicate that great cost and energy savings could be achieved by using information from internet of things devices. However, the cost of obtaining the information often exceeded the realized economic benefit of the energy savings. Most developed systems went a step further and used the data being collected to intelligently control the building. These systems, however, lacked a clean interface. Many of them had advanced capabilities, but they were hidden behind masks of non-user friendly software that no one besides an expert could operate. Furthermore, many tried to integrate with current building energy management systems, but again, the systems were very complex, and had an overwhelming number of features and settings.

Next, using understanding gained from the literature research, the development of the sensors and web interface began, parts were ordered and designs took shape. We developed a working hub that hosts the website. The hub is configured with the capability to host eight remote sensor nodes. These nodes can be strung with wires through the ceiling to different rooms. Each node can currently take three pieces of data: light levels, temperature, and occupancy. The current prototype has four of the sensor nodes connected to the hub. The hub is located above the ceiling in the Science Building hallway, and the four sensor nodes are in professor's offices. The sensors and hub were designed with fabricated circuit boards and 3D printed enclosures. The goal was to reduce setup time and costs for future installs to make the economic benefit of obtaining information with these sensors more viable. Furthermore, the website was designed to be intuitive, and easily configurable. The interface looks clean and simple, while still maintaining powerful analysis capabilities.

During testing we collected data in the Science Building. Some interesting trends were already observed as the motion-activated lights in the Science Building labs were shown to be faulty and stayed on for the entire 4th of July holiday weekend. It was fascinating to observe the temperature swings as Calvin shuts of its HVAC (Heating, Ventilation, and Air Conditioning) system at night and starts it up again in the morning. It was interesting to see the lag time between when the system turned on and when it was back in regulation. This information could be useful for more-optimally setting the start time of the HVAC system in the future to find the sweet spot between a comfortable building, and the energy savings associated with turning the system off.

The research experience has been great so far. It has been interesting learning to work very independently. With research there isn't exactly a customer that has to be pleased, and individual interest drives the work. I have explored some of my passions and tried many new things. I am very excited for the work I have accomplished and the things I have learned.

118. Jacob Milhorn, Calvin College **Engineering**

(Co-Authors: Vincent Rovedatti, Professor R. De Jong)

"Road Tests of the Acoustic Loads on the Back Panel of a Pickup Truck"

Scale model wind tunnel tests and full scale road tests have been performed to determine the noise sources for the back panel surfaces of the Tundra pickup truck. Experimental microphones arrays have been developed using the wind tunnel tests as a preliminary assessment and the road tests as a final validation.

119. Vincent Rovedatti, Calvin College **Engineering**

(Co-Authors: Jacob Milhorn)

"Vehicle Wind Noise Measurements in a Wind Tunnel with a Contoured Top Profile"

My name is Vincent Rovedatti, senior ME from Calvin College. This summer I worked at Calvin with Jacob Milhorn, senior ME classmate, Rich De Jong, vibration and noise control engineering professor, and Gordon Ebbitt, Toyota Technical Center USA Inc. We researched the aerodynamics and vibrations coming from the back window and panel of the Toyota Tundra. We used transducers made at Calvin with microphones that we phase matched.To understand the problem we first designed a wind tunnel with a contour top profile in CFD. The top profile of the wind tunnel simulates driving outside (realistic) and accounts for boundary layer growth so there is equal pressure across the top of the streamline. After analyzing the wind tunnel in CFD, we built the wind tunnel from the inside out as described in the Building Procedure paper. My paper is being submitted and not approved yet for public viewing. I will be giving a talk in April at the SAE conference this year in Detroit.

120. Andrew Twining, Calvin College **Engineering**

(Co-Authors: Mark Michmerhuizen)

"Simulation and Modeling of LED Characteristics in a Solar SImulator"

To build upon the success of Calvin's current solar simulator project, a research team of student Andrew Twining and Professor Mark Michmerhuizen was set to the task of finding the ideal characteristics of the Light Emitting Diodes (LEDs) on a 127 mm by 127 mm board, including viewing angle, intensity, wavelength, and placement position. After obtaining LightTools, an optics software package, as a tool for the project, the team optimized two designs made by Calvin Professor Yoon Kim. After making some observations on the two designs, the team suggested their own design. The suggested design added more green LEDs and differentiated wavelengths at 490 nm, 500 nm, 600 nm, 700 nm, and 900 nm.

121. Jacob Pledger, Hope College **Engineering**

(Co-Authors: Dr. Stephen Remillard, Dr. Paul DeYoung)

"MeV Ion Beam Channeling Into Crystalline Structures"

Thin film strontium titanate ($SrTiO_3$) on single crystal MgO substrate, and thin film strontium manganese oxide ($SrMnO_3$) also on single crystal MgO substrate, are being considered for use in engineered superlattices. Crystal matching of the films to the substrates is indicated by channeling of an ion beam through the lattice. With its ability to resolve depth in a sample, Rutherford backscattering of helium ions is used to determine layer thickness and the depth profile of the elemental composition of a sample. Ion beam channeling occurs when the beam's incident angle is parallel to crystal planes, or rather normal to the surface. Channeling can occur in well-ordered and pure crystals, providing an indication of sample quality. Comparison of the backscattering yields at different incident angles will show a drop in yield as the optimum channeling angle is approached. Channeling is seen with the bulk $SrTiO_3$ sample as well as with the thin film samples. Even though an 8% lattice mismatch exists between $SrMnO_3$ and MgO, channeling was still evident, although in this case the yield suppression revealed structure around normal incidence.
This work was funded by a seed grant from the Michigan Space Grant Consortium and by the Hope College Natural and Applied Sciences Division.

122. Erica St Clair, Ferris State University **Forensic Biology**

(Co-Authors: Brandon Good and Katie Szczegielniak)

"Validation of the QIAsymphony"

The most critical stage in forensic analysis is DNA isolation, so that as much DNA can be recovered as possible. The © QIAGEN QIAsymphony SP is an instrument that can automate the DNA extraction process. In a forensics lab, a batch of 40 samples can take eight to twenty-four hours to extract by hand using the organic extraction method with phenol-chloroform (PCI). Not only is this method time consuming, but manual manipulation of the substrate and extract leaves room for error and contamination. The QIAsymphony SP (QS) will allow for a higher volume of sample throughput while minimizing the potential for contamination and error. In order for this instrument to be used in a forensics lab, the lab must first validate the instrument. Validation refers to the process of demonstrating a laboratory procedures efficacy and reliability for forensic casework analysis. The FBI quality assurance standards state that internal validation shall include known and non-probative evidence samples or mock evidence samples, reproducibility and precision, sensitivity studies, mixture studies, and contamination assessment. The results from this validation study showed that the QIAsymphony worked just as well, or in some cases better than the manual PCI method of extraction. The results of the sensitivity and mixture studies were comparable to the manual method of extraction. Results also show that contamination does not occur to the sample while within the QIAsymphony. These studies, along with many others that were conducted, have shown that the QIAsymphony can get the job done just as well as PCI extraction.

123. Emily Macqueen, Aquinas College **Geography**

(Co-Authors: James Rassmussen, Mary Clinthorne)

"All Mapped Out: Land Use Land Cover of Aquinad College"

Aquinas College lacked a current Land Use/Land Cover map. I created such a base map of Aquinas College, at a very high resolution which can be used as a base map for many different disciplines. Economic valuation of the land cover/land use of the campus for sustainable planning will be a future use of this map. Recently many campus buildings were renamed. This map identifies these changes, and should prove very useful to students and faculty.

124. Matt Raybaud, Calvin College **Geography**

(Co-Authors: Henk Aay)

"Dutch Immigration to the United States"

Since the early seventeenth century, there have been records of the Dutch immigrating to the United States, and other places around the world. These records include census data, ship manifest logs, and Dutch Churches located in the American colonies and states that suggest a presence of immigrants. All of this data exists, but to this day it has yet to be used to map out the path of immigration that Dutch used during these past four centuries. My summer research project was to create series of maps that projected the numbers of Dutch immigrants in a variety of different ways. These maps will be used for future research projects, presentations, and maybe one day be published in an official atlas for Dutch immigration.

125. Annaka Scheeres, Calvin College **Geography**

(Co-Authors: Charlotte Reynolds, Dr. Jason VanHorn)

"Geographic Information Systems (GIS) Development for the Plaster Creek Watershed"

Plaster Creek Watershed suffers from a wide range of ecological impairments and environmental inequalities and, as one of the most polluted watersheds in Michigan, serves as a model example for restoration practices, community engagement, policymaking, and research. Yet, specific ecological and sociological problems cannot be adequately addressed without first developing a spatial understanding of the watershed. We set out to accomplish three main objectives through our research: to create new spatial layers that explore the complex issues in the watershed and incorporate these into the redesign of the Plaster Creek Interactive Online GIS; to develop an online Story Map Journal that combines ecological concerns, current restoration efforts, and public health problems into Plaster Creek Watershed's narrative; and to produce a number of educational videos to educate the public about the the Plaster Creek Watershed. We followed a different set of methods to address each objective. To begin our research, we identified key layers of the watershed to incorporate into the Plaster Creek GIS. We used these layers to construct a narrative of the Plaster Creek Watershed, including land use within the watershed, E. Coli concentrations in the creek, the locations of polluting facilities within the watershed, and key demographic factors such as racial distribution, poverty levels, and health risks. We anticipate community members, local policymakers, and academics will use the updated online mapping application and the Story Map Journal to better understand Plaster Creek's challenges and its potential for restoration.
Keywords: GIS, Story Map Journal, watershed, Michigan

126. Peter Boersma, Calvin College **Microbiology**

(Co-Authors: Loren D. Haarsma, Mark P. Schotanus, John L. Ubels)

"UVB-induced Activation of K+ Channels in Corneal Epithelial Cells Via TNF-R1 and FADD"

Purpose: Exposure to ultraviolet B (UVB) radiation causes K+ efflux from corneal epithelial cells due to activation of K+ channels. This loss of intracellular K+ is an early step in UVB-induced apoptosis, and inhibition of K+ efflux results in decreased rates of apoptosis in corneal epithelial cells following UVB exposure. Ligand-independent activation of tumor necrosis factor receptor-1 (TNF-R1) by UVB is known to result in apoptosis. This study was designed to investigate the roles of TNF-R1 and Fas-associated protein with death domain (FADD), which is activated by TNF-R1, in the initiation of the UVB-induced potassium efflux. Methods: Ion chromatography was used to measure potassium loss from human corneal limbal epithelial (HCLE) cells following exposure to 150 mJ/cm2 UVB radiation. Activation of K+ channels by 80 mJ/cm2 UVB was measured by whole-cell voltage-clamp current recordings using standard amphotericin-B perforated patch techniques. siRNA was used to knock down TNF-R1 and FADD in HCLE cells. Results: Cells exposed to UVB lost 45% of intracellular potassium within 20 minutes of exposure. When TNF-R1 or FADD was knocked down, only 15% of intracellular potassium was lost following UVB exposure, as compared to FADD or TNF-R1 knockdown cells not exposed to UVB. Exposure to UVB causes an immediate increase in K+ channel activation in control cells. Knockdown of TNF-R1 resulted in a 50% reduction in UVB-induced K+ current, while FADD knockdown resulted in complete inhibition of K+ channel activation following UVB exposure. Conclusion: The data suggest that UVB activates the apoptosis inducing receptor TNF-R1, which then activates K+ channels via FADD. This signaling pathway appears integral to UVB-induced potassium efflux because when levels of expression of either TNF-R1 or FADD are diminished, UVB-induced K+ channel activation and K+ efflux are diminished as well.
Supported by NIH grant R15 EY023836 and the Arnold & Mabel Beckman Foundation Scholars Program

127. Julie Cole, Grand Valley State University **Microbiology**

(Co-Authors: Elizabeth A. Summers, Ian A. Cleary, Derek P. Thomas)

"Analyzing the Role of a Putative Phosphatase 2A Component in C. albicans"

Candidiasis now represents the fourth most frequent nosocomial infection both in the US and worldwide. Candida albicans is the most common cause of candidiasis, the pathogenic potential of which is intimately related to certain key processes, including filamentation. The transcriptional repressor Nrg1 has been shown to be closely linked to the control of both filamentation and pathogenicity. Proteomic studies have shown that the gene 19.1468 is altered during filamentation. 19.1468 is thought to encode a protein similar to Cdc55p which is one of two regulatory subunits of the Phosphatase 2A (PP2A) complex, and plays an important role in cell cycle progression and filamentation. S. cerevisiae strains that lack Cdc55p are defective for filamentous growth. Here we demonstrate that an over-expression of Cdc55p is sufficient to override Nrg1-mediated repression; this over-expression drives filamentation in a variety of conditions. We used Real-time PCR analysis to examine the regulation of filamentation-associated genes during Cdc55p driven filamentation in the presence of high levels of Nrg1p. Furthermore, we demonstrate that when compared to a strain over expressing just NRG1 this strain restores virulence in the Galleria mellonella infection model. We are now further examining the specific contributions of this protein to hyphal development in C. albicans.

128. Drew McWilliams, Grand Valley State University **Microbiology**

(Co-Authors: Dr. Rick Rediske, Tori Harris)

"Implementation of a Quantitative Polymerase Chain Reaction (qPCR) for Escherichia coli on Lake Michigan Beaches"

Quantitative Polymerase Chain Reaction (qPCR) is a genetic amplification technique that can be used to quantify bacterial DNA in water samples. The Step One Plus qPCR instrument can yield results in ~2 hours, whereas previous methods, including the IDEXX Colilert18 Defined Substrate Method, took up to 18+ hours to analyze the sample. For beach monitoring, the advantage lies in the qPCR method because beach samples can be analyzed and if the bacterial levels are too high, closed in the same day, thus minimizing public health concerns.

129. Adam Pickruma, Grand Valley State University **Microbiology**

(Co-Authors: Steve Wilkinson, Jordan Zhou, M. Aaron Baxter)

"Utilizing Transposon Mutagenesis to Identify Environment-sensing Regulators Important for Biofilm Formation Within Escherichia coli"

Biofilms are complex 3-D structures that allow bacteria to persist during infection and survive in a variety of environments. Biofilms increased the organism's ability to colonize a larger array of environments and increases their resistance to metabolic stress, antibiotics and host immune components. Composed of cellulose and other extracellular polysaccharides and proteins, the structural scaffolding of the biofilm is important. Its structure allows for nutrient and metabolic waste flow throughout the structure and accentuates adherence of the organism to a variety of substrates. Thus, an organism within a biofilm undergoes a tremendous change in gene expression in comparison to when it is in a planktonic state. Organisms like E. coli are capable of forming a biofilm and do so in many of the environments they are typically found. Previous work has shown that the regulation of a variety of host processes involve the ability to sense the surrounding environment and then adjust their growth to compensate for these environmental changes. These sensors will monitor conditions such as pH, oxygen levels and temperature. It is proposed that one of signals that allow this bacterium to colonize and form a biofilm is its ability to sense oxygen levels, as oxygen varies tremendously when outside a host versus within the gastrointestinal system of a host. Utilizing a random transposon mutagenesis procedure, our group is creating a growing library of E. coli mutants. Additionally, we have developed a biofilm assay utilizing techniques from previous work that uses crystal violet to determine biofilm thickness and also a congo red binding assay to measure the amount of extracellular polysaccharides and proteins secreted by the organism. Mutant E. coli are being grown under aerobic, microaerophilic and anaerobic conditions and then compared to identify mutants that show a difference in biofilm formation in response to oxygen levels. It is our goal to identify these regulators and determine how they effect a change in biofilm formation.

130. Dallas Rohraff, Grand Valley State University **Microbiology**

(Co-Authors: William Schroeder, Robert Smart, Roderick Morgan)

"The Evaluation of Essential Oils as Antibiotics"

The emergence of antibiotic resistant bacteria is of pressing concern as health care associated infections kill 99,000 people a year in the United States alone. Researchers are currently looking for new antibiotics in alternative sources. Essential oils are traditionally known to have medical benefits, and cinnamon bark (Cinnamomum cassia Blume), tea tree (Melaleuca alternifela), and eucalyptus (Eucalyptus globulus) oils have shown antibiotic activity. Initial testing via standard microbiological protocols found minimum inhibitory concentration (MIC) values of 0.0391% for cinnamon bark, 1.25% for tea tree, and 0.313% for eucalyptus. All three oils proved effective against both Gram-positive and Gram-negative bacteria, Staphylococcus aureus and Escherichia coli, respectively. As cinnamon bark oil had the lowest MIC, a more thorough microbiological analysis revealed that it retained antibacterial activity in the presence of 10.0% human serum protein and had bactericidal activity. Three of the main components of cinnamon bark oil; trans-cinnamaldehyde, cinnamyl cinnamate, and benzyl cinnamate, were subjected to preliminary testing. Trans-cinnamaldehyde appeared to be the only effective component against both Gram-positive and Gram-negative bacteria. Results suggested that cinnamon bark oil may contain a promising novel antibiotic.

131. Dallas Rohraff, University of Georgia **Microbiology**

(Co-Authors: Evelina Basenko, and Zachary Lewis)

"Analysis of Replication and RNAi in Neurospora crassa"

Regulation of chromatin structure is essential for several cellular processes including DNA replication and repair in eukaryotes. Heterochromatin refers to parts of the genome that are generally transcriptionally inactive due to being highly compacted throughout all or most of the cell cycle. The Δdim-5 mutation in Neurospora crassa disrupts heterochromatin formation and causes multiple phenotypes including hypersensitivity to the DNA damaging agent methyl methanesulfonate (MMS) and increased production of small RNAs from heterochromatic regions. Small RNAs can arise from the degradation of full length RNA Polymerase II transcripts or could be generated by the specialized RNA-dependent polymerase, QDE-1. Project 1 tested the hypothesis that QDE-1 is responsible for small RNA production from heterochromatin regions in the Δdim-5 strain as qde-1 knock-in constructs with HA, FLAG, and GFP tags were created using overlapping PCR. The constructs were transformed into wild type cells, and their expression was confirmed by western blot analysis. Strains with successful integration of the qde-1 knock-in were crossed with a Δdim-5 mutant for future analysis using ChIP-seq. Project 2 tested the hypothesis that MMS-hypersensitivity of the Δdim-5 strains reflects a defect during the S phase of DNA replication. Δdim-5 and wild type strains containing both mcm-2-rfp and h2a.z-gfp were identified through Southern blot analysis and compared using fluorescent microscopy.

132. Brady Hasse, Central Michigan University **Neuroscience**

(Co-Authors: Dr. Jamie Johansen, Jessie Zenchak)

"Androgen Receptor Coregulator Transcriptional Activities in Kennedy's Disease"

Spinal and bulbar muscular atrophy (SBMA, Kennedy's disease) is an X-linked progressive neuromuscular disorder caused by polyglutamine repeats in the androgen receptor (AR) gene. SBMA is associated with androgen dependent muscular weakness. Recent studies have challenged the neurocentric theory of the cause of SBMA, and suggested a muscular origin of pathophysiology. Exeriments using several mouse models of SBMA seem to show toxicity introduced into the muscle cells from altered transcriptional activities. Because coregulators are capable of altering transcriptional activities, in this paper we examine the role that a particular AR corepressor, SMRT, has in a mouse model of SBMA.

133. Kelsey Idyle, Central Michigan University **Neuroscience**

(Co-Authors: Lucas Huffman, Dylan Dues, Aaron Antcliff, Dr. Andrew Crane, Dr. Kyle Fink, Dr. Julien Rossignol, Dr. Gary Dunbar)

"Bone Marrow-Derived Mesenchymal Stem Cells in the Suppression of Highly Proliferative Glioblastoma Multiforme"

Glioblastoma multiforme (GBM) is one of the most aggressive and infiltrative primary tumor formations of the central nervous system. Current therapies are ineffective in eradicating this deadly type of tumor. In fact, the resurgence of GBM is almost inevitable and patient outcome following diagnosis remains dismal. Therefore, a novel and efficacious therapy is desperately needed to prevent tumor resurgence and improve patient outcome and quality of life. Mesenchymal stem cells (MSCs) have recently become a very popular avenue for the delivery of a variety of molecules and substances, and of particular interest to this project is their ability to release endogenous anti-inflammatory cytokines, such as interleukin-10 (IL-10). Importantly, solid tumors often secrete pro-inflammatory cytokines in an effort to increase angiogenesis and nutrient support to promote further proliferation. Specifically, the MSC therapy utilized in this study aimed to diminish this pro-inflammatory effect and ultimately slow and eradicate tumor progression. To these ends 24 rats were randomly placed into three groups: SHAM controls (n=8) received only vehicle treatments; the F98 group (n=8) received only a transplantation of F98 tumor cells; and the F98+MSC group (n=8) received a transplantation of MSCs seven days post-F98 transplantation. Stem cell grafts were placed adjacent to the tumor bed in order to promote the optimal release of anti-inflammatory signaling molecules. All animals were euthanized 21 days following F98 transplantations and histological analyses were performed to compare tumor size and inflammatory response between each group. Results indicated that the ipsilateral MSC treatment was unable to affect the inflammatory response produced by the tumor, nor significantly mitigate tumor growth. However, current studies aim to investigate the optimization of the stem cell graft to tumor cell ratio as well as the utilization of stem cells over-expressing these endogenous signaling molecules and their effects on tumor proliferation. Support for this study was provided by the Office of Research and Sponsored Programs at CMU, the College of Medicine, and the Field Neurosciences Institute and John G. Kulhavi Professorship

134. Alyssa Shepard, Central Michigan University **Neuroscience**

(Co-Authors: Brook Stevens, Emily Cooksey, Michelle Steinhilb)

"Examining the intracellular breakdown of toxic tau fragments"

Alzheimer's disease and other tauopathies are characterized by the accumulation of abnormally phosphorylated and aggregated forms of the microtubule-associated protein tau. Several independent laboratories have reported the appearance of a soluble, 17kD fragment of tau in dying neurons that is the product of calpain cleavage. Results from our lab using Drosophila as a genetic model organism for tauopathy show that calpain cleavage of tau has profound impact on neurotoxicity in vivo. Many researchers now support the idea that the toxic tau species is a soluble, highly phosphorylated, aggregated form of tau. What remains unknown is the mechanism controlling how toxic tau moieties cause neuronal dysfunction. The two major degradation pathways for both physiological and pathological forms of tau are the ubiquitin-proteasome system and the autophagy-lysosome system. Other labs have shown that full-length tau is degraded by the proteasome, but that truncated fragments and soluble oligomers are cleared by autophagy. Accumulating evidence suggests that there is significant cross talk between degradation systems and that phosphorylation and truncation may play an important role in targeting proteins to the appropriate degradation pathway. Since others have noted that tau assembly into oligomers inversely correlates with proteasomal degradation-suggesting that soluble oligomers may be degraded via autophagy-we are particularly interested in studying the degradation fate of 17kD tau.

135. James Hentig, Western Michigan University **Neuroscience**

(Co-Authors: Christine Byrd-Jacobs)

"Zinc Sulfate Affects Ciliated Olfactory Sensory Neurons More Than Microvillous Olfactory Sensory Neurons in the Adult Zebrafish"

Our aim was to examine the effects of zinc sulfate on olfactory sensory neuron (OSN) subtypes in the adult zebrafish (Danio rerio). Fish were anesthetized and 1M ZnSO4 was infused into the right olfactory organ, while the left served as an internal control. Hematoxylin and eosin stain showed severe morphological disruptions 2 d after exposure: the olfactory organ was highly inflamed and lamellae appeared fused. After 5 d, inflammation had subsided but the olfactory epithelium appeared thinner than controls. By 10 d, the olfactory organ appeared recovered. Optical density was used to quantify anti-calretinin labeling of mature OSNs. There was a significant decrease in the treated side compared to control side 2 d after exposure. Labeling was not different from control at 10 d. Scanning electron microscopy was used to examine the ultrastructure of the olfactory organ. The surface of unlesioned organs appeared densely packed with ciliated OSNs and longer non-sensory cilia. At 2 d, the organ appeared absent of ciliated OSNs though non-sensory cilia were still present. At 5 d, areas of ciliated OSNs were observed, and at 10 d the sensory area of the organ surface resembled controls. Olfactory-mediated behavior was assayed to determine function of the lesioned organs. Control fish and treatment groups were exposed to an amino acid or bile salt mixture, and the number of turns fish made pre- and post-odor exposure was counted. At 2 d, fish could not detect either odor mixture. Given 10 d to recover, the ability to perceive amino acids was regained, but it was not until 14 d that the ability to detect bile salts recovered. Thus, structure of the olfactory organ returns prior to function, and microvillous OSNs recover before ciliated OSNs showing differential effects of this chemical on neuron subtypes.
Supported by NIH-NIDCD #011137 (CBJ), NSF-REU DBI-1062883 to WMU (JTH), WMU College of Arts and Sciences (JTH), and WMU OVPR (JTH).

136. Jacqueline Saunders, Ferris State University **Pharmacy**

(Co-Authors: Dr. Eric Nybo, Ph.D., Assistant Professor at Ferris State University College of Pharmacy)

"Metabolic Engineering of Valerenadiene in Escherichia coli"

Terpenes are a large class of volatile organic compounds naturally produced by plants and some insects. They are used as fragrances, biofuels, and even medicinal compounds. The root of Valerena officinalis yields a terpene derivative called valerenic acid, which holds important medicinal properties for treatment of insomnia and anxiety. Development of valerenic acid as a drug is inhibited by low production in the native plant root and differences in production between plant cultivars. Our strategy to develop new valerenic acid analogues focuses on production of valerenadiene, an intermediate compound with lower anxiety reducing activity, in an E. coli host. Our strategy is two-fold: 1) first, we will engineer the valerenadiene synthase gene into the organism and 2) we will enhance in vivo levels of an important key substrate in the production of valerenadiene known as farnesyl diphosphate (FPP). We envision this production platform to be a forward movement in the development of new pharmacologically active valerenic acid analogues.

137. Aaron Abma, Calvin College **Physics**

(Co-Authors: Jonathan Shomsky, Professor Matt Walhout)

"Optical Methods for Trapping Atoms and Making Cold Molecules"

Krypton, a generally unreactive element, can be made to briefly form molecules at low temperatures through a process called photoassociation, where photons of specific wavelengths are used to "glue" the atoms together into molecules. The wavelengths at which these molecular interactions occur reveal information about krypton's quantum structure. To find these wavelengths, we set up two overlapping magneto-optical traps to produce a cloud of krypton atoms. We then used a tunable probe laser to illuminate the cloud. We took data on cloud fluorescence, ion rate, and laser wavelength. We repeated this over a range of laser wavelengths. Although we did find dips in trap fluorescence, we were unable to confirm that these are molecular resonances caused by the photoassociation process. We hope to study these potential molecular resonances further to confirm them or rule them out for certain.

138. Matthew Link, Calvin College **Physics**

(Co-Authors: Aaron Abma, Ryan Balili)

"Enabling automated, high-quality phase-sensitive detection of quantum well and microcavity polariton spectra"

Polaritons are quasi-particles which can be formed in semiconductor microcavities. Due to their low mass, they can undergo Bose-Einstein condensation near room temperature, making applications feasible. In the studying them, light can be used to probe semiconductor samples to produce spectra. To best study polaritons, high quality spectra are required. We built and automated a detection system which employed phase-sensitive detection and common-mode rejection to obtain high signal-to-noise ratio spectra.

139. Brennan Kerkstra, Central Michigan University **Physics**

(Co-Authors: Brennan Kerkstra, Jamie Lomax, Karen Bjorkman, Jon Bjorkman, Kevin Covey, Brian Skiff, John Wisniewski)

"PRISM Polarimetry of Massive Stars"

We present the early results from our long-term, multi-epoch filter polarization survey of massive stars in and around young Galactic clusters. These BVRI polarization data were obtained using the PRISM instrument mounted on the 1.8m Perkins Telescope at Lowell Observatory. We first detail the creation of our new semi-automated polarization data reduction pipeline that we developed to process these data. Next, we present our analysis of the instrumental polarization properties of the PRISM instrument, via observations of polarized and unpolarized standard stars. Finally, we present early results on the total and intrinsic polarization behavior of several isolated, previously suggested classical Be stars, and discuss these results in the context of the larger project.

140. Bailey Groendyke, Grand Valley State University **Physics**

(Co-Authors: Karen Gipson)

"Acoustic Response of a Multi-Purpose Theatre"

Like many multipurpose auditoriums, the Louis Armstrong Theatre (LAT) at Grand Valley State University has long been reported to have unsatisfactory acoustics for music performance. This study focused on physical measurements of the LAT to understand the acoustic response of the hall. Reverberation time (RT) was measured by filling the LAT with sound and measuring the decay for select frequencies as per ASTM E2235 protocol, and the initial time delay gap (ITDG) was determined using slapsticks as an impulsive sound source. Data from the physical measurements confirmed that the RTs over a wide range of frequencies were smaller than desired for music, whereas ITDG measurements showed prevalent spurious reflections. A simulation of the room was created using the software package ODEON, and the simulated data compared favorably with measured data. However, attempts to modify the model to improve the acoustic response were not conclusive.

141. Katie Kruk, Grand Valley State University **Physics**

(Co-Authors: Jeffrey Gunter, Clifford Jack)

"Developing Automated T1 Analysis Software for the MRI System Phantom"

Magnetic Resonance Imaging (MRI) is an imaging technique based on the principles of nuclear magnetic resonance (NMR). Since water is common in the living tissue, protons are typically the nuclei of interest in MRI. Protons have an intrinsic magnetic moment (a.k.a. spin), and placing protons in a strong magnetic field polarizes the magnetic moments along the magnetic field. The polarized protons can absorb and emit electromagnetic energy at the Larmor frequency, which depends linearly on the magnetic strength. When a radiofrequency (RF) pulse is applied at this frequency, the spins absorb energy and are excited, or tipped away from their alignment with the external magnetic field. As the spins relax to align with the main magnetic field, RF energy is emitted and detected by an antenna array. The time it takes for the complete relaxation to occur is known as the T1 time. By varying the timing of the RF pulses and the gradients used, images of different "contrast" may be created. In this work, we assess the absolute correctness of T1 measurements with different RF and gradient sequences on a System Phantom devised by a committee of the ISMRM in concert with NIST. A program that automatically detects the regions of interest (ROIs) is developed to calculate T1 times, and the results are compared to the analysis program developed by NIST. In the NIST program, one must manually choose the location and size of the ROIs, and, by changing these parameters, one changes the calculated T1 times. It was found that the results from the automatic program match the reference T1 times with precision and will allow for a greater reproducibility of results.

142. Jacob Hall, Calvin College **Pre-Medicine**

(Co-Authors: Ping Zhao, Mary Durston, Austin Voydanoff, Abhinav Beeravally Nagulapally, Jeffrey Bond, Giselle L. Saulnier Sholler)

"BKM120 (Buparlisib) induces apoptosis in medulloblastoma through the inhibition of the PI3K signalling pathway and prevention of cell proliferation"

BKM120 (Buparlisib, Novartis, Switzerland) is a novel cancer therapeutic that targets the PI3K/Akt/mTOR signaling pathway, and has recently been shown to have great potential in the clinic by acting on Class IA PI3Ks. In this study, we show the inhibitory effect of BKM120 on medulloblastoma cell lines that over-express PI3K, suggesting a promising role in the clinic for children with this expression profile. Deregulation of the PI3K pathway is linked to the development of cancerous tumors, as this pathway plays an important role in both cellular proliferation and apoptosis. Given this function, regulation of the PI3K pathway could prevent tumerogenesis, especially in cancers that overexpress PI3K, such as medulloblastoma. Accordingly, it has been shown that PI3K inhibitors similar to BKM120 display significant antiproliferative effects in medulloblastoma.
Given this information, it has been theorized that BKM120 could display single agent toxicity in medulloblastoma due to its capabilities as a PI3K inhibitor. Due to increasing need for improved, personalized treatment options for pediatric brain cancers, this study examined the cytotoxicity of BKM120 both in vitro and in vivo in order to assess the drug's potential for clinical trial as a therapeutic treatment against medulloblastoma.

143. Bretton Hoekwater, Calvin College **Psychology**

(Co-Authors: Eric Jones)

"Stigma After Exoneration? How Potential Employers View Those with a Wrongful Conviction"

Research has insufficiently examined the challenges that exonerees face once they leave prison. In this study, employed people evaluated a fictitious job applicant with no criminal record, an actual criminal record, or a wrongful conviction. Results were mixed. Sometimes the wrongfully-convicted applicant was perceived similarly to an applicant with no prior conviction. Other times, the wrongfully-convicted applicant was perceived similarly to an applicant with an actual conviction. Additional concerns about the wrongfully-convicted applicant appeared in participants' written impressions of the applicant. Overall, these results support anecdotal evidence that exonerees may face biases when applying for jobs.

144. Ohanes Khacherian, Hope College **Psychology**

(Co-Authors: Brandi Ledbetter, Sean P. Deats, Antonio A. Nunez, Lily Yan, Laura Smale, and Andrew J. Gall)

"Effects of Olivary Pretectal Nucleus (OPT) Lesions on Brain Responses to Light in Diurnal Grass Rats"

The olivary pretectal nucleus (OPT) receives direct retinal input, exhibits light-induced Fos expression, and is involved in the pupillary light reflex (Gall et al., 2014; Trejo & Cicerone, 1984). We have recently shown that OPT lesions cause diurnal grass rats to decrease their activity in response to a light pulse (LP) given at Zeitgeber time (ZT) 22, opposite to controls. Therefore, the way grass rats respond to acute pulses of light (i.e., masking) is influenced by the OPT. The objective of the current study was to use Fos to examine brain areas through which the OPT might influence this masking effect of light in grass rats. We examined the effects of OPT lesions on the photic response in three retinorecipient brain areas, the suprachiasmatic nucleus (SCN), the ventrolateral geniculate nucleus (VLG), and dorsolateral geniculate nucleus (DLG). OPT lesioned and sham grass rats were either sacrificed at ZT23 at the end of a 1-h LP, or sacrificed at the same time without receiving a LP. We found that following the LP, both shams and animals with OPT lesions exhibited a significant increase in Fos expression in the SCN. In contrast, in the VLG, Fos was increased following a LP in shams, but not in lesioned animals. Finally, the DLG did not display increases in Fos in either controls or lesioned animals. Altogether, our results suggest that interconnections between the OPT, SCN, and VLG play a critical role in masking responses to light in grass rats.

145. Danielle Winkler, Ferris State University **Public Health**

(Co-Authors: Emmanuel Jadhav, DrPH, MHM)

"Contemporary Trends in Vaccination"

Background: Vaccination coverage levels among young adults are low. The stable vaccination waiver rates in MI coupled with low vaccination coverage among young adults could lead to geographical clustering of vaccine preventable diseases. Many individuals in the young adult population will have children and if they do not support vaccination, a future of unvaccinated children awaits. Mistaken information and poor communication are among some of the known barriers to vaccination uptake. Not much is known about the attitude, experiences and barriers that influence the vaccination choices of young adults. This study examines the contemporary trends in young adult vaccination.
Research Objectives: 1. Categorize characteristics of young adults by vaccination waiver status. 2. Identify contemporary trends associated with benefits, barriers and influencers of adult vaccination.
Methods: The study design involves a cross-sectional survey of Ferris State University students. The survey is currently open. Exploratory and bivariate analysis will be used to categorize characteristics and identify trends.
Findings: Preliminary results show that 67% of surveyed young adults consider effective control against the disease to be the most highly valued benefit of vaccination. 14% of young adults considered the risk of adverse event being greater than the benefit of vaccination as the greatest barrier. 56% of young adults considered vaccine safety to have the greatest influence on their vaccination status. 66% of young adults surveyed do not feel that a relationship exists between vaccination and autism.
Implications: Findings of the study will inform development of young adult vaccination programs at the campus, local and regional levels.

146. Will Adamson, Aquinas College **Biology**

(Co-Authors: L. Rob Peters, Ph.D, Kevin Strychar, Ph.D, Claire Krohn, Isabella Deveau**)**

"In Vitro Culturing of *Aiptasia pulchella* and *Montastraea cavernosa "*

The need to understand coral and its physiological and ecological properties has become a pressing issue as the earth's reef systems are dealing with new, physiological-altering stressors (Cacciapaglia et al. 2015). The aim of this report is to contribute to the growing research surrounding coral culturing *in vitro*. Attempts to culture one coral species, *Montastraea cavernosa*, and one sea anemone species, *Aiptasia pulchella* have been completed. These cultures had varying levels of success. The culturing of *A. pulchella* is important because it has been proposed as a model organism for understanding corals and their biological processes (Weiss et al. 2008). Furthermore, *A. pulchella* was successfully amplified and sequenced from its extracted and purified DNA. However, *s*equencing of *M. cavernosa* has not been successful thus far. The following information serves as an explanation and analyses of these initial cell culture trials. The end goal of the project is to establish a coral or sea anemone cell line.