

Student Summer Scholars

Summer Showcase

August 7, 2008

2204 Kirkhof Center (Pere Marquette Room)

4:00 PM – 7:00 PM

Welcome to the 2008 Student Summer Scholars' Summer Showcase!

The Student Summer Scholars (S3) Program provides funds for a student and faculty mentor to devote twelve weeks to a research and/or creative project during the spring/summer semester. Through these grants and the mentorship of a faculty member, the S3 program offers a unique opportunity for undergraduate students to do hands-on, professional research and creative practice in their chosen field. Combining academics, field work, and a reflection component provides students with a meaningful learning experience that helps to prepare them for graduate school and future careers.

For each S3 participant, the project begins with an innovative and thoroughly researched proposal. With guidance from faculty mentors, students identify a research question or an area of creative practice, and then shape the structure of their project. The value of mentorship is an important part of S3. Experienced faculty mentors act as support and a sounding board for their students.

Through S3, students begin to direct their own educational paths and familiarize themselves with the requirements and structure of professional research. Participants quickly learn that a successful project requires more than scholarship. Detailed planning, attention to budget, and creativity allow student researchers to innovate while working in a self-structured environment, and to cope with unexpected complications. By building on a foundation of academic and critical thinking skills provided by undergraduate courses, self-motivated students can use S3 to further their knowledge in a specific area while learning to incorporate academics with professional work.

The project's critical assessment component requires each participant to reflect on and evaluate his or her own project and the S3 experience as a whole. This comprehensive analysis of a self-directed project provides students with an opportunity to examine their own learning styles and academic strengths in order to shape further learning and working habits. S3 provides students with a new lens through which to view their long-term educational, work, and life plans.

We thank you for joining us for this important step in the learning process, and we know you will enjoy seeing the S3 Scholars' work thus-far.

## 2008 Student Summer Scholars

Andrew Bellenir	Andrew Sisson
Brittany Benson	M. Ben Stacey
Rebecca Bolen	Norrissa Thomas
Laura Dahmer	Leonard Van Gelder
Michelle Frasco	Kirk Wyatt
Emily Henk	Sandi Xhumari
Derek Janssens	
Kevin Maupin	
Elise Miller	
Brandon Moblo	
Dennis Nagelkirk	
Connie Pan	
April Russell	
Kyle Schneider	
Carrie Schoenborn	

## Order of Events

4:00 PM – 4:45 PM	Poster Presentations and Hors D'ouvres
4:45 PM – 5:00 PM	Remarks by Dean Wendy Wenner, College of Interdisciplinary Studies
5:00 PM	Dinner
5:30 PM – 7:00 PM	Oral Presentations

Andrew Belliner

Faculty Mentors: Christian Trefftz and Greg Wolffe

### Graphics Process-Based Implementation of Bioinformatics Codes

We created a powerful computing platform based on graphics cards to improve the performance of bioinformatics codes. A graphics processing unit (GPU) is a component of a computer responsible for showing a display on the screen. To keep up with the video gaming industry, modern GPUs have become very advanced computational devices. Recently computer scientists have taken interest in a GPU's ability to perform computational commands on multiple sets of data simultaneously, leading to improved performance.

Our system contains two GPUs, capable of working in parallel, for a total of 256 processors (for comparison, a modern desktop will have two or four processors). Our plan includes using this computational power to improve the performance of existing bioinformatics codes, specifically, the Smith-Waterman algorithm for finding DNA or protein sequence alignment.

Brittany Benson

Faculty Mentor: Brad Waller, Chemistry

### Defining specific protein interactions in Diaphanous-related Formins: an essential step in the development of a potential anti-cancer drug

Diaphanous-related formins (DRFs) are a conserved family of proteins that are involved in the regulation of cellular shape, motility, and cell division by regulating the construction of the cellular "skeleton" (cytoskeleton). Normally, the DRFs are kept in an inactive state by the intramolecular binding of two regions of the protein, the Diaphanous Autoregulatory Domain (DAD) and Diaphanous Inhibitory Domain (DID). This binding can be alleviated by various naturally-occurring mechanisms, but regulation of the activity of these proteins is vital to cell survival because prolonged activation can cause cells to die. A recent scan of 10,000 compounds found two that can bind to the DID and activate DRFs indefinitely and subsequently have been shown to kill breast and colon cancer cells. These compounds work much like many anti-cancer drugs, such as Taxol, which bind to the cytoskeleton and cause cell death. Though Taxol is an effective chemotherapeutic drug, it exhibits side effects and tumor cell resistance. We have proposed that compounds I/II work differently by instead binding to DRFs and regulating the cell signaling pathways that govern the formation of the cytoskeleton.

While it has been shown that these compounds are able to cause cell death, where these compounds bind to DRFs still must be elucidated. Through the use of fluorescence anisotropy and isothermal titration calorimetry (ITC), we intend to prove that these compounds are able to alleviate DID/DAD binding, and we have hypothesized that this is done by each compound binding to the DID region. To prove this, we have probed for specific residues on DID that contribute to the binding of the compounds. We have hypothesized that three residues (arginine-230, glutamine-322 and isoleucine-276) play a role in this binding. Using site-directed mutagenesis, we have generated these mutations that should decrease or inhibit binding if these residues are involved, and have tested for their ability to bind to DAD and compounds I/II using anisotropy and ITC. So far, we have shown that mutations at arginine-230 and glutamine-322 result in weaker binding, while a mutation at isoleucine-276 results in almost no binding. Further experiments will test how these mutations affect the ability for compounds I/II to bind to DRFs and inhibit binding.

Rebecca Bolen

Faculty Mentor: David Eick, French Studies

### The Marriage of Rosine: Discourses on Women in the Plays of Beaumarchais

By the latter half of the eighteenth century, women in France had gained a new sort of power, both in culture and politics. This new social structure sparked a reactive and occasionally vehement debate, known as *le quarrel des femmes*. In that same time period Beaumarchais's *Le Marriage de Figaro* was written and produced. Often seen as a symbol of the French Revolution, the play has already generated many volumes on research on its political and social implications. This paper will take a slightly different view. As *le quarrel des femmes* continued and grew, representations of women also transformed, and this carried over into play writing.

Women were thought to be calm, moral influences by nature; this made their position as salonieres natural and desirable as it would create the required balance in conversation. However others were not willing to be directed by women, whom they knew to be inferior. These diverse opinions contain a shared thread, women as a moral force. This idea may be flattering, but also definitively put women on a different plane with men. In stark contrast to other discourses *Le Marriage de Figaro*, most often studied for its presentation of equality between men, advocates for equality in marriage and criticizes the society that puts women at the mercy of men. Four couples, each, to varying degrees, a composed of a virtuous woman and a villainous man, demonstrate the benefits of equality, the destruction the subjugation of women may cause, and the joy that is found once these inequalities are righted.

Laura Dahmer

Faculty Mentor: Dawn Coe and Brian Hatzel, Movement Science

### Determination of Energy Expenditure during Pregnancy and its Comparison to the Compendium of Physical Activity Values: A Pilot Study

Current exercises recommended during pregnancy are prescribed at the same intensity as the general adult population, 3-6 METs. It is unclear whether these MET values can be applied to the pregnant population. **Purpose:** To determine energy expenditure of pregnant women while participating in three exercises (walking, stationary biking, and prenatal aerobics) during the second and third trimesters. And second, to determine whether the energy expenditure of the exercises would change from the second to third trimester. **Methods:** Participants were 3 women, ages 23-32, in their second trimester (weeks 14-26) of pregnancy at commencement of the study. Subjects reported to the Human Performance Lab twice, once during the second trimester and once during the third trimester with at least 6 weeks between visits. During each visit, subjects were in a resting state for 30 minutes and then participated in stationary biking, walking, and prenatal aerobics for 10 minutes each with a break between exercises. Data was analyzed using a sample t-confidence interval test to compare the average energy expenditure of each activity during the 2<sup>nd</sup> and 3<sup>rd</sup> trimester to recommended values. A paired t-test was used to compare values between the trimesters. **Results and Discussion:** Results from the statistical analysis cannot be determined as significant at this point. While numbers were highly or moderately correlated, the p-values were not significant due to the low sample size. This indicates that there is potential for significant data but more subjects are needed to be able to draw any conclusive evidence.

Michelle Frasco

Faculty Mentor: Pablo Llerandi-Roman, Geology

### Overcoming barriers in geoscience education at the elementary school level

The purpose of this study was to provide solutions to overcome the barriers of teaching geoscience according to elementary school teachers in Michigan. After two months of data collection, 37 public school teachers (100% Caucasian) with a geoscience teaching experience ranging from 1 to 30 years ( $M = 12$ ) completed an online survey aimed to answer the following research questions: (a) What barriers do teachers face when teaching geoscience topics and (b) What are possible strategies to overcome these barriers? Answers were analyzed through descriptive statistics and qualitative research methods following a mixed-methods research approach. Preliminary results showed that teachers perceive the lack of resources, time, and geoscience knowledge as the principal barriers for teaching geoscience concepts. Issues associated with state standards and the primacy of other subject areas were also mentioned as significant barriers. Teacher-proposed solutions to overcome those barriers included being proactive in locating resources, improving their geoscience knowledge, and involving the school administration. Teachers' geoscience pedagogical and concept knowledge, including their ability to integrate different subject areas, and their understanding of educational standards seemed to play a critical role in their perception of barriers. Implications for professional development and teacher education were discussed and a series of practical solutions were proposed. Semi-structured interviews with selected participants will be conducted to gain a deeper understanding of teacher perspectives. Teachers, policy makers, and teacher educators can apply the results of this study to develop short-term solutions in the classroom setting and more effective teacher education programs by emphasizing the critical role of pedagogical knowledge in science education.

Emily Henk

Faculty Mentor: Margaret Dietrich, Biology

### Identifying Lactic Acid Bacteria in Michigan Cherry Wines

Many factors contribute to the final flavor of wine. One factor is malolactic fermentation, during which lactic acid bacteria (LAB) transform the harsh tasting malic acid into a more drinkable lactic acid in grape wine. The role of LAB in the production of cherry wine is completely unknown. The goal is to identify the species of LAB in cherry wine and compare them to those found in grape wines. Bacteria from cherry wine were grown on general media plates and plates fortified with malic acid, which may provide optimal growing conditions for the LAB. To identify the bacteria, we will isolate 16S ribosomal DNA sequences, which encode a general gene found in all bacteria. We will then narrow our focus to a specific variable region of the gene; this will differentiate the DNA of different LAB after sequencing. To isolate the 16S gene and the variable regions, we will use polymerase chain reactions (PCR) which will exponentially copy the desired region of DNA. The PCR products will go through submarine gel electrophoresis to confirm the size of the 16S sequences and the specific variable region. We will sequence the variable region PCR products and the DNA sequences will be entered into an online database which will allow us to identify the bacteria. By identifying LAB in cherry wine, winemakers may be able to determine how to use LAB to enhance the final flavor of wine and discourage growth that contributes to spoilage of wine.

Derek Janssens  
Faculty Mentor: Merritt Taylor, Biomedical Science

The discovery of new signaling pathways that regulate neural stem cell differentiation into glia.

In the developing nervous system the Notch signaling pathway is known to be necessary and sufficient for astrogliogenesis, the process by which neural stem cells divide and mature into astrocytes. However, the mechanism of how Notch regulates this process has not yet been characterized. Our lab is examining whether Notch controls the expression of the genes *NFIA* and *Sox9* which are known to regulate astrogliogenesis. These candidate genes were selected because their DNA sequences contain characteristics that are indicative of Notch effectors. A low-cost, effective method of Quantitative Polymerase Chain Reaction was developed in order to study the relative abundance of gene expression in Notch-deficient mice. We found that in the developing central nervous system the disruption of Notch signaling correlates with a significant decrease in both *NFIA* and *Sox9* gene expression. In order to insure that this trend is reflected at the protein level we are performing fluorescence microscopy utilizing anti-bodies targeting the NFIA protein. A Chromatin Immuno-Precipitation assay will also be used to determine if the Notch complex actually binds to the NFIA and Sox9 DNA sequences, this will establish whether Notch directly regulates these genes. The potential discovery of this novel signaling pathway will be an exciting advance in the understanding of how neural stem cell differentiation is regulated.

Kevin Maupin  
Faculty Mentor: Matthew Hart, Chemistry

Novel Indane Derivatives as Regulators of TAAR Activity

The goal of this project was to synthesize and test novel TAAR regulators. Various aminoindane derivatives in the literature have been shown to be potent agonists or antagonists for the TAAR receptor. By testing different, but similar structures more potent agonists and antagonists could be uncovered. This, in turn, would allow more thorough research of the biological activities involved with the receptor. Developing these compounds could therefore lead to advancements in the treatment of patients with thyroid hormone related diseases. The following work in progress reports the synthesis and trouble shooting involved for the formation of novel indane derivatives and their subsequent regulatory behaviors with the TAAR-1 receptor. 5-Hydroxy-1-indanone underwent a copper coupling reaction with 6 equivalents of phenyl boronic acid to produce 5-phenoxy-1-indanone (72% yield). A grignard addition-elimination sequence gave (*Z*)-5-phenoxy-1-phenylindene (69.7% yield) using phenyl-magnesium-bromide and p-Toluene-Sulfonic Acid. An attempt was made to do a hydroboration with sodium borohydride and boron tri-fluoride followed by an amination with 1.25 equivalents hydroxyl-amine-O-sulfonic acid to give the desired aminoindane, however analysis of the reaction via <sup>1</sup>H NMR, GC/MS and IR shows that an oxidation and not an amination occurred at the 1,2 carbon-carbon double bond. Repeated trials of the reaction show the same result. An alternative route was attempted via a mesylation of the alcohol group in order to allow a subsequent SN<sub>2</sub> substitution with sodium azide, however all reaction conditions have shown negligible, if any, mesylation activity. In order for the regulatory behaviors of the compound to be examined, a suitable synthesis of the desired amines needs to be discovered.

Elise Miller

Faculty Mentor: Martin Burg, Biomedical Sciences

### Determination of Epitope-Labeled Hdc Gene Expression in Transgenic Flies of *Drosophila*

Histidine decarboxylase, or HDC, is a protein that catalyzes the synthesis of histamine from histidine. Present in both vertebrates and invertebrates, *Hdc* functions in both the peripheral and central nervous systems of the fruit fly. Mutations in the *Hdc* gene cause visual and behavioral abnormalities. Epitope-labeled Hdc transformant flies were created by injecting a newly constructed transgene, containing the promoter of Hdc fused to the eGFP protein (enhanced green fluorescent protein), into fly embryos. This new transgene should serve as a tool in understanding the processes involved in the development of histamine-containing cells in the nervous system as well as allow the identification of histaminergic cells in living tissue, enabling the study of these cells *in vivo* using biochemical and electrophysiological tools. The work presented generated two transformant fly lines containing the pHdc-eGFP transgene, one line with the transgene on the second chromosome and the other line with the transgene on the third chromosome. An inverse polymerase chain reaction (iPCR) approach was used to characterize the specific genetic location for the transgene in each of the transformant lines obtained. Analysis indicates that the transgene is located in separate and distinct locations in the fly genome, supporting the linkage analysis done earlier. Microscopic analysis of the transformant flies will reveal whether the level of eGFP expression directed by the Hdc promoter region used is sufficient to mimic the known position of histaminergic cells in the *Drosophila* CNS. Should eGFP not be easily detected in the transformant flies, further experiments such as RT-PCR and GFP immunocytochemistry will be carried out to see whether any GFP expression may be detected in these transformant flies.

Brandon Moblo

Faculty Mentor: Jason Crouthamel, History

### Trauma And Masculinity In France: 1914-1930

Masculinity has been viewed by scholars as a concept which was concerned with *becoming* as opposed to *being*. One could not achieve the state of being a man and become complacent. One needed to continuously prove one's masculinity to oneself, other men, and women.

With its emphasis on the core values of masculinity such as strength, duty and above all, courage, the First World War was seen in France as the ultimate test of manhood. However, confronted with the horrors of modern industrial warfare, men were put into a situation where they were bound to fail that test. This led to a gender crisis in France during the immediate post-war period.

Historians who have studied this crisis have focused on French women's resistance to reverting to their pre-war positions in the home after filling positions made by men fighting at the front and the threat that this posed to men and the traditional gender roles which they desired. However, I will argue that the post-war gender crisis was not solely caused by women resisting the authority of men, but also by the returning soldiers' inability to retake their pre-war positions of power. To support my argument I will use a large collection of primary sources such as soldiers' memoirs/letters, socio-political cartoons, and newspaper and journal articles. I will also use the available secondary sources concerning masculinity studies, shell-shock/emotional trauma, and the general war experience in France.

Dennis Nagelkirk  
Faculty Mentor: Ed Wong-Ligda, Art and Design

### Mural, Painting, and Art Education Project with African Refugees and the African Center of Grand Rapids

My Summer Scholars project is an Art Education project involving the African Community Center of Grand Rapids. The main goal was to design and create a large scale mural covering the 60' wide 2-story building using elements of rural African lifestyles. The project also entailed creating an Art-based ESL (English) class for the refugees.

Our first few weeks was spent getting to know Yaka Kamungi, the director of the organization, and the families that he helps. We were brought around to meet the refugees over the course of a couple of weeks. We wrote about our experiences in detailed logs which we emailed out to friends, family and prospective volunteers.

Along with fellow Art student, Carrie Schoenborn, we created an Art-based ESL class and headed up the programming for the Center. We purchased a variety of Art supplies and using pictures, colors, and activities we were able to teach English lessons using a creative, hands on approach. The refugees, called "clients", would come in regularly to learn English and to pick up food, and have Yaka translate their mail and bills.

Over the course of the month, myself and other artists, would draw characters to compile in a landscape mural suggesting the journey which the refugees have taken. The mural is a sort of narrative landscape with the left side of the building depicting rather universal, iconic, rural African lifestyles. As the eyes pan to the right, the narrative slowly shifts to Grand Rapids, complete with big city skyline and freeway overpass. The entire scene will be peppered with characters interacting and existing in everyday situations. While the left part of the narrative will focus on general African lifestyle themes, the right side will focus on all cultures-- a comment on the beautiful melting pot of cultures in Grand Rapids. This mural is meant to promote an optimism for the ever changing cultural make-up of West Michigan.

We are videotaping the experience as it unfolds and will likely compile the elements into a short documentary which we can use to publicize our efforts and promote the Center.

Connie Pan  
Faculty Mentor: Nicole Walker, Writing

### Kinana Hale: An Investigation of the Tropical and the Desert and How They Shape Our Notion of Identity and Self

My project is a series of creative non fiction writing which ranges from small bodies of writing that explore a simple idea or a simple moment to larger essays that contemplate more complicated ideas. The writing attempts to expand on the definition of the personal narrative within the genre of creative non-fiction by juxtaposing personal experience and research to demonstrate what Sandell Morse insists is desired: "Creative non-fiction seems to be filling a universal craving for what is theoretically true... Yet, something insides us craves a reality closer to home."

I combined my personal experiences of growing up on Maui, being removed from Maui and my numerous visits to the island combined with knowledge acquired through extensive research including but not limited to the Hawaiian language, Hawaiian history, monarchy, flora and fauna, geography, lifestyles and values of Maui and the social issues facing a multicultural community of such rich diversity.

I explore the idea of home using my unique perspective of the non-definitive and ever changing term, home. I try to express the value of home, the value of land and the value of tradition by exploring the moments in which I have felt at home in a geographical place, in a dwelling place, in a moment shared with another person, in a family recipe and how these experiences I try to capture in writing shape my notion of identity and self.



April Russell

Faculty Mentor: Shelly Smith, Mathematics

### The Puzzling Mathematics of Sudoku

Sudoku is the latest craze in puzzles, and is played by entering the digits from 1 to 9 to complete a partially filled 9x9 grid so that each digit appears exactly once in each row, column and 3x3 subgrid. There are numerous game variations, each of which has additional restrictions. The focus of my research was to investigate a few of these variations, for example, Sudoku X, where the entries on each of the main diagonals must be distinct. Another variation, Rainbow Sudoku, has nine additional colored regions which wrap around the board in a torus fashion, each of which must also be distinct. I have developed various algorithms for creating Sudoku boards which satisfy the additional conditions, and found a minimal set of operations for each set of boards generated which form an equivalence relation.

There are roughly  $6.7 \times 10^{21}$  different Sudoku boards, a value which has only been calculated through the use of computers. While the total number Sudoku X boards remains an open question, I have been able to determine the number of distinct diagonalizations using topics from discrete mathematics, such as permutations with restricted position and rook polynomials. Future areas of research include determining whether each diagonalization can be extended to a completed board, and to how many completed boards each diagonalization may be extended.

Kyle Schneider

Faculty Mentor: David Leonard, Chemistry

### Mutation of the active site carboxy-lysine of OXA-1 $\beta$ -lactamase results in deacylation-deficient enzyme

$\beta$ -lactamases hydrolyze penicillin, cephalosporin and carbapenem  $\beta$ -lactam antibiotics. The class D  $\beta$ -lactamase OXA-1 has a catalytic serine (position 67) thought to be deprotonated and thereby activated by a carboxylated lysine (position 70). We have made several mutations of OXA-1 at both Lys70 and Ser67 to help elucidate the role of these two critical residues in the catalytic mechanism. We have used the fluorescent substrate BOCILLIN FL to demonstrate that the Lys70 mutant can acylate but is severely impaired for deacylation of various substrates. Interestingly, deacylation rates vary depending on the identity of substituting residue, from  $t_{1/2} = 30$  min for Lys70Ala to undetectable deacylation for Lys70Asp. We have used tryptophan fluorescence spectroscopy to confirm that these results are applicable to natural (i.e. Non-fluorescent) substrates.

Carrie Schoenborn  
Faculty Mentor: Jill Eggers, Art and Design

### Mural, Painting, and Art Education Project with African Refugees and the African Center of Grand Rapids

In starting the project at the African Community Center, we spent time getting to know the center, the people who use it and how it is used. We began by simply being at the center and helping with whatever needed to be done. We answered phones, met people who came and cleaned the donation closet. Yaka, the director, brought us to visit many of the families that use the center and we talked to both the refugees and Yaka about the experiences these individuals had coming to the United States; the difficulties they faced in Africa, on their journey to the U.S. and continue to face today. We also did research about Africa and the refugee experience. Soon we began teaching ESL and art classes and got to know many of the families quite well. The next step was to use the knowledge we gained of the center to recreate the interior of the center. We hoped to make it more friendly, inviting and useful for all those who use it. We repainted the walls and created interactive maps of Africa and the United States to help individuals have a fun way to learn and talk about where they came from and where they are now. In addition, we rearranged the rooms to create a “kids’ room,” allowing the adults to focus on their classes. The kids’ room was then repainted with a sunset and the silhouette of an African landscape and animals. This allows the kids to talk about Africa and reminds them of where they came from. The silhouette is also painted in chalk paint, encouraging the children to interact with each other by drawing directly on the walls. We documented the entire process through photos and film with the hopes of using these materials to inform others of the center’s vital programs and their importance to the greater Grand Rapids community through the media and other contacts.

Andrew Sisson  
Faculty Mentor: Peter Wampler, Geology

### Evaluation of Spring Flow, Bacterial Contamination, and Distribution of Fresh Water Resources in the Vicinity of Verrettes, Haiti

In order to gain a better understanding of the fresh water springs used as the primary source of potable water in the mountains surrounding Verrettes, Haiti we conducted a study mapping, sampling, and analyzing several springs in the region. Turbidity, pH, salinity, conductivity, temperature, and flow volume were recorded at each spring to determine if any of these parameters can be correlated with the presence or absence of E-coli. We sampled both capped and uncapped springs to help determine whether capping improves the quality and safety of the water. 27 springs were mapped using handheld GPS and imported into an ArcMap 9.2 data layer. GPS elevations suggest spring locations may be elevation dependent. Further analysis is being done to determine the significance of elevation and rock structure at spring locations, and may aid in locating additional springs.

Through a Haitian interpreter, 31 questionnaires were completed by people filling water containers at selected springs to provide data regarding the health and number of people relying on the springs, and their perceptions of the drinking water. More surveys are currently being conducted. Once all surveys have been conducted, data will be compiled and summary statistics calculated.

Two water samples were taken at most springs for bacterial analysis. One sample was submitted to a local hospital for bacterial analysis and a duplicate sample was cultured using Coliscan Easygel. Of the 27 springs sampled, 16 were capped and 11 uncapped. Based on preliminary results from 21 samples, 52% of the springs analyzed by the hospital were deemed “non-acceptable for consumption”; 50% of the capped and 44% of uncapped springs did not meet acceptable drinking water standards.

M. Ben Stacey

Faculty Mentors: Carl Ruetz III and Ryan Thum, Annis Water Resource Institute

### Gene Flow of Round Gobies in Lake Michigan

Population genetic analyses can provide important insight into the role that evolutionary processes may play in facilitating the invasion of non-native species. I am examining population structure of the non-native fish species, the round goby (*Neogobius melanostomus*), in Lake Michigan. Specifically, I hypothesize that populations of round gobies occurring at different pier heads along eastern Lake Michigan represent discrete reproductive units with low gene flow among them. I collected 30-40 round gobies from each of 9 pier heads spanning a distance of nearly 370 km. I extracted DNA from the caudal fin and amplified 7 microsatellite markers for each fish. I am currently analyzing the microsatellite data using several methods ( $F_{ST}$ , Analysis of Molecular Variance, and Bayesian assignments) to compare genetic diversity and test for significant population structure among pier head populations.

Norrissa Thomas

Faculty Mentor: Daniel Bergman, Biomedical Sciences

### The Distribution of Crayfish Species within the Tributaries of the Grand River, Michigan.

Invertebrate animals make up the greater part of the world's biological diversity and are present in about all habitats in the world, where they perform essential ecological functions. Their survival is fundamental to the maintenance of ecosystems. Large numbers of invertebrate species are under severe threat of extinction, or are already extinct due to the extreme transformations that habitats have suffered due to human activities. Crayfish are one such important invertebrate under pressure and applying pressure to other organisms in an ecosystem. Crayfish are keystone species in most aquatic systems. Keystone species are those species that are most important in shaping the total ecology of a system. Crayfish are often keystone species because they are an important resource for many other animals and can affect species diversity and abundance directly. Specifically, crayfish can adversely affect systems by removing plants from an aquatic system making the water turbid, and prey on fish eggs reducing their numbers. There are over 415 species of crayfish in North America. It is recognized that at least eight species of crayfish are found in the state of Michigan. For these reasons, crayfish are an important organism to study. In our study, we found three species, *Orconectes virilis*, *O. propinquus*, and *Cambarus diogenes*, in the tributaries of the Grand River. An invasive species, *Orconectes rusticus* – “rusty crayfish”, was found south of the Grand River and its tributaries, but not in the Grand River water drainage. Our results indicate that the Grand River’s crayfish population is diverse for Michigan and at least at this time seems to be safe from the invasive crayfish species, *Orconectes rusticus*.

Leonard Van Gelder  
Faculty Mentor: Shari Bartz, Movement Science

### The Affect of acute Static, Dynamic or No Stretching on Agility Performance

Many components play a role in athletic performance, not the least of which are strength, power, flexibility, sprint performance, jump height and distance, and agility. Agility in particular is an important component of athletic performance in many sports. The objective of this study is to determine whether performing static, dynamic, or no stretching prior to performing an agility based activity has a positive, negative, or no effect on an individual's performance.

Twenty subjects consisting of male and female collegiate and recreational basketball athletes volunteered for the study. Subjects were randomly assigned to one of three intervention groups: static, dynamic, or no stretching. Each subject completed a ten minute warm-up jog followed by an eight and half minute stretching intervention if assigned to either the dynamic or static stretching groups. The non-stretching group went directly to the agility test following the jog. Each subject then completed 3 trials of the 505 Agility test with 2-5 minutes rest between each trial. Analysis of variance (ANOVA) was used to determine statistical significance. Preliminary results utilizing 20 subjects thus far have indicated no significant difference between the three intervention groups. However, there was a trend towards faster times for the dynamic stretching group, but this has not been revealed as significant and cannot be determined until the full population size has been reached. Sixty subjects is the optimal population number. No conclusions can be made at this time since the subject target size has not been achieved.

Kirk Wyatt  
Faculty Mentors: Lauri Witucki and Felix Ngassa, Chemistry

### Structure/function studies of an enzyme involved in bacterial resistance to penicillin-class antibiotics

Derivatives of 3-aminoquinazolinone and 2'-deoxyguanosine were synthesized as potential protein tyrosine kinase (PTK) inhibitors. PTK inhibitors are of important significance because of their ability to act as anticancer agents.

The 3-aminoquinazolinone derivatives were formed by reaction with aldehydes to give imine products and with acid chlorides to give amide products. In all, eleven 3-aminoquinazolinone derivatives were synthesized.

Before synthesis of the 2'-deoxyguanosine derivatives, the hydroxyl groups of the sugar moiety first had to be protected (this was accomplished with the *tert*-butyl dimethyl silyl protecting group) and then a sulfonate had to be introduced at the O6 position. Once the sulfonate had been introduced, its displacement by amines and alcohols via an S<sub>N</sub>Ar pathway gave the desired products which were purified via chromatographic methods. Two alcohols as well as a variety of amines were used in the S<sub>N</sub>Ar reactions to give a total of six 2'-deoxyguanosine derivatives.

The inhibition studies which will determine the activities of the compounds with the target kinases will be done within the coming weeks.

Sandi Xhumari

Faculty Mentor: William Dickinson, Mathematics

## Equal Circle Packing on a Flat Torus

What is the optimal way to pack equal circles into a container? A packing of equal circles into a container is an arrangement of circles such that any circle does not overlap another or the boundary of the container. A packing is optimal if it covers more of the space inside the container than any other packing. For example, packing equal circles into squares is a well studied mathematical problem. In 1963, Graham found the optimal packing of six equal circles in a square.

In this presentation, we will explore packing six equal circles into a container called a triangular flat torus. We will show you the optimal packing in this situation and how we proved it to be optimal. The proof uses tools from several different mathematical areas including graph theory. Using numerous pictures, we will introduce you to all the basic concepts (including the notion of a triangular flat torus, an optimal packing and the graph of a packing) and guide you through our proof.