2012-2013
Undergraduate Research Award
Scholars and Abstracts

Danielle Adekunle, Biological Sciences

Christina Animashaun, Media and Communications and Visual Arts

Yevg**eniy Arber**, Information Systems

Aryana Arsham, Physics

Comfort Azubuko-Udah, English

Zach Bailey, Chemical Engineering

Kelin Brace, Biochemistry

Brian Brown, Biochemistry

Caroline Brunschwyler, Information Systems

Lauren Bucca, English

Matthew Buchanan, Mechanical Engineering

Nathaniel Buechler, Political Science

Robert Burton, Chemical Engineering

Grace Calvin, Psychology

John Chavis, Chemistry

Kathryn Cronise, Biology and Mathematics

Sonia Dalal, Biological Sciences

Soutry De, Physics

Andrew Dillon, Chemical Engineering

David Eisen, Computer Engineering

Nathan Fastman, Biochemistry

Julian Feild, Computer Engineering

Thomas Hervey, Aneep Bindra, and **Zachary Hullihen**, Information Systems, Computer Science, Computer Science

Hannah Kurlansky, English

Asif Majid, Interdisciplinary Studies

Gabriella Marano, Biological Sciences

Kelley Mason, Environmental Studies

Adam Mayer, Biological Sciences

Elizabeth Milligan, Music

Alexander Morrow, Computer Science

Kimchi Nguyen, Biochemistry

Michael Nguyen, Biological Sciences

Uchenna Okoro, Biochemistry

John Packard, Chemical Engineering

Adam Page, Mechanical Engineering

Julius Patellis, Biochemistry

Christopher Paymon, Mechanical Engineering

Megan Pejsa, Psychology

Nathan Scavilla, Physics

Matthew Schley, Environmental Science

Reema Sharma, Biochemistry

David Sweigart, Physics and Mathematics

Ke Tang, Political Science

Samiullah Wagan, Biological Sciences

Andrew Wright, Music

Christopher Yankaskas, Chemical Engineering

Shannon Zik, Biological Sciences

Danielle Adekunle
Biological Sciences
"IL-1β Induced Inflammation and MYC Oncogene Activation: A New Model for Colon Carcinogenesis"
Faculty Mentor: Charles Bieberich
Expected Graduation Date: Spring 2013

Preclinical models that recapitulate the features of human colorectal cancer (CRC) development are central to understanding the mechanisms underlying tumorigenesis and malignancy. Inflammatory cells are frequently observed near invasive tumors suggesting that inflammation may mechanistically contribute to tumor metastasis. We propose to develop a model that combines inflammation with expression of a potent onco-protein to achieve inflammation. Inflammation is typically linked with development of colorectal cancer in patients suffering with Inflammatory Bowel Disease (IBD). Colon- and prostate-specific expression of the cytokine IL1β will induce an inflammatory response in the epithelial cells of the colon. Teto-IL1β mice will be crossed with Hoxb13-rtTA mice to generate teto-IL1β/Hoxb13-rtTA mice. We anticipate that performing long-term induction studies inflammation in these mice will lead to the development of malignant tumors. A preclinical CRC model that metastasizes has the potential to shorten drug-development timelines to expedite clinical entry of new therapeutics. This may diminish the time from compound discovery to clinical entry, and reduce CRC-associated morbidity and mortality, providing new hope to individuals suffering with this disease.

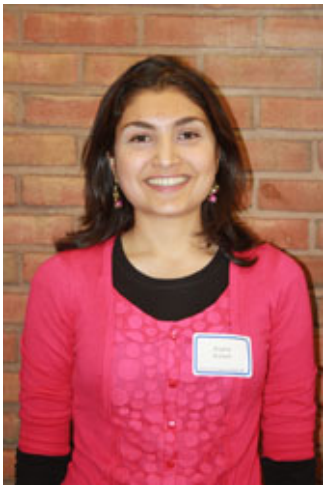
Christina Animashaun
Media and Communication Studies and Photography
"My Gray Life: Performing for the Spectator"
Faculty Mentor: Mark Durant
Expected Graduation Date: May 2013

Through performance, I seek to create a work in which the meaning is the audience in order to critically analyze spectatorship encountered through the arts in a contemporary setting. I will alienate myself from society by covering my body with gray body paint and only wear clothing that is black, white, or any hues in between. Focusing on urban environments, I will walk to and from definitive landmarks in Baltimore City, Washington D.C., New York City, and Philadelphia. By creating a physical barrier between myself and the surrounding populous, I will create the wall that divides the performance and the audience. However, in each city I will fully communicate with individuals as a bystander walking through the city would, despite my physical barrier. Resulting interactions and confrontations will be recorded by a sound device hidden on my person and will be documented with pictures from disposable cameras. These two forms of

documentation will be synced together to create media that allows for constant sensory awareness of the people who are in the performance as well as displays established archival visual images.

Yevginiy Arber
"Making Web Design Accessible through Haptic Technologies"
Faculty Mentor: Ravi Kuber
Expected Graduation: May 2013

While assistive technologies are valuable to individuals with disabilities, research suggests that challenges continue to be experienced when interacting with graphical user interfaces. Advances in assistive technologies have enabled individuals who are blind to access programming compilers and software-development environments. Screen readers translate the content from graphical interfaces into speech-based format, enabling the user to listen to the programming code entered into the compiler. However, browsing the output of the compiled code can pose challenges, as key information regarding the position of interface objects is omitted from presentation. As a result, blind programmers and web designers often rely on sighted colleagues and peers to evaluate the aesthetic design of interfaces. Haptic (touch-based) technologies have been designed to improve non-visual access to graphical user interfaces, by providing many of the structural cues which are inadequately presented by speech-based assistive devices. This research focuses on evaluating a haptic tool, by determining its efficacy when used by blind web designers, in order to identify whether individuals who are blind can develop web interfaces which are aesthetically pleasing without the assistance of sighted individuals. After undertaking a guided literature review, interviews will be conducted with up to ten blind web developers. Semi-structured questions will be presented, and transcripts analyzed to reveal the current problems faced with existing technologies. An observational study will then be conducted with up to six blind web designers from the Baltimore/DC areas, to determine the efficacy of using the haptic tool in the process of web design.



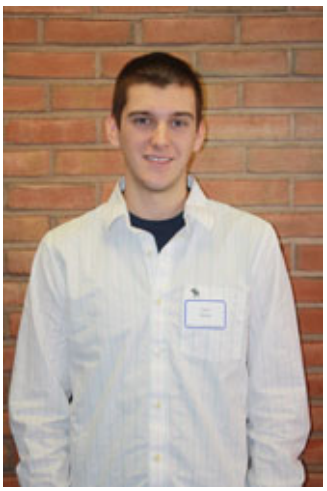
Aryana Arsham
Physics
"The Radiative Deceleration of Large-scale Extragalactic Jets at Large Cosmological Redshifts"
Faculty Mentor: Markos Georganopoulos
Expected Graduation Date: Spring 2013

Radio galaxies are powered by twin relativistic jets of plasma that originate from accretion of material onto the super massive black holes in the center of their host galaxy. The jets propagate out to Mpc scales, terminating at the radio lobes. Observed X-ray

emission from these jets can be explained as Inverse Compton scattering off the CMB (Cosmic Microwave Background), provided the large-scale jets are highly relativistic (bulk Lorentz factor Γ »10-20). If this is the case, the jets should maintain an approximately constant X-ray brightness at large distances from us (distances are measured by the redshift z of the spectral lines observed in the host galaxy), because the energy density of the CMB increases with redshift as (1+z)4. However, observations of jets at high redshifts (z of 2-5), have failed to reveal the anticipated population of bright x-ray jets. This research will evaluate the possibility that the increased energy density of the CMB produces a decelerating force, through the process of inverse Compton scattering, that is significant enough to slow down the jet and reduce its initial high Lorentz factor. In this case, and if the jets decelerate substantially, no significant X-ray emission due to inverse Compton scattering of the CMB is anticipated from the large-scale jet. The goal of the research is to derive realistic radiative deceleration profiles for jets with (i) realistic electron energy distributions and (ii) a range of plausible baryon loading factors in the jet. Mathematically, I anticipate a system of two coupled non-linear ODEs. At first, I will advance a set of simplifying assumptions and solve these ODEs analytically. I will then proceed to the numerical solution of the general case including considerations of observationally driven electron distributions and a range of plausible jet baryon loading. Eventually, I will compare my results to quasar observations and evaluate their astrophysical relevance.

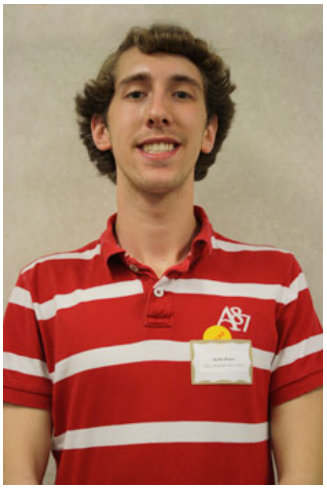
Comfort Azubuko-Udah
English, Psychology Minor
"Colonial Discourse in Nigerian Novels by Women Writers The Lingering Effects, and the Move towards Westernization"
Faculty Mentor: Dr. Jessica Berman
Expected Graduation Date: Fall 2013

This research will explore the lingering effects of colonization and the move towards westernization as represented in Nigerian novels by women authors. I will carry out this analysis by examining novels by such authors as Flora Nwapa and Buchi Emecheta using a combination of both post-colonial and feminist theories. I will examine a range of books set in colonial Nigerian society in order to effectively examine the colonial discourse which permeates these works. I will also be looking at some of the major historical events that took place from the colonial era until shortly after Nigeria gained independence, such as the civil war and the series of riots preceding it. I am interested in looking at how and why grand, public history is retold on a personal level and becomes very much private. Thus, looking through the filter of the female Nigerian will also allow me to explore the domestication of colonization, and Nigerian history in general.



Zach Bailey
Chemical Engineering
"Investigating the Effects of Aβ's Interaction with the G0 Subunit of G-protein Coupled Receptors on Electrophysiological Properties and Calcium Transport in a Rat Hippocampal Neuron"
Faculty Mentor: Dr. Mariajose Castellanos
Expected Graduation Date: Spring 2013

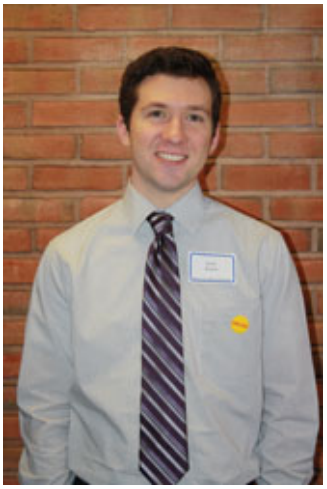
We are using a computational model to explore the complex interactions between Beta-Amyloid (Aβ) and a neuron that has proven to be experimentally difficult to resolve. Aβ is a 39-43 amino acid peptide that originates through mutations in the genes for the Amyloid Precursor Protein. One of the most researched and widely accepted hypotheses about the etiology of Alzheimer's disease is the Aβ cascade hypothesis, which postulates that an increase in Aβ peptide production and aggregation disrupts normal neuronal functions including ion homeostasis, membrane permeability and effects on specific ligands resulting in apoptosis (cell death.) We hypothesize that Aβ causes aberrant activation of G0 subunit of G-protein coupled receptors (GPCR), resulting in neuronal dysfunction. This hypothesis will be tested through simulation of a C++ based neuronal model. The current model lacks some potentially influential mechanisms describing cell surface properties and signaling pathways that will need to be considered through kinetic formulation. I will adjust the current model to include the Aβ interaction with the Go subunit of G-protein coupled receptors. I will then use this model to investigate the changes in electrophysiological properties and calcium response due to Aβ exposure at increasing concentrations. The incorporation of this interaction will take us a step closer towards a better understanding of how Aβ interacts with the neuron. We believe that a better understanding will yield necessary information for improved drug design to mitigate Alzheimer disease progression.



Kelin Brace
Biochemistry and Molecular Biology
"Synthesis of C-nucleosides and their Biological Implications"
Faculty Mentor: Dr. Katherine Seley-Radtke
Expected Graduation Date: Spring 2013

Modified nucleosides have been intensely studied for their ability to alter normal biological functioning, and are increasingly being considered as important medicinal candidates. In particular, the deazapurines have been investigated because of their antimicrobial, antiviral, and anticancer potential. These particular analogues show promise because their structure is similar to that of the natural nucleosides, and their carbon-carbon glycosidic bond is impervious to hydrolytic and enzymatic cleavage, which is a serious problem for many nucleoside drugs. In the past year, our laboratory has identified a new lead

compound with strong potential as a cancer therapeutic. The focus of this investigation will be to synthesize several additional modified pyrimidine derivatives to improve on the activity pyrimidine scaffold identified previously. This project will have a more narrow focus than last semester's, because I have the benefit of a well characterized lead. The synthesis of the derivatives will be accomplished through the use of state-of-the-art carbon-carbon coupling reactions that have been developed over the last year. Once the compounds have been synthesized and fully characterized to confirm their structure and purity, their biological activity will be assessed through the use of biological screening to be carried out by our research group's biological collaborators in Belgium and the USA. The results of this study will expand our library of modified pyrimidines compounds and provide new insight into the biological importance of the identified scaffold as potential drug candidates as well as their mechanism of action.



Brian Brown
Chemistry
"Synthesis of a Novel Flexible Nucleotide Antiviral Agent."
Faculty Mentor: Katherine Seley-Radtke
Expected Graduation Date: Spring, 2013

As viral resistance to current nucleoside based chemotherapies continues to develop due to the accumulation of point mutations in polymerase binding pockets, there is an ever-increasing need for novel therapeutics against Human Immunodeficiency Virus (HIV), Hepatitis C Virus (HCV) and other RNA viruses that are capable of overcoming these escape mutations. The aim of this project is to synthesize and test a flexible nucleotide viral polymerase inhibitor, Flex-4'-azido GTP, for the treatment of HCV. The parent compound 4'-azido GTP has been a potent inhibitor of HCV's viral polymerase NS5B. Recently, however, mutations have accumulated in the NS5B binding pocket which are beginning to render 4'-azido GTP inactive due to the presentation of steric and electronic barriers. Previous work done in the Seley-Radtke laboratory has shown that introducing conformational flexibility in the purine nucleobase by separating it into its pyrimidine and imidazole heterocycles can increase binding affinity and allows for access to secondary amino acid residues in the binding site by avoiding these unfavorable interactions and sampling residues previously not involved in the mechanism of action. By coupling this novel flexibility with the scaffold of previously-developed NRTIs, a new class of antiviral drugs will be created that can inhibit the progression of the viral lifecycle while being able to overcome viral resistance.

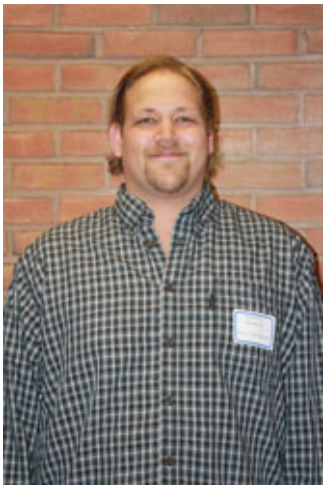
Caroline Brunschwyler
Information Systems
"Using Mobile Technologies to Support Procedural Memory for Individuals with Executive Functioning Deficits"
Faculty Mentor: Ravi Kuber
Expected Graduation Date: Fall 2012

The ability to plan, organize and execute tasks is often taken for granted. However, for individuals with executive functioning deficits, challenges with procedural memory, may directly impact the ability to care for oneself or to live independently. The aim of this study is to examine whether individuals with executive learning deficits can interact with a mobile application to aid them to rehearse the sequence of steps within a common task (e.g. making a bed). The user will be asked to interact with the application to place each step in its respective order within the sequence. The research will examine whether skills developed from interacting with the mobile application can aid them within a real life situation. The long-term goal is to help individuals with cognitive disabilities to perform common tasks without the assistance of caregivers, enabling them to live more independently.

Lauren Bucca
English
"St. Cuthbert and Pilgrimage 664-2012 AD: The Heritage of the Patron Saint of Northumbria"
Faculty Mentor: Dr. Gail Orgelfinger
Expected Graduation Date: May 2013

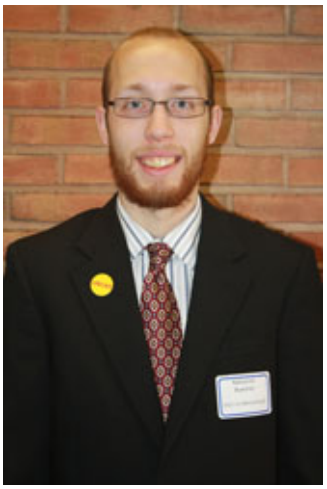
The purpose of this research is to shed light upon pilgrimage during the Middle Ages, a time when arduous journeys were a part of daily life. This study concerns both the literal and figurative aspects of pilgrimage during the Middle Ages, as well as the cultural significance of St. Cuthbert, patron saint of Northumbria. St. Cuthbert, a seventh-century saint, was himself a traveler whose shrine at Lindisfarne was and is a popular pilgrimage site. This research will focus primarily on the travels of St. Cuthbert across Northumbria, in particular his journey from Melrose, Scotland to Lindisfarne, England. This journey has become known as St. Cuthbert's Way and has been traveled by pilgrims from its inception to the present day. During the summer of 2012, my research will bring me to St. Cuthbert's Way so I can elucidate the cultural heritage of St. Cuthbert to an audience unfamiliar with pilgrimage during the Middle Ages. St. Cuthbert, as a saint who has drawn pilgrims to Lindisfarne from the seventh to the twenty-first century, offers a window to understanding both medieval and contemporary perceptions of pilgrimage. In addition to researching secondary sources on medieval travel, such as those reflected in illuminated manuscripts of St. Cuthbert's Life, my observations will include interviews and photographs. The final essay will focus on medieval and modern cultural ideas of pilgrimage. The imprint of St. Cuthbert upon

Northern England is just as vibrant as it was in the seventh century—for 1300 years St. Cuthbert has drawn pilgrims to his shrine in Lindisfarne and will continue to do so, for the significance of pilgrimage and travel is just as relevant and meaningful today as it was in the Middle Ages.



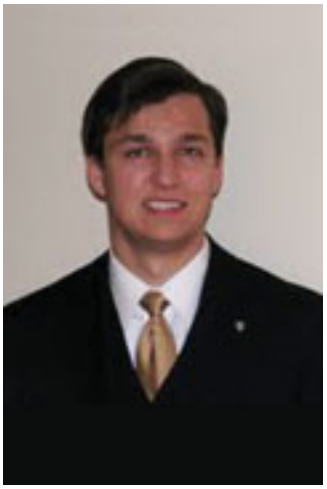
Matthew Buchanan
Mechanical Engineering
"Characterization of Carbon Nano-tube Infused Fiber Reinforcements"
Faculty Mentor: Dr. Marcus Zupan
Expected Graduation Date: December 2012

Fuel efficiency and passenger safety are paramount design constraints placed upon modern vehicular systems; these design constraints often play against each other in a negative fashion with passenger safety taking precedence, thus leading to designs that waste precious and environment-destroying fuels. There exists an inherent global need for multifunctional structural materials that are both cost effective and weight/volume efficient. The MicroMaterials Characterization Laboratory (MMCL) at the University of Maryland, Baltimore County (UMBC) in collaboration with Lockheed Martin's Applied NanoStructure Solutions, LLC (LM ANS) are currently working on characterizing Carbon Nanotube Structure (CNS) infused fiber composites which aim to satisfy this need. The target of this research is to characterize micromechanical behavior of CNS-infused fiber reinforcements. Emphasis will be placed on characterizing the mechanisms that govern the performance of CNS-modified conventional filaments of carbon and glass substrates considering key manufacturing processes. Characterization of the materials behavior will be achieved by classifying the fiber defects by location, size, failure mechanisms, and cross-phase coupling. Embedded single-filament testing will be carried out in order to achieve characterization and identification of failure mechanisms occurring in the sub-components and CNS-fiber/epoxy matrix interface. Direct observations of the stress state around and across the engineered fiber-CNS-matrix interface under uniaxial tensile loading will be acquired by photo-elastic and optical strain measurement techniques. This characterization will assist LM-ANS to transition to a scalable production of CNT-infused fibers, which currently does not exist at any facility.



Nathaniel Buechler
Political Science and International Affairs
"Neo-Corporatism, American and German Insurance Companies, and the 2008 Financial Crisis: The Relations between Western States and their Corporations"
Faculty Mentor: Dr. Carolyn Forestiere
Expected Graduation Date: Spring 2013

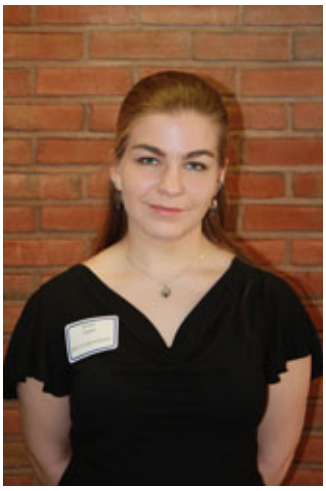
This research project will examine why German insurance industries were more sheltered from economic hardship in the 2008 economic crisis relative to their American counterparts. The project suggests that Germany's extensive use of Neo-Corporatism is a primary explanation to German superior performance. Neo-Corporatism is a system of interest group aggregation whereby government, corporations, and labor unions work together to find consensus for economic policies. My working hypothesis is that while the American system of interest group pluralism protected American firms, corporatism protected German firms better. I will investigate the difference between Allianz, a large German insurance company and its counterpart in the United States, AIG. Neo-Corporatism will be measured by (1) a certain degree of homogeneity inspired by Mancur Olson, and (2) the type of interaction between each insurance company, Allianz and AIG, and their respective government and labour unions in their countries. News articles, scholarly sources, and other pieces of literature will provide insight into the 2008 financial crisis. Budgetary information, government bailout packages, and other legislation from Germany and the United States will supplement this information. Using these two main blocks of sources, my goal is to identify specific interactions that Allianz and AIG had with their separate governments and their separate labour unions. In sum, Neo-Corporatism could be the key factor explaining why Allianz continues to thrive while AIG failed.



Robert Burton
Chemical Engineering
"Treatment of Tetracycline Antibiotics in Water Using the UV-H2O2 Process"
Faculty Mentor: Dr. Lee Blaney
Expected Graduation Date: Spring 2015

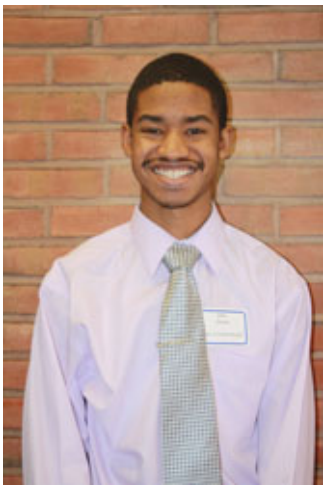
Tetracycline antibiotics are widely prescribed; these compounds are also employed as veterinary drugs. As a result of high consumption, these pharmaceuticals have been detected in water supplies around the world. Furthermore, tetracycline-resistant genes have been detected in wastewater effluent, which also contains low concentrations of tetracycline antibiotics. This coincidence heightens concerns that the presence of antibiotics in water supplies may contribute to an increase in antibiotic resistant bacteria. For that reason, we plan to investigate the ability of the ultraviolet hydrogen peroxide (UV-H2O2) treatment process to

effectively transform tetracycline antibiotics (e.g., tetracycline, chlortetracycline, oxytetracycline, demecycline) into benign compounds, thereby, reducing the potential for developing antibiotic-resistant microorganisms. In particular, we will study the transformation efficiency and transformation kinetics of tetracycline antibiotics with hydroxyl radicals produced by UV irradiation of hydrogen peroxide. Experimental solutions containing tetracycline antibiotics and other background water quality constituents will be spiked with a specific concentration of hydrogen peroxide and continuously pumped through a UV reactor. Samples will be taken at specific times. These samples will be analyzed for tetracycline concentrations using high performance liquid chromatography (HPLC). Furthermore, using liquid chromatography mass spectrometry (LC-MS), we will determine the transformation products generated by hydroxyl radical driven reactions with tetracycline antibiotics. Ultimately, the goal of this research is to describe the removal efficiency of tetracycline antibiotics in the UV-H2O2 process using reaction kinetics and to identify the reaction products created during treatment.



Grace Calvin
Psychology
"Acculturation Stress, Psychological Well-Being, and Parenting among Chinese Immigrant Families"
Faculty Mentor: Dr. Charissa Cheah
Expected Graduation Date: May 2014

Over one third of America's immigrant population is from Asia and a large and growing portion are of Chinese descent. It is crucial that the acculturation experiences of this growing population are studied and understood in order to promote positive, and decrease negative, outcomes in these families. Although prior research shows that immigrant parents' acculturation experiences and psychological well-being are associated with their parenting styles, the specific pathways among these variables are not well understood. To extend the existing literature, the current project aims to understand the predictive role of the acculturation experiences of Chinese immigrant mothers on their parenting styles and practices towards their young children, through their psychological well-being. We predict that a negative acculturation experience will be positively associated with poorer psychological well-being, which will, in turn, be associated with more maladaptive parenting styles and practices. Findings from this study will shed light on risk and protective factors in the parenting of the children of Chinese immigrants.



John Chavis
Chemistry
"Determining the Effect of Dithiolethione Compounds on the Activity of Human Glyceraldehyde-3-phosphate dehydrogenase"
Faculty Mentor: Dr. Elsa D. Garcin
Expected Graduation Date: Spring 2014

Dithiolethione compounds, like anethole dithiolethione (ADT) have chemopreventive, cytoprotective, and antimitogenic effects. The chemopreventive effects are thought to be mediated by the activation of antioxidant response elements and of the tumor repressor PP2a. We have shown that ADT interacts with the glycolytic enzyme glyceraldehyde-3-phosphate dehydrogenase (GAPDH). Cancer cells usually exhibit increased glycolysis (Warburg effect) that generates ATP to meet their energy needs. Mounting evidence suggests that inhibition of glycolysis in cancer cells severely depletes ATP and may be an effective strategy in chemoprevention. We hypothesize that the chemopreventive effects of ADT may be in part due to inhibition of glycolysis via inhibition of GAPDH. Dithiolethiones can directly or indirectly modify cysteine residues in protein targets. GAPDH contains three cysteine residues that are susceptible to thiol-modifying agents. Therefore, we set out to examine how ADT affects GAPDH activity. Human GAPDH was overexpressed in bacterial cells and purified by ion-exchange and affinity chromatography. We measured the catalytic activity of GAPDH in the absence and the presence of ADT and showed a concentration-dependent inhibition of GAPDH catalytic activity by ADT. In order to determine the exact mechanism of ADT modification of GAPDH we are coupling site-directed mutagenesis with enzymatic assay, and mass-spectrometry.

Kathryn Cronise and
Gabriella Marano
"Identification of Genes Regulating Stem Cell Division in C. elegans"
Faculty Mentor: David Eisenmann
Expected Graduation Dates: Spring 2014, Spring 2013

The division of seam cells in C. elegans is analogous to that of human stem cells. They divide to give rise to another seam cell and a cell that differentiates. The genes responsible for this behavior are not completely understood. Our project aims to identify unknown genes that affect seam cell development and begin to characterize the roles that these genes play. We have a library consisting of 950 genes encoding transcription factors and we will be using RNA interference (RNAi) to reduce the function of these genes by feeding the worms E. coli that produce double-stranded RNA for a specific gene. The

presence of this double-stranded RNA in the worm's cells leads to the destruction of the normal message for that gene, thereby reducing the level of gene product. We will then screen for those genes that affect any characteristics of the seam cells, such as seam cell number, distribution, morphology or division pattern. After performing RNAi with every gene in the library, we hope to create a list of genes that affect seam cell development.

Sonia Dalal
Biological Sciences
"Determine the Mechanism CD80 Uses to Activate T-Cells and Induce Immunity in Individuals with Cancer"
Faculty Mentor: Dr. Suzanne Ostrand-Rosenberg
Expected Graduation Date: Spring 2013

Programmed Death Ligand-1 (PD-L1) is expressed by many tumor cells and increases tumor progression by binding to its receptor PD-1 on T-cells, thereby inhibiting T-lymphocyte activation and causing T-cell apoptosis. Cluster of Differentiation 80 (CD80), expressed by antigen presenting cells provides a potent costimulatory signal needed for T-cell activation by binding to T-cell-expressed CD28. We have recently identified another function for CD80 and shown that human cancer cells modified to express CD80 inhibit PD-L1 binding to its receptor, resulting in increased T-cell activation. To distinguish if tumor cell-expressed CD80 promotes T-cell activation by binding to CD28 and/or inhibiting PD-L1 we must construct a mutant CD80 that does not bind to CD28. We are generating a soluble CD80 mutant (sCD8096,97,99) because it is not feasible to inject cancer cells expressing CD80 into patients. Previous studies demonstrated that CD80 mutated at amino acids 96. 97, and 99 (CD8096,97,99) no longer binds CD28. To generate a mutant soluble molecule the sCD8096,97,99 gene was inserted into the pINFUSE-hIgG1-Fc vector. Mammalian cells are being transfected with the sCD8096,97,99 construct. sCD8096,97,99 will be purified and western blot analyzed and used in functional experiments to determine how CD80 restores T-cell activation.

Soutry De
Physics
"Design and Construction of a Liquid Helium Cryostat for use in Terahertz Spectroscopy"
Faculty Mentor: Dr. Michael Hayden
Expected Graduation Date: Spring, 2013

The need for electro-optic materials is becoming extensive due to their applications in optical signal processing and telecommunications. In Dr. Michael Hayden's research laboratory, these kinds of materials are studied by performing terahertz spectroscopy. This research will investigate electro-

optic crystals and their phonon composition using terahertz time-domain spectroscopy (TDS) over a wide temperature range (8K - 300K). Determination of the low-temperature phonon line widths and peak frequencies will help to identify the atomic and molecular motions responsible for these lattice vibrations. We anticipate that the amplitude and position of the absorption peaks will evolve as a function of temperature and that the peaks will become sharper as temperature is lowered. Such low temperatures can be achieved using helium gas. As a major part of this project, I will integrate a new closed-cycle helium cryostat into the THz-TDS system. I will then use sub-picosecond THz pulses, at a variety of temperatures to study the major THz absorption features of some important electro-optic crystals (DAST, alpha-BBO, and beta-BBO) used in the generation of THz radiation.

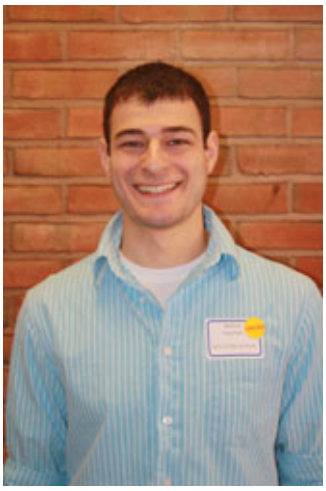
Andrew Dillon
Chemical Engineering
"Optimization of a Process: Are Algae-based Biofuels the Solution to the Energy Crisis?"
Faculty Mentor: Dr. Mariajose Castellanos
Expected Graduation Date: Spring 2013

With the price of crude oil steadily growing, a search for the next generation liquid fuel that can replace dependence on crude oil is essential. For some time corn and other plant-based biofuels have been in the forefront of this search, but scientists are discovering problems with these alternatives that cripple their sustainability. Recently, algae-based biofuels have entered the spotlight and are believed to be a potential alternative. While algae as an alternative fuel source is promising, little analysis of an industrial-sized plant has been performed. This research project will provide a critical analysis on whether a pilot algae-to-biofuel plant is currently feasible. The plant will be modeled with Aspen Plus, a powerful chemical process simulator. The unit operations that make up the basic pieces of a production plant will be included in the model and optimization techniques will be applied to individual components and to the processing plant as a whole. Our results will be evaluated through both comparison to other plant designs and analysis of the best energy output per energy input for the process.

David Eisen
Computer Engineering
"Mid-IR Optical Stimulation of Nerve Cells"
Faculty Mentor: Fow-Sen Choa
Expected Graduation Date: Spring 2014

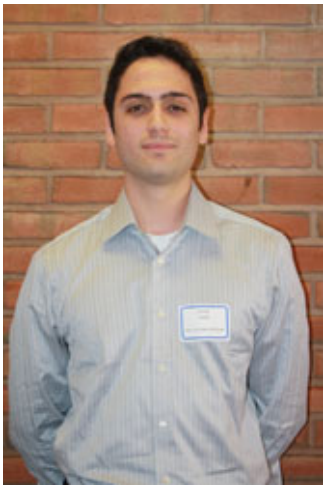
Neuron excitation and inhibition have been previously studied as they have important applications to bio-medical fields, particularly in human prosthetics, as well as in audio and visual assist devices. Optical stimulation via high power mid-IR (MIR)

quantum cascade lasers (QCLs) coupled with a MIR fiber provides a non-contact method of stimulus delivery direct to the neural site. It offers possible advantages over traditional electrical stimulation techniques, which can lead to either electrode or cellular damage. By using cultivated rat nerve cells on a multi-electrode array circuit board we can configure MIR optical fiber coupled QCLs to deliver signals in the 3 μm wavelength range. The focus will be on examining the range of excitation energy per unit area, possible excitation rates, wavelength dependence of the excitation and inhibition characteristics around the main peaks of the neuron absorption spectra, and identifying optical stimulation/inhibition thresholds as well as damage thresholds at these wavelengths. We will also apply similar studies to plants and insect subjects such as Venus Fly Traps, and fruit flies and hope that this will eventually lead to in vivo studies of small-animal brains with our collaborators at NIH NIDA lab., Baltimore, who are interested in applying MIR techniques to the studies of brain circuitry, chemical pathways, and drug effects.



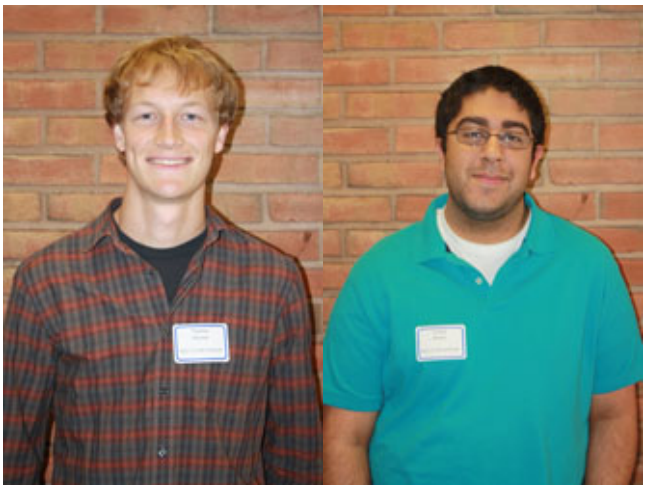
Nathan Fastman
Biochemistry and Molecular Biology
"Determining the Binding Site of Novel Inhibitors of the Hepatitis C Helicase"
Faculty Mentor: Dr. Paul Smith
Expected Graduation Date: Spring 2013

The hepatitis C virus (HCV) is a global health concern, infecting 170 million individuals worldwide and resulting in the death of approximately 350,000 people every year. The HCV genome encodes various proteins required for viral replication within a host cell. Non-structural protein 3 (NS3) plays several essential roles in HCV replication, making it an attractive target for therapeutic drugs. Our lab has identified and synthesized several novel compounds proven effective in halting viral proliferation at low micromolar concentrations via inhibition of NS3 helicase activity. The ultimate objective of this project is to make structural modifications to these compounds in an attempt to increase potency. The precise region of the enzyme where the inhibitor binds must be identified in order to take a rational approach to these structural modifications. Accordingly, inhibitor analogs with a photo-reactive substituent will be used as an affinity label in order to identify the NS3-inhibitor binding site. The photo-reactive analog will be incubated with HCV NS3 helicase and, upon irradiation with light, will form a highly reactive intermediate that will covalently bond to a nearby amino acid. Proteases will then be used to digest the protein into smaller peptide chains, which will then be analyzed using mass spectrometry to identify the amino acids residues to which the inhibitor bound. With this information, computer modeling will be used to gain a three dimensional picture of the inhibitor-NS3 complex. Rational structural modifications can then be made to increase favorable interactions with the amino acid residues in the binding pocket, providing a new generation of more potent inhibitors and potential drug candidates.



Julian Field
Computer Engineering
"Ultrasound Imaging with a Custom Many-Core Processor"
Faculty Mentor: Dr. Tinoosh Mohsenin
Expected Graduation Date: Spring 2013

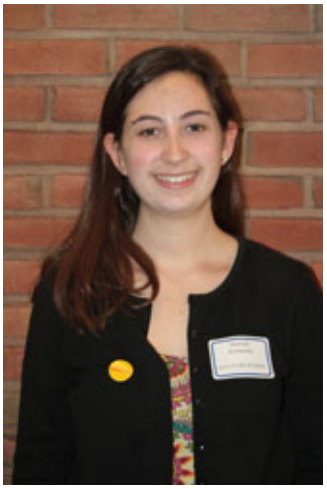
Dr. Mohsenin's Energy Efficient High Performance Computing (EEHPC) Lab, as the name suggests, is involved in the design and implementation of specialized high-speed, high performance, and energy-efficient digital systems. One such system is a many-core digital signal processor (DSP) for biomedical imaging. This research will develop the code for ultrasound imaging algorithms and then to map these algorithms onto the processor. Ultrasound imaging uses very high frequency sound waves to generate images of the interior of a given medium. It is especially useful for medical imaging, since it provides real-time data, is more portable than other imaging technologies (MRI, CT, X-ray), and, perhaps most importantly, it avoids the dangers of ionizing radiation that are present in X-rays and in the radioactive isotopes used in other forms of imaging. The goal of this project is to deliver a system that not only performs this imaging, but does so in a fast and efficient way and, since it is implemented on a programmable processor, allows for a great amount of flexibility in building upon the design in the future. The design will be implemented with a maximum amount of parallelism to provide fast computation and very high throughput, while minimizing the hardware footprint and energy consumption. The processor itself is being developed using the Verilog hardware descriptor language and will be implemented on a field-programmable gate array (FPGA). The ultrasound processing algorithms will be written in assembly language and programmed onto the processor.



Thomas Hervey, Aneep Bindra, and **Zachary Hullihen**
Information Systems, Computer Science, Computer Science
“Lights, Camera, Motion, Action: The Dance Application of Microsoft’s Kinect and Intelligent Stage Lighting”
Faculty Mentors: Dr. Marc Olano, Ms. Carol Hess
Expected Graduation Date: May 2014

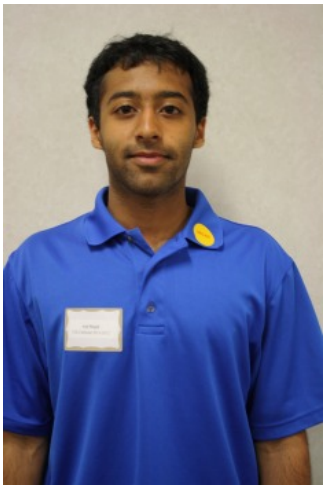
The Microsoft Kinect is one of the premier entertainment peripherals in today’s gaming scene. There are, however, many other uses for this sensor apart from the world of motion-controlled gaming. Our group will design a system which uses the Kinect’s motion-tracking capabilities and will integrate it with dancers through intelligent stage lights. The lynchpin of the system will be a DMX controller which will connect the PC (and by

extension, the Kinect) with the lights. These lights can then be controlled to do certain actions in response to the motion input garnered by the Kinect. This fusion of art and technology will provide for a unique and surreal performance piece.



Hannah Kurlansky
English and Media and Communication Studies
“Linguistic Significance: How Language Colors Childhood Imagination”
Faculty Mentor: Dr. John Stolle-Mcallister
Expected Graduation Date: Spring 2013

This research will examine the relationship between language and perception, specifically its role in imagination and artistic creation. Though communication is often thought to be transparent, language is closely related to culture and inherently conveys cultural differences. I will write a children's story in both English and Spanish with simple vocabulary to minimize translation differences. I will then present Spanish-speaking students with the Spanish text and ask them to create appropriate illustrations. This will be repeated with the English text and English-speaking students to provide an alternative set of images. Both sets of text and illustrations will be collected and produced into a dual-language children's book. This final product will allow for easy comparison between the two sets of interpretations and provide examples through which to discuss the impact of language. I will write a critical paper discussing the cultural similarities and differences as expressed through the illustrations.



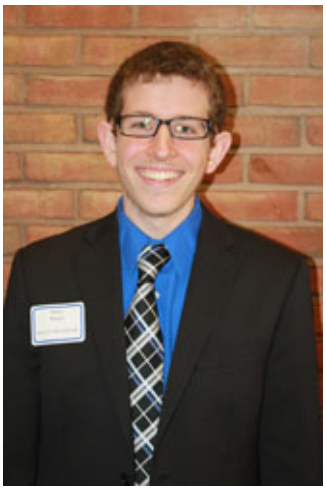
Asif Majid
Interdisciplinary Studies
"This Moroccan Life"
Faculty Mentor: Steven McAlpine
Expected Graduation Date: May 2013

My yearlong study-abroad experience resulted in an interdisciplinary exploration of multiple issues – migration, transnational identity, human rights, gender, and harassment – specific to Morocco. While investigating, it became apparent that qualitative research methods such as interviewing and surveying were insufficient to understand my time in Morocco. As a consequence of the themes I sought to explore, I needed a creative alternative; this resulted in a play entitled “This Moroccan Life: Part 1.” Written in Bertholt Brecht's model of epic theater, the play uses multiple interruptions in an overarching story to challenge the audience. Through Brecht's model, the play pushes the audience to consider the thematic social justice questions asked within. A complementary academic paper "This Moroccan Life: Part 2," connects the play to scholarship, personal experiences,

conversations, and observations in a way that reflects the themes of my research. This furthers the Brechtian idea of engaging social issues in a reflective and galvanizing way. Current funding supports a combined presentation of the two parts: a production of "Part 1" and a discussion of "Part 2." In staging the two elements as one, I will take inspiration from Brecht's epic theater structure by pushing for emotional detachment and critical thinking on the part of the audience.

Kelley Mason
Geography and Environmental Systems
"Assessing the Impacts of Corridor Conservation on Local Livelihoods in Costa Rica"
Faculty Mentor: Dr. Margaret Holland
Expected Graduation Date: Spring 2013

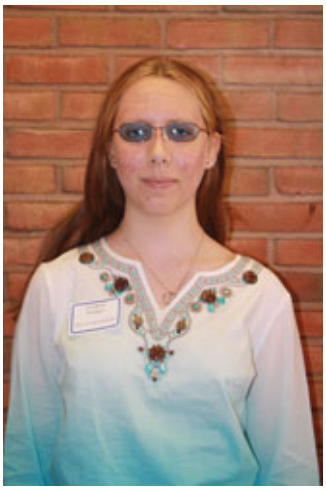
As of 2010, 37 conservation corridors had been formally declared in Costa Rica where conservation and sustainable development go hand-in-hand. However, the national corridor program has yet to develop a clear system for monitoring social outcomes related to communities living within these corridors. This project creates baseline socioeconomic profiles for a set of conservation corridors in Costa Rica through an analysis of census and GIS data. I will use this data and compare it to national level trends to determine if they are consistent or exhibit unique differences. I will travel Costa Rica and assist my mentor in conducting a series of key informant interviews to identify potential socioeconomic outcomes for future evaluation. I will use the profile I generate for Tortuguero as the baseline information, and provide a set of recommendations for socioeconomic indicators that the national program could use in assessing its influence on communities living within the corridors in Costa Rica.



Adam Mayer
Biological Sciences
"Development of Optimized SAM SERS Nanosensors for Intracellular Analyses"
Faculty Mentor: Dr. Brian Cullum
Expected Graduation Date: Spring 2013

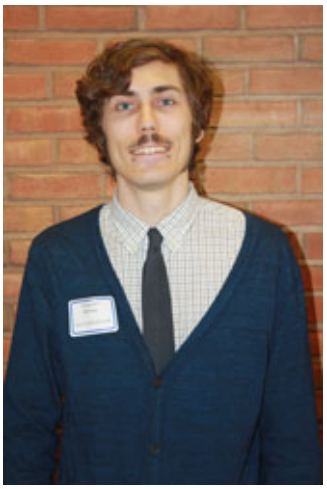
Surface-Enhanced Raman Scattering (SERS) is a highly sensitive vibrational spectroscopic method that can be used to detect target analytes down to the single molecule level. The analytical power of SERS, which stems from the quality of the substrate on which the measurements are conducted, can be applied to numerous areas, including disease diagnosis and biodefense. The present focus of our work has been on the optimization of the SERS substrate for maximum molecular information acquisition. However, the long-term objective of the project is to effectively incorporate and use the substrate as nanosensors for real-time intracellular

monitoring. By optimizing the individual nanosensors and determining the best method by which to introduce them into the cell, accurate intracellular SERS analyses can then be performed. This project will specifically focus on the monitoring of ZAP-70 and Interleukin-2 protein activity in T-lymphocytes upon activation of the immune response in those cells. By monitoring changes in the concentration and activity of these proteins, information about the activation state of the immune system can be easily and non-invasively accessed, allowing for the early detection and subsequent treatment of harmful pathogens in the body.



Elizabeth Milligan
"The Evolution of Flute Technique through a Study of the Examination Repertoire of the Paris National Conservatory of Music and Dance"
Faculty Mentor: Dr. Lisa Cella
Expected Graduation Date: Spring 2013

This research project will identify and document current and historical standards of flute performance from the mid-nineteenth century to the present day, as demonstrated by the annual graduation competition repertoire for flutists of the Conservatoire National Supérieur de Musique et de Danse de Paris (CNSMDP). This elite conservatory has produced some of the most distinguished and accomplished musicians of the last 200 years. The repertoire commissioned pushed the limits of contemporary technique and is a uniquely qualified historical reflection on the development of technical abilities. Select compositions will be analyzed to identify the challenges present within, including but not limited to rhythmic complexity; key signature; presence of accidentals; time signature; smallest, largest and average intervallic distances between consecutive notes; articulations; and range. Graduates of the CNSMDP will also be interviewed whenever possible to gain an understanding of the cultural context in which these pieces were commissioned, learned, and performed. The results of the research will map a technical development trajectory of the flute and will be presented in an article that will be submitted to popular flute magazines and publications. A lecture recital will also be designed and performed, presenting the research alongside a selection of the compositions studied. This lecture recital will be submitted to regional and national flute conventions for the purpose of reaching a broad audience of students, teachers and performers.



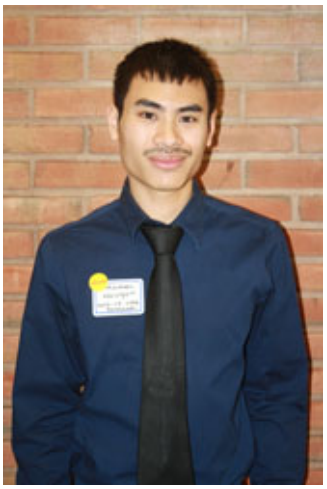
Alexander Morrow
Computer Science
“A Comparison of Dimension Reduction Techniques”
Faculty Mentor: Dr. Marie desJardins
Expected Graduation Date: Spring 2014

Dimension reduction techniques are commonly used in machine learning to simplify complex multivariate data into a more manageable form, to discover underlying groupings in data, and to prepare data for visualization. Many dimension reduction techniques exist, each providing a unique approach to compressing data. While many of these provide results that work there has not been great exploration of the comparative benefits and downfalls of each method. Through this work widely used dimension reduction techniques such as multidimensional scaling, self organizing maps, principal components analysis, and feature selection will be explored and compared. The ability of each dimension reduction technique to preserve region shape and density and to discover underlying trends will be tested using synthesized data. Ultimately a comparison will be formed, quantitatively describing each method's ability in context of the other methods and qualitatively assessing which techniques are most appropriate for different domains and problem types.

KimChi Nguyen
Biochemistry and Molecular Biology
“Determination of dsDNA Binding Site on Gene 32 Protein”
Faculty Mentor: Dr. Richard Karpel
Expected Graduation Date: Spring 2013

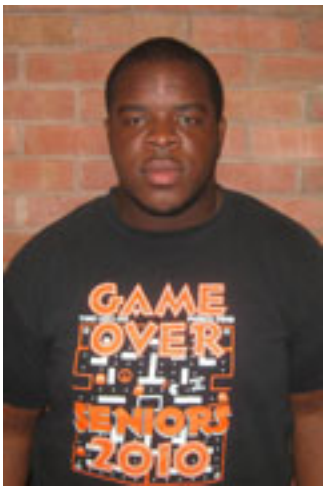
Bacteriophage T4 gene 32 protein is known to be a single stranded binding protein which aids in the replication and repair of its own DNA within a host cell. In DNA replication, gene 32 protein helps in protecting the DNA from nuclease attack, destablization of the double-stranded helix, and guiding important protein factors to the replication site. Gene 32 protein has a high affinity for binding to single-stranded DNA; its cooperative binding abilities are due to the conserved amino acid sequence (Lys-Arg-Lys-Ser-Thr) within the binding cleft known as the Last Motif. Recent experiments suggested that gene 32 protein also contains a cluster of positive charges in a chin-like region that electrostatically interacts with double-stranded DNA. This electrostatic interaction with double stranded DNA allows the protein to approach the replication fork and carry out its replication functions. The focus of the proposed experiment is to use DNA affinity chromatography method to obtain the binding constant for the interaction of the wild type protein with DNA. Then we will compare the binding constant of the wild type with that of protein with a mutated chin. The result of this experiment will confirm the theory that the lysine residues are important for the protein's interaction with double-stranded DNA. This

is critical because the interaction accelerates the rate at which the single- stranded binding protein gets to the single-stranded DNA in order to protect it from nucleases.



Michael Nguyen
"A Comparison of Genetic and Epigenetic Diversity Between Urban and Nonurban Populations of a North American stream Fish (Etheostoma olmstedi) in the Potomac Basin"
Faculty Mentor: Tamra Mendelson
Expected Graduation Date: 2013

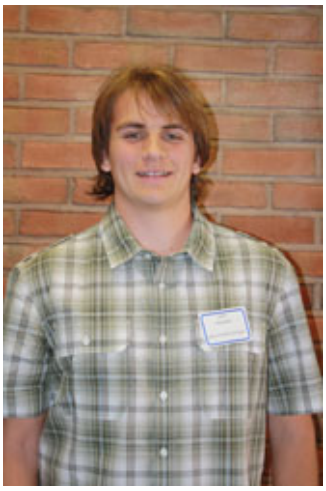
Many urban pollutants such as metals (e.g., cadmium, arsenic), peroxisome proliferators (e.g. trichloroethylene), and endocrine-disrupting/reproductive toxicants (e.g. bisphenol A) have been shown to alter the epigenome, specifically DNA methylation. The epigenome literally translates to "above the genome," and is composed of numerous chemical modifications to DNA and histones, such as methylation of cytosine bases and acetylation of lysine residues in the histone tail. Methylation typically occurs at the 5-C of cytosine in DNA and does not alter the nucleotide sequence. However, DNA methylation can effect gene expression and has been shown to be transgenerationally heritable for many traits, therefore providing a potential substrate for evolution. The goal of this study is to test the hypothesis that urban pollution affects epigenetic DNA methylation diversity both within and between natural urban populations and clean reference nonurban populations of a freshwater stream fish. Genome-scan methods known as Amplified Fragment Length Polymorphism (AFLP) and Methyl-Sensitive Amplified Polymorphism (MSAP) will be utilized to assess both genetic and epigenetic diversity in six different urban/nonurban populations of Etheostoma olmstedi (Tessellated Darter) in the Potomac basin. Significant differences in epigenetic diversity between the urban and nonurban populations may suggest a role of anthropogenic activity in evolution.



Uchenna Okoro
Biochemistry and Molecular Biology
"Flexible Carbocylic Nucleosides as Antiviral Agents"
Faculty Mentor: Dr. Katherine Seley-Radtke
Expected Graduation Date: Spring 2014

One of the most prominent themes in antiviral treatment today is the use of nucleoside analogs. Nucleosides can act as inhibitors of important cellular enzymes by prematurely terminating the growing viral DNA or RNA strand. One of the largest obstacles these drugs must overcome is the development of resistance. Viral polymerases frequently undergo mutations in the active site by introducing steric or electronic hindrance to prevent the drug from binding properly. As a means to enable them to overcome this resistance, the Seley-

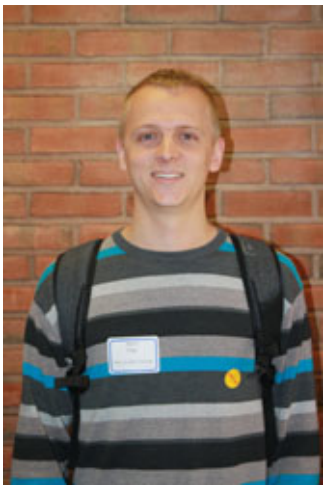
Radtke lab has designed a series of flexible nucleotide analogs. The structures of the modified nucleotides retain essential hydrogen bonding motifs so that they are properly recognized by the enzyme, but are flexible enough to interact with secondary amino acids in the active site as a means of overcoming resistance and retaining their biological activity. Through a series of synthetic organic chemical reactions, including the iodination of imidazole, and subsequent Vorbruggen coupling, an important intermediate in the fleximer target synthesis has been realized. This analog will be further functionalized to lead to a key tricyclic intermediate for the synthesis of the flexible nucleotide analog, Flex-2'-fluoro-2'-methyl GTP. Once in hand this novel compound will be tested for antiviral activity against Hepatitis C Virus and studied to explore the capabilities of flexible nucleosides in polymerase binding sites.



John Alexander Packard
Chemical Engineering
"Deactivation of Reactive Astrocytes in a 3D in vitro Laminin Containing Biomaterial."
Faculty Mentor: Dr. Jennie Leach
Expected Graduation Date: Spring 2014

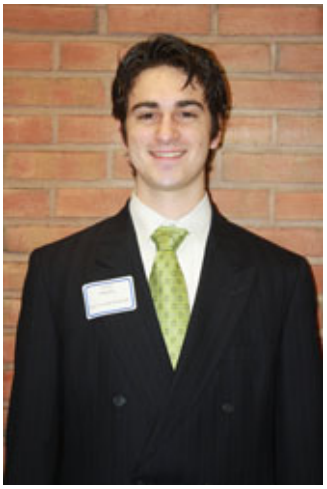
In the central nervous system, astrocytes are major glial cells which provide supportive activities for neuronal functions including homeostasis, vasomodulation, synaptic formation and long term potentiation [1]. However on injury, astrocytes become reactive and release inhibitory cytokines, ECM molecules and form a glial scar[2]. Though considered to be beneficial in sealing the injured site from further damage, the glial scar becomes a physical and chemical barrier to nerve regeneration after the initial phase of injury[3]. To overcome this impediment, we need biomaterials that will deactivate astrocytes while promoting neuronal regeneration. My work will focus on investigating biomaterials that will deactivate astrocytes by reducing their production of active transforming growth factor beta (TGF β), a key cytokine involved in scar formation. We hypothesize that the TGF β can be down regulated using laminin as a major component in the ECM. To test this hypothesis we will expand and purify astrocytes taken from the dissociated cortex of postnatal mice. These astrocytes will then be characterized to set a base line for inactive astrocytes. Astrocytes will then be induced into an activated state by exposure to lipopolysaccharide and transferred to various concentration of 3D laminin (10%, 20% v/v) containing biomaterials. Reactive astrocytes cultured on 2D surfaces will be our control. Immunocytochemistry, fluorescent microscopy, and immunoblotting will be used to determine the glial reactivity markers and thereby test our hypothesis. The results from this study will help us better understand how ECM plays a critical factor in nerve regeneration, regulating inflammation and scar formation after injury and will help us design better biomaterials for nerve repair and neurodegenerative disorders.

[1] M. Sofroniew, The neuroscientist, 2005 11:400. [2] M. Kalman, Advances in molecular and cell biology 31: 787. [3] J. Feng et al., Life Sciences, 2011 89:141.



Adam Page
Computer Engineering and Mathematics
"Low-power FPGA Implementation of Ultrasound Beamforming"
Faculty Mentor: Prof. Tinoosh Mohsenin
Expected Graduation Date: Spring 2013

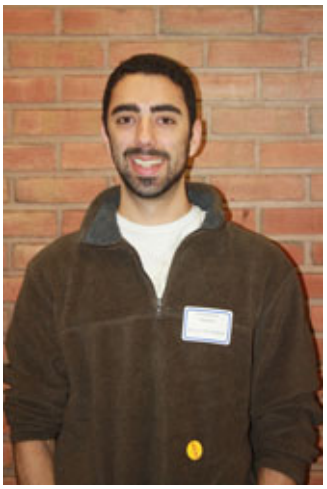
Advanced medical data sensing and processing is an increasingly common tool utilized in the modern health care infrastructure alongside information and computing technologies. These systems must provide both highly accurate and quick processing of vast amounts of data. In addition, wearable biomedical devices are used in inpatient, outpatient, and at home e-Patient care to constantly monitor the patient's biomedical and physiological signals 24/7 and, therefore, must be ultra low power.
The goal of this project is to implement highly energy-efficient digital signal processing (DSP) blocks needed for biomedical ultrasound imaging systems. One of the major blocks I will be implementing is a digital beamformer,. Digital beamforming is a signal processing technique that can be used for phase alignment and summation of signals received at different times from a multi-element ultrasound transducer. This technique will be implemented in Verilog and will then be integrated with other blocks on a Virtex-5 FPGA board. Upon completion of this project, I will be able to demonstrate a complete ultrasound imaging system on an FPGA.



Juilus Patellis
Biochemistry and Molecular Biology
"Surface-sensing Gene Expression in Proteus mirabilis"
Faculty Mentor: Dr. Robert Belas
Expected Graduation Date: Spring 2013

Proteus mirabilis is a dimorphic, motile gram-negative bacterium associated with urinary tract infections. Pathogenicity of this species is directly correlated with the formation of a differentiated "swarmer cell" that is produced only when P. mirabilis is on a surface. Swarmer cells are a prerequisite for P. mirabilis movement over surfaces, a phenomenon known as swarming. It is known that P. mirabilis senses surfaces by detecting the inhibition of rotation of its flagella (helical proteinaceous filaments that are used for bacterial swimming and swarming). It remains unknown how information from stalled flagellar motors is transmitted into the cell to affect gene transcription; however, recent transcriptomic data highlight several genes that are likely involved in transducing the signal. The regulatory region of each of these genes has been genetically coupled to lacZ (encoding the enzyme β-galactosidase) producing a set transcriptional fusion plasmids that can be used in P. mirabilis. Using this set of reporter plasmids, expression of each target gene can be determined by measuring β-galactosidase activity. The aim of this project is to

move each reporter plasmid into P. mirabilis, and to measure each gene under a variety of growth conditions using qualitative and quantitative assays of β-galactosidase activity.



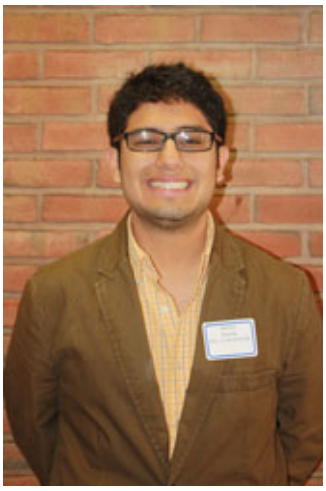
Christopher Paymon
Mechanical Engineering
"Local Mechanical Behaviour Measurements of Friction Stir Welds"
Faculty Mentor: Dr. Marc Zupan
Expected Graduation Date: December 2012

The next generation of light weight, high speed vehicle hull and frame structural strength capabilities must meet the rigors of extreme environmental conditions. To meet these challenges, the concept of Friction Stir Welding (FSW) and its mechanical properties on titanium alloys are being explored. Currently, work is being done in collaboration at the Naval Surface Warfare Center Carderock Division (NSWCCD) and Naval Research Lab (NRL) to link process parameters to resultant microstructure within the FSW regions through the use of computational modeling and thermomechanical simulation. This work uses direct microsample testing, to quantify the link between local microstructure and localized texture to mechanical properties of the material. This is achieved by making direct measurements of the base metal, thermally affected zone (TMAZ), and stir zone mechanical properties using micro scale tensile tests. Mechanical properties determined through the use of microtensile tests show yield strengths for the stir zone ranging from 459-463 MPa and ultimate tensile strengths between 613-620 MPa. Typical properties of CP Ti Grade 2 range from yield strengths of 335-545 MPa and ultimate tensile strengths of 510-605 MPa. The microtensile tests of Ti-CP welded with Ni foil shows higher yield and ultimate strengths. These test results are unique and are required to advance the modeling effort, and our understanding of the complex FSW process.

Megan Pejsa
Psychology
"Video Game Distraction for Acute Pain: The Effects of Pre-Trial Training"
Faculty Mentor: Dr. Lynnda M. Dahlquist
Expected Graduation Date: Spring 2013

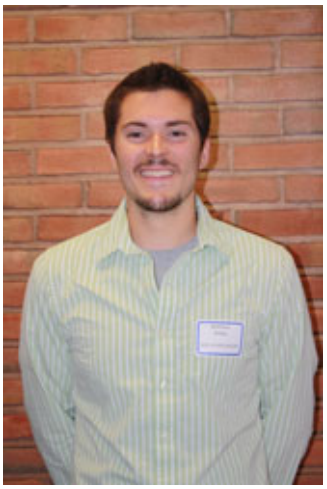
Researchers have shown that video game distraction via virtual reality (VR) technology can be used to provide distraction from a stimulus that causes mild discomfort. The continued research in VR distraction is critical for young patients in hematology-oncology clinics, as they must endure repeated uncomfortable medical procedures. The findings of this research are intended to benefit this population specifically. To the best of my knowledge, there is no guide in the

literature on how long you need to train people before video game distraction becomes an effective pain-reduction tool. This study is aimed to fill this gap in the literature by examining the difference between practicing for 2 to 3 minutes before playing a video game and practicing for 20 to 30 minutes before playing a video game before using the video game as a distraction during exposure to uncomfortably cold water. This study will: (1) test the effectiveness of video games as a distraction for acute pain management, and (2) evaluate the impact of training intensity on the video games' effectiveness as a distracter for acute cold press or pain.



Nathan Scavilla
Physics
"Investigating the Dependence of Low Level Winds on Altitude with Applications to Wind Resource Evaluation and Turbine Engineering"
Faculty Mentor: Dr. Lynn Sparling
Expected Graduation Date: Spring 2013

It is becoming widely recognized that traditional forms of energy such as fossil fuels are not sustainable and are leading to climate change; therefore, research into alternative sources of energy is an important endeavor. There is a lot of interest in wind energy offshore in the mid-Atlantic, but there is uncertainty about certain aspects of the wind. Currently, we do not have much detailed knowledge about the vertical wind profile and wind shear over the mid-Atlantic, making this research imperative for establishing the feasibility of wind turbines off the mid-Atlantic coast. My goal is to perform a multi-platform analysis of coastal winds in the mid-Atlantic in order to determine how the wind speed changes with vertical height since this information will be useful in understanding the complexity of wind profile. In addition to understanding this information, by having a working knowledge of the wind patterns vertically, engineers can also use this research to determine specs for constructing offshore wind turbines if feasible. To accomplish this, I am going to analyze wind measurements from multiple sources, including buoys, weather balloons, and Synthetic Aperture Radar data from a satellite. I will also analyze data from a wind LIDAR instrument on board the Ron Brown research vessel during a measurement campaign. I will develop IDL (Interactive Data Language) programs and perform a statistical analysis of the data to characterize spatial and temporal variability in the vertical wind profile.



Matt Schley
Environmental Science and Mechanical Engineering
"Correspondence among Impervious Surface, Water Quality, and Water Quantity Time Series"
Faculty Mentor: Dr. Matthew Baker
Expected Graduation Date: Spring 2013

Current understanding of the impacts of land development on streams is typically based on study of a single site through time, or multiple sites at a single point in time (space-for-time substitution). Spatially extensive studies through time are needed to generalize long term analyses and confirm broad-scale relationships to better guide land management policy. Recently, investigators have developed an annual history of satellite-derived impervious cover for the Baltimore-Washington, DC metro area spanning the past 20 years. Rates of land conversion and storm water management regulations have changed dramatically during this period. I will compare this "space-time stack" of impervious cover maps to stream discharge and water quality time-series data from more than 30 tributary watersheds of the Chesapeake Bay throughout the region. I will assess whether or not changes in development policy and practices have had a detectable influence on the status and trends of water quantity and quality, and how effectively site-specific or extensive snapshot studies represent the effects of development.

Reema Sharma
Biological Sciences
"Phosphorylation of RPS7A Protein: Impact on Ribosomal Composition and Function"
Faculty Mentor: Lasse Lindahl
Expected Graduation Date: 2013

Cancer cells are able to grow without regard to signals from the environment in the body that would limit growth of normal cells. One group of proteins important for maintaining the cancerous state is kinases which control many regulatory functions in the cell by adding phosphates to specific amino acids of other proteins. A proto-oncogene kinase, PIM1, is upregulated in prostate cancer cells and phosphorylates serines and threonines in other proteins, including RPS7A (Ribosomal Protein S7), one of 40 proteins found in the small subunit of the human ribosome (N. Barkley, C. Bieberich, personal communication). Two threonines are phosphorylated in RPS7, but functional implications of this modification are not known. To determine the impact on ribosomal function of such phosphorylations, we are studying the Saccharomyces cerevisiae (baker's yeast) orthologue (evolutionary equivalent) by mutating the threonine and serine residues in the yeast RPS7A gene to alanine, which cannot be phosphorylated, and to glutamic acid, which carries a negative charge similar to phosphate. We will also mutate both of the threonines together in the RPS7A gene, because

phosporylation of one of two close targets may be enough to maintain protein activity. Studying the phosphorylation of RPS7 can provide us insight about the importance of this protein in ribosome function and may give us a better understanding of how cancer cells function to favor their own growth.

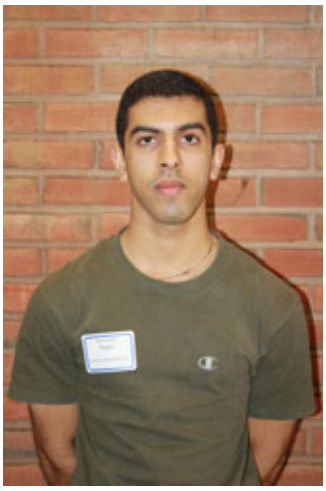
David Sweigart
Physics and Mathematics
"Designing and Simulating THz Waveguide Devices using Finite Difference Techniques"
Faculty Mentor: Dr. L. Michael Hayden
Expected Graduation Date: Spring 2013

Conventional metal and dielectric waveguides are not able to transport terahertz (THz) radiation over long distances due to high losses in this frequency regime. Therefore, the development of novel THz waveguides is crucial to the commercialization of many THz applications such as security imaging. Despite this fact, not much literature exists about how to construct an effective THz waveguide. Hence, I will be designing and simulating a waveguide device at THz frequencies using a finite element method implemented in COMSOL Multiphysics. The aim of my work is to create a realistic model that can be used to optimize the structural and material properties of the device before it is built in the laboratory. To do this, I will apply the governing physical equations to simulate THz generation for a laser pulse travelling through the nonlinear core of a five-layer structure. I will then study the effect of multiple device properties on the efficiency and bandwidth of the THz radiation to find the optimal configuration. This will allow us to better design the optimal THz waveguide and to have a broader impact.

Coco (Ke) Tang
Political Science
"Jordan: NGOs in a Burgeoning Civil Society"
Faculty Mentor: Dr. Brigid Starkey
Expected Graduation Date: Spring 2014

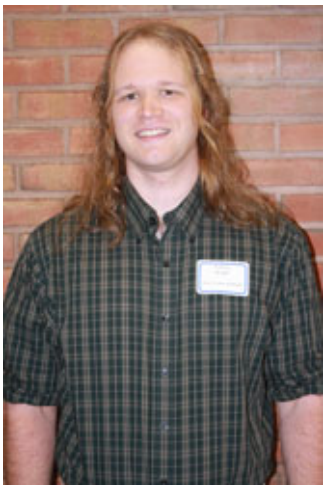
Civil society is the space afforded by citizens who involve themselves in organizations and institutions operating outside of a country's government structure – and civil society can be powerful. This is reflected robustly in the Arab Spring, as civil unrest topples regimes and ousts dictators. But the forces at work within any given civil society are intricate and complex, and they range across a wide spectrum of social, political, and economic activities. This research project focuses on Jordan as a case study, and is designed to examine on-site the organizations and institutions at work within the Jordanian civil society by investigating its Non-Governmental Organizations (NGOs). Using an exploratory

approach, this research will survey targeted NGOs presently operating in Jordan, both local and global, and assess their contributions to the development of civil society in the country. Through the creation of a documentary film consisting of interviews with key staff at the NGOs as well as footage of their day to day operations, this research will inspect the nature and administrative capacities of their functions, and answer the question of whether or not their stated missions are consistent with their achieved goals. By supplementing these interviews with analysis of project data and researched statistics, this research will be able to generate a larger picture of the climate of Jordanian civil society, and draw conclusions with regards to the profound implications the Jordanian civil society has on the country's political realm proper.



Samiullah Wagan
Chemistry
"Biocompatible Electrodes with Copolymer Coatings for Long Term In Vivo Sensing"
Faculty Mentor: Dr. Ryan White
Expected Graduation Date: Spring 2013

The ability to monitor in real-time relevant targets, such as therapeutic drugs, would be revolutionary to healthcare. Development of devices capable of continuous detection in real-time would be able to provide healthcare providers and patients with information necessary to make informed decisions about how to approach further treatment. Not many platforms are available that can properly function in vivo and have the capacity to work over long timescales due to biofouling at the sensor's surface. Implanted sensors are subjected to cellular responses that can lead to the adsorption of cells and proteins to the surface. This leads to signal loss of the sensor, which correlates with loss of sensitivity. The purpose of this research is to combine the specificity and selectivity of electrochemical aptamer-based sensors with biocompatible conducting polymer nanofibrous membranes, in order to create biosensors capable of performing long-term in vivo measurements. I will attempt to accomplish this goal by focusing on three aims; first to electropolymerize conducting, biocompatible polypyrrole nanofibers on microelectrodes. Followed by, fabricating sensors by incorporating covalently attached DNA aptamer recognition elements into the nanofibrous membrane. Finally, I will try to evaluate the biocompatibility of nanofibrous membranes on electrochemical aptamer-based sensors. The results of this research will be sensors coated with pyrrole polymer membrane that are biocompatible.



Andrew Wright
Music
"Players for a String Quartet"
Faculty Mentor: Dr. Linda Dusman
Expected Graduation Date: Fall 2012

It is a growing trend in the classical music community to arrange rock music for classical ensembles with groups, such as the Kronos string quartet, performing the works of great rock musicians like Jimi Hendrix and Metallica. In order to explore this process, I will arrange a song from my rock band, Asbestos, for a classical string quartet. One of the greatest challenges in arranging rock music for a classical ensemble is translating idioms from the rock style into music that will be understood by classical musicians. I will study how other arrangers have solved these problems in the past and apply techniques such as passing melodies throughout the ensemble and adding or taking away instruments to relate to the changing textures in rock music. As a music composition major, the culmination of my undergraduate career will be a presentation of my compositions in the form of a concert. I will hire an ensemble to perform this string quartet at my senior recital so that I may learn to lead professional musicians in rehearsals, teach them to play in a style with which many of them will be unfamiliar, and record audio and video of their performance, which will be helpful for admission to graduate school, receiving grants and invitations to festivals, and to my future career as a composer.

Christopher Yankaskas
"Determining Growth and Branching Rates of Autophagy Mutants in Aspergillus nidulans"
Faculty Mentor: Mark Marten
Expected Graduation Date: 2013

Filamentous fungi are used industrially to produce therapeutics such as lovastatin and cyclosporine, as well as soy sauce and other food products. Filamentous fungi are also characterized as plant pathogens that cause significant crop damage each year. In each of these situations, fungi are subject to limited nutrient availability. Autophagy is a cellular-level recycling process that occurs in a wide range of species from yeast to human beings; the pathway is important to the vitality of filamentous fungi under nutrient limitation. In this study, autophagy was induced in the model filamentous fungus, Aspergillus nidulans, using environmental stress in the form of nutrient starvation or the drug, rapamycin. We hypothesized that autophagy plays a role in regulation of hyphal branching. To test this hypothesis, this study compared the growth and branching rates (i.e., morphology) of wild type A. nidulans with two autophagy mutant strains, Datg8 and Datg13. Each strain has a single gene deletion (symbolized by D). Optical microscopy and digital image analysis were used to quantify growth and branching rates for each strain in both autophagy inducing

(nutrient starvation and/or rapamycin treatment) and non-autophagy inducing growth conditions.

Shannon Zik
Biological Science
"Design and Synthesis of Conjugated and Substituted Vinylene-Linked Chlorin Dimers"
Faculty Mentor: Dr. Marcin Ptaszek
Expected Graduation Date: Spring 2013

An imperative need has arisen for a strongly florescent molecule which exhibits tunable wavelengths in the 650-900 nm region for use in medical diagnoses. Chlorins (synthetic analogues of naturally occurring chlorophylls) present themselves as an intelligent choice to study as they contain a highly conjugated, planar system which produces absorption and emission in the optical range of 650-700 nm. This project will focus on the design and synthesis of chlorin arrays possessing two chlorin subunits connected by a vinyl linker. We hypothesize that such dyads will exhibit strong absorption and emission in the near infrared spectral window (~750 nm), therefore providing an excellent platform in the development of in vivo fluorescence imaging. I will prepare the chlorin monomer comprised of an exocyclic ring and electron withdrawing groups by following well-established synthesis routines. The McMurry coupling reaction will be employed to bridge the chlorin monomers and form the target dyads. The optical properties of extended conjugated structure will be determined through absorption and emission spectroscopies.