INTERSECTIONS
spring symposium

APRIL 20TH, 2012
ADELBERT GYM

Research and Creative
Projects by Undergraduate
Students including Senior
Capstone Students

CASE WESTERN RESERVE UNIVERSITY
EST. 1826
think beyond the possible™
Intersections

SOURCE Undergraduate Symposium & Poster Session

April 20, 2012
Adelbert Gym
SOURCE thanks the following for financially supporting Intersections:

April 2012
  - The Center for the Study of Writing
  - Enrollment Management
  - SAGES

December 2011
  - The Center for the Study of Writing
  - SAGES
Events

Intersections: SOURCE Symposium and Poster Session

April 20, 2012
Adelbert Gym

**Oral/Paper & Performance Presentations**
Adelbert Gym & Kent Hale Smith 231
Individual schedules will be available the day of the event

**Poster Presentations**

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**Second Annual Celebration of Student Writing**

Noon-2:45pm

**Michelson-Morley Research Competition**

Clapp Hall Room 405

10am-Noon
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# Celebration of Student Writing

Sponsored by the Center for the Study of Writing, SAGES and the Department of English

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AWARDS

SOURCE Provost Awards
Students may elect to have their presentations judged by faculty reviewers for our SOURCE Provost Award. One $200.00 and one $100.00 award will be given in each of seven categories: Arts, Engineering & Computer Science, Humanities, Natural Sciences & Mathematics, Nursing, Social Sciences, and Management & Accounting.

Awards will be announced at the Honors Convocation on Friday, April 27th, during the Community Hour.

Michelson-Morley Awards
This annual research competition, sponsored by the Department of Biology, is open to all Case Western Reserve University undergraduates who have conducted research at CWRU or other universities which is biologically related. One $300, one $200, and one $100 award will be given. Awards will be announced today.

The competition honors the collaborative research initiated in 1885 between Albert A. Michelson, a Case physicist, and Edward W. Morley, a Western Reserve Chemist, which culminated in the Michelson-Morley experiment of 1887. This experiment negated the ether theory of space, and constituted some of the experimental findings basic to Albert Einstein’s theory of relativity.
Many Thanks

Thank you very much to our alumni, faculty, post doctorate fellows, and graduate students who have volunteered to serve as judges for the SOURCE April 2012 competition. Without their assistance, our competition would not be possible. In addition, many students request copies of their evaluations to help them better prepare for future presentations.
Intersections: SOURCE Symposium & Poster Session
April 15, 2011 Winners

Arts Overall
Roshanak Ahmadian, Learning is Sweet. Faculty Mentor: Sally Levine, Art Studio Department: Architecture

Humanities Oral Competition
1st Katie Callahan, Girls of Today, Mothers of Tomorrow: Adolescent Girls and Popular Eugenics 1900-1930. Faculty mentor: Professor Renee Sentilles, Department of History.

Humanities Poster Competition

Natural Sciences Oral Competition
1st Varandt Khodaverdian, Decreasing Virulence in Methicillin-Resistant Staphylococcus aureus. Faculty mentor: Professor Menachem Shoham, Department of Biochemistry.

Natural Sciences Poster Competition
1st Karen Kruzer, Identification and Prevention of MRSA Transferred Between Community and Medical Settings on Mobile Phones. Faculty mentor: Dr. Christine Moravec, Department of Medicine, Cleveland Clinic.
1st Matthew Sievers, Does Phenotypic Plasticity Contribute to Invasiveness of Ranunculus Ficaria Across Shade and Water Stress Environments. Faculty mentor: Jean Burns, Department Biology.
2nd Victoria de Leon, Characterizing the Ovarian Tumor Phenotype of the Arrest Mutant in Drosophilia. Faculty Mentor: Professor Helen Salz, Department of Genetics.
2nd Stephen Fleming, ZnO Nanowires: Growth and Applications. Faculty Mentor: Xuan Gao, Department of Physics.

Social Sciences Oral Competition
1st Stephanie Onuoha, A Preliminary Review of Expressive Language Disorder and Its Applicability to Ethnic Minorities. Faculty mentor: Professor Barbara Lewis, Department of Communications Sciences.

Social Sciences Poster Competition
1st Rebecca Chen and Michelle Menegay, Sexual Assault Victims in the Emergency Department: Retrospective Analysis of Rape Incidence and Vulnerability by Situational, Personal, and Interpersonal Predictors. Faculty mentor: Dr. Vicken Totten, Department of Emergency Medicine.
2nd Cari Rosoff, Effects of Depression on PTSD Treatment Choice. Faculty mentor: Dr. Norah Feeny, Department of Psychological Sciences.
2nd Rebecca Berger, Mainstream Education and Cochlear Implants: Information for Teachers and Children. Faculty Mentor: Barbara Lewis, Department of Communication Sciences

Engineering Poster Competition
1st Albert Xue, Preparation of Nanocarbon via Atmospheric Pressure Microplasma Synthesis. Faculty mentor: Professor Mohan Sankaran, Department of Chemical Engineering.
2nd John Stagon, Testing and Analysis of the Mechanical Strength of Thin Diamond Film Covered Substrates in Tension. Faculty Mentor: Professor Heidi Martin, Department of Chemical Engineering.

Best Interdisciplinary Project
Douglas Porr, John Richards, Nicholas Szczecinski, Victoria Webster, Robotic Modeling of Barrier Navigation and Shelter Location in Blaberus discoidalis. Faculty Mentor: Professor Roy Ritzmann, Department of Biology.
**Natural Sciences Poster Competition**

(Tie) **1st** Catherine Osborn, *Genes and Environment: How Do Activity, Density, and Diet Affect Tadpole Oral Morphology*. Faculty mentor: Professor Michael Benard, Department of Biology.

(Tie) **1st** Rebecca Gilson, *Plasmodium falciparum’s Response to Oscillating Weak Magnetic Fields*. Faculty mentor: Professor Brian Grimberg, Department Global Health & Diseases & Professor Robert Brown, Department of Physics.

**2nd** Molly Karl, *A New Transgenic Model for the Inducible Ablation of Astrocytes*. Faculty Mentor: Professor Robert Miller, Department of Neurosciences.

**Social Sciences Poster Competition**

**1st** Maria Lemler, *Discrepancy Between Parent Report and Clinician Observation of Symptoms in Children with Autism Spectrum Disorders*. Faculty mentor: Professor Anastasia Dimitropoulos, Department of Psychology.

**2nd** Courtney Thomas, *Surveying Physician Knowledge and Attitudes Regarding Counseling Women on Alcohol Usage Before and During Pregnancy*. Faculty Mentor: Professor Joseph Koonce, Department of Biology.

**Engineering Poster Competition**

**1st** George Linderman, *OCTivat: Optical Coherence Tomography Image Visualization and Analysis Toolkit*. Faculty mentor: Professor Andrew Rollins, Department of Biomedical Engineering.

**2nd** Bharath Velagapudi, *A Transgenic Study of Molecular Mediators of Neural Degeneration at the Cortical-Tissue Device Interface*. Faculty Mentor: Professor Jeffrey Capadona, Department of Biomedical Engineering.

**Nursing Poster Competition**

**1st** Laryssa Hess, Chan Suk Park, Annie Bosche, Yang Liu & Pan She, *Achieving Cultural Competency to Improve the Delivery of Care to Students in the Cleveland Metropolitan School District*. Faculty Mentor: Professor Cheryl Killion, Frances Payne Bolton School of Nursing.

**2nd** Emily Jasina, Jessica Nuhfer, Erica Pizzolato, & Evalyn Zimpelmann, *What’s on YOUR Plate? Improving Healthy Food Choices and Nutritional Knowledge at CWRU Squire Valleeveue Farm*. Faculty Mentor: Professor Marcella Hovancsek, Frances Payne Bolton School of Nursing.
A quantitative analysis of the islands of Calleja in the olfactory tubercle

Stacey Adjei, Department of Psychological Sciences

The olfactory tubercle (OT) is an olfactory cortical structure with an exceptionally unique cytoarchitecture. One of the unique features of the OT is the presence of dense cell clusters termed ‘islands of Calleja’ (IC). The apparent predominant localization of the ICs within the OT suggests a role for the ICs in olfactory processing or perhaps more specifically odor-guided behaviors, however, the function of the ICs remain unknown. Precluding this realization, not even a thorough quantification of the ICs anatomical properties is currently available. To address this, we examined the ICs from 20µm cresyl violet stained coronal sections of 5 male C57/bl/6J mice. Following staining, basal forebrain sections were sequentially imaged to allow reconstruction and quantification of the ICs. We found evidence for hemispheric differences in the numbers of ICs of individual mice. Further, differences in the anterior-posterior span, area, and density of the ICs were observed across mice. Analysis of the major island of Calleja (mIC) showed differences in size, cell number and area between hemispheres and mice as well. We also found that as the number of IC increased, so did the cumulative number of cells for each individual animal, suggesting a relationship between total basal forebrain cell number and the development of the ICs. This increase in cumulative cell number was also accompanied by an increase in the cumulative number of cells for each mIC. We predict that the profound differences in IC structure found from mouse-to-mouse may be integral to individual differences in cognition and possibly behavior.

Project Mentor: Daniel W. Wesson PhD, Department of Neurosciences
Faculty Sponsor: Lee A. Thompson PhD, Department of Psychological Sciences

Turkish Puzzle Box Gift to Advertise Think[box]

Jai Ahuja, Department of Mechanical and Aerospace Engineering; Benjamin Anderson, Department of Engineering, Gregory Bauman, Department of Biomedical Engineering; Nicholas Bi, Department of Mechanical and Aerospace Engineering.

The purpose of this project was to design and fabricate an object to advertise Think[box] to potential donors, using the facilities in the Reinberger Design Studio and Think[box] at Case Western Reserve University. Preliminary design alternatives were produced and after analysis the team decided to design and create a Turkish Puzzle Box. Turkish Puzzle Boxes can only be opened with a certain sequence of steps; the puzzle challenge is to identify the steps that open the box. The final design had to satisfy constraints and guidelines provided by our professor Dr. Malcolm Cooke. Parametric Technology’s Creo 1.0 design software was used to create the final box design. Once designed, the box sections were manufactured in think[box] using; the ShopBot (CNC router), the Epilog laser cutter and the Fortus 250mc rapid prototyping machine.

Project Mentors: Dr. Malcolm Cooke, Department of Mechanical and Aerospace Engineering; Dr. Patrick Crago, Department of Biomedical Engineering

Pairing in Martian Meteorites RBT 04261 and RBT 04262: Olivine’s Story

Sam P. Alpert¹, J. M. Karner¹, R. P. Harvey¹, D. R. Hull², ¹Case Western Reserve University Department of Earth, Environmental, and Planetary Science, Cleveland, 112 A. W. Smith Bldg, OH 44106, USA, ²NASA Glenn Research Center Advanced Metallics Branch, Cleveland, 21000 Brookpark Road, OH 44135, USA.

The Martian meteorites RBT 04261 (78.8g) and RBT 04262 (204.6g), were discovered at Roberts Massif in Antarctica during the 2004 field season. Initial analysis has shown similarities between the major element compositions of the two meteorites. Original classification suggested that these meteorites were olivine-phryic shergottites; but recently this has been corrected to Lherzolitic Shergottites to reflect their distinct textures. Previous studies assumed that these meteorites were paired based on their proximity (700m) in Antarctica and their similar
texture. In a recent paper by Niishizumi et al, cosmogenic radionuclide and terrestrial residence times based on $^{36}$Cl prompts reevaluation of their pairing. Our research examined the petrography and chemistry of olivine in these meteorites to better understand their similarities and explore any possible differences.

*Project Mentor: Professor Ralph Harvey, Dept. of Earth, Environmental, and Planetary Science*

**Sustained Hypoxia preceding Chronic Intermittent Hypoxia impairs maturation of neonatal respiratory control**

Jingning Ao¹, Peter MacFarlane².

¹Department of Chemistry, Case Western Reserve University; ²Department of Pediatrics, Case Western Reserve University and Rainbow Babies & Children’s Hospital.

In preterm infants, the immature respiratory neural control system leads to a postnatal increase in the frequency of apneic episodes that are typically associated with periods of de-saturation (hypoxemia, <80% saturation). Our objective was to determine whether the baseline level of O₂ saturation during a specific neonatal period (birth-5days) affects the postnatal development of the respiratory control system (specifically, the hypoxic ventilatory response, HVR) in rats. Rat pups were exposed to 5 days of normoxia (21% O₂) or sustained hypoxia (SH, 10% O₂), followed by 10 days of chronic intermittent hypoxia (CIH, 15sec 5% O₂/5mins, 8hrs/day). Using whole body plethysmography, CIH enhanced the HVR (67.8 ± 6.7% above baseline) at P16 compared to normoxic raised rats (48.6 ± 7.1%). On the other hand, the acute HVR of SH treated pups was unchanged (58.7 ± 10.4%). Pups pre-treated with SH followed by CIH had a diminished (28.1 ± 8.8%) HVR response, suggesting that postnatal exposure to SH and CIH functions synergistically to impair the neural mechanisms underlying the maturation of the reflex response to hypoxia. These data are important to our understanding of maintaining adequate O₂ saturation levels during the early neonatal period, particularly in situations associated with increased susceptibility to apnea.

*Project Mentor: Peter MacFarlane, Department of Pediatrics
Faculty Sponsor: Professor Michael Kenney, Department of Chemistry*

**Grander than Greece: Political Careers in the European Union**

Zachary Arace, Department of Political Science, Department of Economics

Is the European Union robbing states of political talent? Has the creation of EU institutions impaired the ability of member nations to respond effectively to national crises and contributed to ineffective governance on the Continent? This paper posits that the addition of a supranational layer of governance over Europe has, in fact, drawn talent away from less influential countries and towards the (relatively) grander stage of the EU. The implications for governance are significant, especially in the current climate of crisis: talent pools and recruitment inevitably influence political decision-making and effective leadership. To unravel these talent flows, this paper discusses the results of a cross-sectional study of career trajectories. The study employs an index of influence to rank each member country and combines it with data from all European Commission appointments since 1995 to measure whether Commissioners have come from national governments or international sources and how influential their home countries are—thus delineating the relative attractiveness of each layer of European government.

*Project Mentor: Kelly McMann, Department of Political Science
Faculty Mentor: Karen Beckwith, Department of Political Science*
Intersections: Symposium and Poster Session
Page 27

Evaluation of Interference Induced by Switching Between Social and Mechanical Networks as Measured by Response Time to a DANVA Social Information Processing Task Following Social or Mechanical Primes

Jeffrey Atkinson, Departments of Chemistry and Psychology

A recent fMRI study has shown that social reasoning and mechanical reasoning are governed by two distinct neural networks. These neural networks are also antagonistic: the activation of one results in the deactivation of the other. The brain switches between these two networks to process information in different domains. This study is a continuation of the aforementioned research. Experiments are currently underway to determine whether interference occurs when a person switches from one neural network to the other in order to complete a new task. Participants are administered a computerized behavioral task composed of social or physics primes accompanied by corresponding social or physics questions followed by a DANVA social information processing task. It is hypothesized that participants administered a physics prime will demonstrate decreased reaction times for the DANVA task in comparison to participants administered social primes.

Project Mentor: Dr. Anthony Jack, Department of Cognitive Science

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Modifying Potato Virus X by Genetic Engineering Techniques

Nadia Ayat, Department of Biomedical Engineering

Nanotechnology and biomedical engineering has been shown to have great potential to revolutionize medicine. One class of nanomaterials is nanoparticles derived from plant viruses. Our research focuses on the use of viral nanoparticles for applications as cancer medicines. Specifically, this project focuses on the genetic modification of Potato Virus X (PVX). The goal of this project was to develop vaccine against HER2 positive breast cancer cells. PVX is genetically modified to contain the epitope P4, which is an HER2 epitope. This peptide will elicit an immune response in the body to produce antibodies against HER2 receptors, a receptor that is commonly overexpressed in breast cancer. The genetic modification is done by (1) transformation of the PVX genome-containing pCX1 vector, (2) then using restriction digest as well as ligation strategies to cleave the vector and insert the peptide P4, (3) the vector is produced in bacteria, (4) recombinant PVX-P4 is produced in Nicotiana benthamiana plants through mechanical inoculation. From there, the leaves will be analyzed using techniques such as TEM, size exclusion chromatography, Western blots, and MALDI Mass Spectrometry.

Project Mentor: Dr. Nicole Steinmetz, Case Western Reserve University School of Medicine

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Comparison of Bipedal Walking Cycles in Humans and Birds

Lara Backus, Department of Biology; Sabina Chandiramani, Department of Biology

Bipedalism has only evolved successfully in birds and humans. The goal of this experiment is to compare and contrast the walking cycles of these two species and see how the locomotion of humans and birds will be affected by the differences in anatomical structure. While birds walk on their toes and use the ankle joint to lift up the lower portion of the leg, humans walk on the soles of their feet and the knee joint is responsible for lifting up the lower portion of the leg. Humans also have most of their mass vertically oriented (parallel to the legs), while the body mass of birds is oriented more horizontally and thus the center of gravity is lower. We chose a bird species that we would be able to visually record the movement of the foot joint to at least the ankle joint. Many birds have a large portion of their leg covered in feathers, so we chose to record the flamingo, which has long enough legs that most (if not all) the joints are visible. In order to track the walking cycle, we focused on the changing angle within the joint that lifts up the lower portion of the leg, as this is the most easily tracked. We would like to analyze several bird and human walking cycles, focusing on the angle change of one leg. We plan to examine differences in the maximum and minimum joint angles and frequency of angle change.

Project Mentor: Dr. Roy Ritzmann, Department of Biology
The Fabrication and Characterization of Ferromagnetic Vortices in Thin Film Magnetic Particles

Robert Badea, Department of Physics

With rising interest in nanotechnology and the application of quantum mechanics to electrical devices, the dynamics of electron spin are of great interest. This project aims to investigate and characterize electron spin dynamics by exposing them to controlled and highly localized magnetic fields. Such magnetic fields are created through the fabrication of nanomagnets, tiny magnetic particles (1-10 micrometers in diameter and 50 nanometers in thickness.) Due to their small size and thickness these particles display a vortex magnetization structure. The creation of the nanomagnets involves the application of precise photolithography and selective chemical wet etching. The imaging of the vortex magnetization structure is accomplished using Magnetic Force Microscopy (MFM).

Project Mentor: Professor Jesse Berezovsky, Department of Physics

Applications of DSC for selecting a polymer for a medical device and a recyclable polymer identity

Jessica Lin Biology, Tyler Srail Biomedical Engineering, Dillon Goral Biomedical Engineering, Avik Banerjee Biomedical Engineering, Theodore Nowak Bioelectrical Engineering, Michelle Song Macromolecular Science and Engineering

Differential Scanning Calorimetry can be used to characterize multiple crystalline (melting temperature and heat of fusion) and amorphous (glass transition temperature) polymers rapidly and based on small sample size. Evaluation of the Acetals, PVC and PETG identified the Acetal homopolymer to be most stable crystalline material and PETG most stable amorphous selection. The effect of metals on the melting peak temperature (mp) and heat of fusion (Delta Fusion) of an Acetal Homopolymer and copolymer revealed that the mp did not vary with the pan type: Aluminum, copper and platinum, but Delta Fusion maximum was observed for the common Aluminum pan and varied the most with the copper pan. Weight average molecular weights Mw from 6400 to 2.7 million polystyrene where the log Mw was linear with Tg with a correlation coefficient of 0.95 over a narrow Tg range. Real world Low density to High Density Polyethylene as well as a number of other recycling coded polymers were easily identified by DSC. The Heat of Fusion aided the analyst in determining the % crystalline polymer in the recyclable polymer. One can use the attributes of our testing for identity check and quality control of coded recyclable polymers.

Mentor: Dr. Alan Riga, Macromolecular Science and Engineering

Actors, Resources and Motivations in Local Environmental Action: A Case Study of the Local Food Movement in Cleveland

Camerin Bennett, Department of Environmental Studies, Department of Psychology

In modern society, environmental action has shifted away from being the duty of the average citizen. Now, it is in the realm of activists to move the public towards sustainable behaviors. This trend raises the following questions: What makes people act sustainably? What causes local environmental action? Can local action create lasting, widespread changes? The answers to these questions are not obvious, for it is not only the question of how to cultivate sustainable action, but also who takes that action, and why they do. All three of these questions are highly debatable, but they hold the potential for understanding the best ways in which to move society towards a sustainable future. Using the movement towards local farming in Cleveland as a case study, this capstone project investigates the answers to these questions. Through service within the community, particularly at CWRU’s University Farm, and visits to local farming sites, the project developed a proposal concerning the best path towards sustainability. Suggestions are made to unite the powers of local and federal actions to facilitate interactions necessary for promoting widespread, lasting environmental change.

Project Mentor: Elizabeth Banks, Center for Civic Engagement and Learning
Fourier Domain Optical Coherence Microscopy for optical detection of fast-spiking neural activity in *Aplysia californica*

**Corbett T. Berry,** Department of Biomedical Engineering; **Michael W. Jenkins,** Department of Biomedical Engineering; **Hui Liu,** Department of Biology; **Kendrick Shaw,** Department of Biology; **Zhao Liu,** Department of Biomedical Engineering; **Hillel J. Chiel,** Departments of Biology, Neurosciences, and Biomedical Engineering; & **Andrew M. Rollins,** Department of Biomedical Engineering

Standard intracellular electrode-based experiments for the characterization of neural activity are invasive and limited to a relatively small number of neurons. Developing a practical method for non-invasive optical detection of neural activity presents an opportunity to characterize multiple neurons simultaneously with minimal disruption to tissue. Scattering and structural changes in neural tissue as a result of action potential propagation have been reported using Optical Coherence Tomography (OCT) and Optical Coherence Microscopy (OCM). Thus far, research has investigated this technology in crustacean nerves and in *Aplysia* bag cells. Attempts to characterize this signal at the cellular level in fast-spiking neurons have not been made. We investigate the use of Fourier Domain Optical Coherence Microscopy for the detection of the fast transient structural changes and/or scattering changes in the membrane of *Aplysia californica* buccal ganglia cells.

**Faculty Mentor:** Dr. **Hillel J. Chiel,** Departments of Biology, Neurosciences, and Biomedical Engineering  
**Project Mentors:** Dr. **Michael W. Jenkins,** Department of Biomedical Engineering; Dr. **Andrew M. Rollins,** Department of Biomedical Engineering

This is a Michelson-Morley Research Competition Presentation

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**Meta-analysis of Urinary Dipstick Performance of *Schistosoma haematobium* in Low Prevalence Areas**

**David Bertsch,** Department of Biology, Department of Classics; Dr. **Charles H. King,** Center for Global Health and Disease

Urinary schistomiasis (bilharzia) infections are still highly endemic in developing countries lacking adequate sanitation and safe water supply. The urinary dipstick used for detection of hematuria and proteinuria is a relatively cheap and potentially accurate test for determination of the infection. As with any diagnostic test, performance characteristics can vary with the underlying population prevalence of the targeted disease. While dipstick performance has been extensively examined in endemic communities before therapy, its performance after mass treatment or in communities with marginal transmission is currently unknown. We have assessed the performance characteristics of urinary chemical reagent dipsticks for the diagnosis of *Schistosoma haematobium* in low prevalence areas as well as evaluated the utility of dipstick diagnosis for community-level mass-treatment assignments in campaigns for schistosomiasis control in lower prevalence areas. This has been accomplished through a meta-analysis using the both the available unpublished data and the published studies from 1 Jan 1970 to 1 July 2012.

**Project Mentor:** Dr. **Charles H. King,** Center for Global Health and Disease  
**Faculty Sponsor:** Professor **Emmitt Jolly,** Department of Biology

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**Regulation of Drought Stress Response in *Arabidopsis* and Gene Expression**

**Cynthia Bogusky,** Department of Biology

Plants have a generalized response to many forms of stress whether abiotic or biotic and specific responses towards individual stresses, but it is often difficult to discern the effects of individual stresses due to interactions

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between them. These interactions may be due to the timing of stresses, or the semblance of the molecular mechanisms used to signal and regulate the responses to the stress. Many responses to stress are mediated by the plant hormone Abscisic Acid (ABA); thus, the signaling responses to stress can be classified as either ABA-dependent or ABA-independent. Signaling can result in the expression of either functional genes that enable the plant to cope with the stress, or regulatory genes that control the expression of the functional genes involved in the response. For the purpose of this review, the molecular mechanisms and functions of responses to drought stress in the model plant *Arabidopsis thaliana* will be evaluated. The mechanisms of drought stress tolerance are conserved across many species, so the results found in *Arabidopsis* should be comparable to those in other higher plants. When evaluating the responses to drought stress it is important to consider other stress that commonly occur at the same time, such as cold, heat, or salt stress, to discern whether the response is specific to drought.

*Faculty Sponsor: Professor Richard Drushel, Department of Biology*

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**DNA Methylation: An Epigenetic Impact on Memory and Learning**

**Nia Martin**, Department of Biology: **Amy Braunstein**, Department of Psychology

Neurological diseases such as Alzheimer’s exert devastating effects on those who suffer from them. Fortunately, most of us will not experience a neurological disease within our lifetime. And most of us will also not experience a severe cognitive deficit even without a pathological problem within the brain. However aging is inevitable, and as an effect, our brains physiologically wear down. Therefore, memory formation becomes difficult and often bothersome to those afflicted with it. This research is concerned with manipulating a mechanism known to exert effects on memory. It is an epigenetic mechanism called DNA Methylation and it works by an enzyme donating a methyl group to a cytosine base pair. This usually occurs in the promoting regions of DNA. This process usually silences gene expression but in some cases, it does work to enhance it. The extent of gene expression depends on how heavily methylated that region of DNA is. DNA methylation is a reversible process and can be manipulated by an organism’s response to the environment. Our goal is to vary methyl rich donors in the diets of Rhesus Macaque monkeys and test them on memory related tasks to see if there is an observable difference. We will then perform a Global methylation analysis to measure the extent of methylation within the genome.

*Project Mentor: Professor James Zull, Department of Biology*

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**Imagery and Expertise: The use of visualization in fencing**

**Amanda Brown**, Departments of Cognitive Science and Psychology

In recent years, cognitive science and psychology have begun looking at sports as a way to understand the brain and human cognition. An entire subfield, sport psychology, is devoted to using psychological techniques to help athletes improve their performance. One of these techniques is known as mental imagery or visualization. Through visualization, people can imagine themselves performing successfully without moving. Research has been conducted that shows that as a coaching or practice technique, visualization is helpful. This raises a question that is the topic of the current research: do athletes of different skill levels use visualization differently? Beilock and Gonso (2008) suggest that expert athletes benefit more from visualization in a situation for acting quickly is necessary and novice athletes use visualization more to help them completes the steps required in order to perform an action. The research performed sought to extend the original study, which was conducted using golfers, to the Olympic sport of fencing.

*Project Mentor: Kensy Cooperrider, Department of Cognitive Science*
Improving Spectral Coarse Graining Using Clustering Algorithms

Michael Bryniarski, Department of Biology, Department of Mathematics

Networks are commonly used to capture the behavior of systems composed of interacting units. Examples of such systems arising in nature include cell signaling pathways, nervous systems, and food webs. Complex behavior in these systems is often the result of the large number of units in the system. To make analyzing and otherwise understanding a complex network feasible, researchers often attempt to reduce the number of units in the network. This often takes the form of lumping units that are highly interconnected. While this preserves the topology of the network, it fails to preserve the dynamics of processes on the network, such as the diffusion of a cellular signal or the flow of carbon in a food web. A relatively new method known as spectral coarse graining (SCG) addresses this problem by lumping units in a way that preserves the dynamics of network processes at longer time scales. SCG, as originally proposed, suffers from some issues that impact its usefulness: the lumping method relies on a parameter for which there is no reasoned way a choosing a value and it produces suboptimal communities for any parameter value. The aim of this project is to provide a publicly available implementation of SCG, as well as offering some improvements based on spatial clustering algorithms.

Project Mentor: Professor Robin Snyder, Department of Biology

Challenges of National Park Management

Natasha Gandarilla, Department of Biology; Natalia Cabrera, Department of Economics; Erik Milzck, Department of Sociology; Kenneth Walther, Department of Biology

The National Park Service has been tasked with multiple primary goals, often with contradictory implications. Balancing these goals can leave the National Park Service struggling with management problems with complex solutions.

This group capstone project explores protected areas from a management perspective, utilizing Cumberland Island National Seashore, managed by NPS, as an informative case study. Students’ individual projects investigate management problems surrounding four park issues: endangered species, fire management, retained rights holders, and invasive species. Students traveled to Cumberland Island and worked with NPS to experience the island and management issues firsthand. Their individual projects, listed below, utilize this experience, literature review, and learning that took place in seminar prior to the trip.

- Of the seven species of sea turtles in U.S waters, six are listed as threatened or endangered. More than one hundred sea turtles nest on the seashore of Cumberland Island. This project is concerned with the management and protection of sea turtles on Cumberland Island.
- In the period of acquiring land for Cumberland Island National Seashore, the National Park Service granted 21 retained rights to landowners, which has affected island management. This project addresses the complications resulting from additional demands of retained right holders in National Parks.
- Invasive species have had a significant impact on Cumberland Island. The feral swine, which have been very destructive, have had their numbers cut to minimal levels. However, feral horses not only still roam freely, but have the support of many. This project aims to identify the threat posed by such invasive species, propose most effective means of population control, and examine the differences between feral swine and horses on Cumberland Island.
- Like in most National Parks, on Cumberland Island, fires can pose a threat to natural and historic resources that NPS works to protect. This project explores the various complications involved in fire management on the island.

Project Mentor: Elizabeth “Betsy” Banks, Center for Civic Engagement & Learning
Hydrologic Modeling of the Chagrin River

**Chris Carlson**, Department of Geology

New digital elevation maps (DEM’s) have become available with a much finer resolution than previous editions. Digital elevation maps break up the land into tiled segments and take elevation readings for each one. Using these new DEM’s we can more accurately model local hydrology over larger areas. Our area of interest was the Chagrin River in Cleveland, Ohio. We were able to use a specialized computer program GRASS to take the new DEM’s and overlay a segmented map of the river and all its tributaries. Using GRASS we took elevation readings for every river segment and were able to calculate the stream slopes. We then compared these new slopes with slopes taken from older DEM’s graphically because if we are comparing the same area the slopes should be identical giving a one to one relationship. Our findings found different slopes which we believe to be a more accurate model of the Chagrin River.

Project Mentor: Joseph Koonce, Department of Biology

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The Struggle for Modern Basque Identity
Among Youth in the Context of Globalization

**Eva Carlson**, Department of Anthropology; Lawrence P. Greksa, Department of Anthropology

Located in northern Spain is a region known as Basque country, home to a large group of people who identify themselves as being Basque. Today, the Basque identity has become highly controversial, both objectively and subjectively to the point where even some Basques find themselves in search of their identity. Nevertheless, a sense of national identity remains very much alive among even the youngest generation. Basques have a strong history, withstanding the earliest peninsular migrations and continuing through their region’s incorporation into the Spanish government. At its core, three historical pillars stand as a testimony to their ability to maintain their group identity: the belief that they constitute a unique race, the use of a distinctive language called Euskara, and loyalty to a unique set of laws known as the Fueros that took shape in 1452. Today, given the fact that the genetic composition of the Basque population has been dramatically influenced by numerous migrations through their territory of other peoples, few can still speak Euskara, and the Fueros has been superseded by Spanish law, it has been questioned whether or not one may be considered Basque anymore. However in the midst of today’s level of globalization, Basque youth are intentionally building and defining their identity in new ways based on a long history of nationalistic sentiment. In some cases for example it can take on the form of the Basque separatist organization known as ETA, and other times a widely celebrated cultural practice such as bertsolari, a form of poetry sung in Euskara. In sum, the current and future existence of this identity among current youth is directly linked to the will of the people.

*Project Mentor: Lawrence P. Greksa, Department of Anthropology*

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think[box] Device

**Alexander Caveny** (Mechanical Engineering); **Ryan Hansen** (Aerospace Engineering); **Anthony Fernando** (Biomedical Engineering); **Christian Gundlach** (Mechanical Engineering); Ian Charnas, think[box] Lab Staff, Engineering student programs

Our objective was to design and produce a toy or device which would effectively advertise the think[box] facility at Case Western Reserve University. Many organizations or groups advertise by means of handing out items such as brochures, pens, or bookmarks. However, this method of advertising has become cliché. It no longer truly represents what a group or organization (i.e. think[box]) wants to convey. By designing a unique device representative of think[box] we are able to not only advertise the facility, but we are also able to continuously remind prospective financiers and customers of the need for the economic sustenance of think[box]. In addition,
advertising via our interesting device or toy may spark conversation between its owner and various people. This would further advertise the facility. In essence, our device is not only the product of a class project, but also a real method of marketing an up and coming facility here at Case.

**Project Mentors:** Malcolm Cooke, Department of Mechanical and Aerospace Engineering; Patrick Crago, Department of Biomedical Engineering

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**A DNA construct for photoreceptor-specific superoxide dismutase 2 expression in mice**

**Stephanie Chen**, Department of Biology

Diabetic retinopathy is the most common diabetic eye disease as well as a leading cause of blindness in all adults. It is caused by damage to the blood vessels of the retina, which leak blood and other fluids, inducing swelling of retinal tissue and clouding and/or loss of vision. The development of diabetic retinopathy has been linked with increased oxidative stress resulting from the hyperglycemia-induced accumulation of superoxide, a toxic byproduct of mitochondrial respiration. In almost all types of tissues, enzymes of the superoxide dismutase family can catalyze the dismutation of superoxide into hydrogen peroxide and oxygen, thus acting as an important antioxidant defense. Superoxide dismutase 2 (SOD2) is a specific mitochondrial form of the enzyme encoded by the SOD2 gene and is expressed in the retina. But while superoxide has been implicated in the pathogenesis of diabetic retinopathy, the major source of it and the possible protective role of SOD2 are not clear. The aim of this project is to develop a transgenic mouse that expresses the human SOD2 gene in a photoreceptor specific fashion. This will provide a novel *in vivo* model to study the possible role of photoreceptor-generated oxidative stress and its control in the development of diabetic retinopathy, which could facilitate new therapeutic approaches for the treatment of this devastating disease.

**Project Mentor:** Professor Feng Lin, Department of Pathology  
**Faculty Sponsor:** Professor Debra Wood, Department of Biology

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**Characterization and Analysis of Barrier Navigation in *Blaberus discoidalis***

[1] Department of Biology  
[2] Department of Electrical Engineering and Computer Science  
[3] Department of Physics and Department of Mechanical Engineering

With the advent of mobile robotics, new challenges in navigation and goal-seeking must be addressed. Biological systems provide excellent models for efficient spatial exploration, and the availability and accessibility of *Blaberus discoidalis* cockroaches make them especially well-suited for behavioral experiments. Previous data collected in our lab suggest that cockroaches are strongly attracted to a darkened shelter when in a well-lit arena, though qualitative data suggests secondary preferences and different behaviors for walls and barriers. Current knowledge gaps exist in how the antennal input to the cockroach impacts its turning behavior, and also how barriers impact cockroach behavior can be quantified and translated into robotic applications.

To elucidate the mechanisms of tactile locomotive responses and barrier encounters, male *Blaberus discoidalis* cockroaches were placed in a square, lit arena with a transparent L-shaped barrier. Their movements around the arena were recorded with a high speed camera. Data will be analyzed using statistical bootstrapping to search for significant trends in barrier encounter behavior based on angle of arrival and areas previously searched. We hypothesize that cockroaches will be more likely to depart the barrier when they are out of antennal contact with it, they have traversed that section of barrier previously, and when they are not facing the shelter. Based on our results,
we set forth a series of rules to be implemented into the random walk algorithm governing the behavior of our mobile robot.

*Project Mentors: Professor Roy Ritzmann, Department of Biology; Professor Roger Quinn, Department of Mechanical and Aerospace Engineering*

**Isocyanate Functional Benzoxazine Cross-linking Agent with Model Reactions to Glycerin and Poly(vinyl alcohol)**

Kevin Chiou, Department of Macromolecular Science and Engineering

Benzoxazine thermoset is a material that exhibits unusual and advantageous properties, such as near zero volume change upon curing. As part of an effort to conduct green synthesis, a reaction by-product of bio-fuel production from waste oil, glycerin, is used to model the reaction of useful cross-linking agent based on the benzoxazine chemistry. Isocyanate functional benzoxazine is synthesized and tested for coupling with hydroxyl group containing molecules. Formation of urethane bond by reaction between isocyanate functional benzoxazine and glycerin's hydroxyl groups has been studied. This reaction was then used to characterize side-chain type polymer made of isocyanate functional benzoxazine and poly(vinyl alcohol). The resulting poly(vinyl alcohol) compound showed improved char yield as determined by thermogravimetric analysis. Reactions are characterized by infrared spectroscopy and nuclear magnetic resonance spectroscopy.

*Project Mentor: Dr Hatsuo Ishida, Department of Macromolecular Science and Engineering*

**The Effects of Caloric Restriction on Taste Bud Morphology**

Patrick Chirdon1, Huan Cai2, Bronwen Martin2,1Case Western Reserve University, Department of Biology – Case Western Reserve University, Cleveland, OH, 44106, 2 Head, Metabolism Unit, National Institute on Aging, Baltimore, MD 21224

It is well known that caloric restriction (CR) can exert numerous beneficial effects on a myriad of organ systems. The most widely used form of CR is 40% CR. This dietary regiment has been demonstrated to reduce body weight, improve metabolic function, increase insulin sensitivity, and improve health-span during the aging process (Martin et al, 2007). It is not presently known how dietary intake in caloric restriction can affect taste bud morphology and function. We examined the expression of taste cell markers, glucagon-like peptide I, and leptin receptor in rats under caloric restriction and those that were not. These intracellular signaling elements may act downstream of the T1R3 receptors and play important roles in the perception of sweet taste. We were interested in the leptin receptor because it has been found that leptin suppresses the sweet taste response (Shigemura et al, 2004). In addition, we examined the expression of Glucagon-like peptide I (GLP-1). GLP1 has been recently discovered by our laboratory to increase sweet taste sensitivity. GLP 1 receptor knockout mice exhibit a dramatic reduction in sweet taste sensitivity (Martin et al, 2009). We hypothesized that there would be changes in the expression of the cell markers, T1R3, GLP-1 and leptin receptor as a result of caloric restriction.

*Project Mentor: Dr. Chris Cullis, Department of Biology*
Modulation of splice variant expression and activation-induced pore-mediated nucleotide release: potential mechanisms of propagated P2X7 activation

Daniel Chopyk, Biochemistry B.S.; Jason Robinson, Department of Physiology & Biophysics; Christina Antonopolous, Department of Physiology and Biophysics; and George R. Dubyak, Department of Physiology & Biophysics

The purinergic receptor P2X7 is an extracellular, ATP-gated nonselective cation channel which is predominantly expressed in cells of hematopoietic origin, where its activation is involved in multiple immune and inflammatory responses including cytokine release and apoptotic death. A few key characteristics of the P2X7R set it apart from other P2R-family members: 1) P2X7R is highly specific for ATP, which is its only known natural ligand; 2) particularly in macrophages, P2X7R’s affinity for ATP is drastically lower than other purinergic receptors’ affinities for their ligands; 3) prolonged activation of the P2X7R leads to formation of a large, non-selective pore capable of allowing transport of molecules up to 900 Daltons in size. The paradox of P2X7R’s high specificity yet low affinity for ATP has raised questions as to how the receptor may be activated under physiological context. Widespread cell necrosis during the initial response to acute infection or injury causes a massive surge of ATP release. However, extracellular ectonucleotidases with high affinities for ATP quickly metabolize the nucleotide and return its concentration to much lower, controlled levels. Although P2X7R has observed implications in such health issues as adverse cardiac remodeling following cardiac infarction, allodynia, and arthritis, the mechanism underlying its activation during late stages of an immune/inflammatory response is poorly understood. In this study, two potential hypotheses regarding propagation of P2X7R activation were explored: 1) differential P2X7R splice variant expression is modulated by inflammatory cytokines and sensitizes P2X7R activation 2) release via P2X7R-mediated pore formation causes high, localized concentrations of nucleotides sufficient for activation of adjacent P2X7Rs. We conclude that pore-mediated nucleotide release, but not modulated splice variant expression, remains a possible mechanism for propagated P2X7R activation.

Project Mentor: Professor George R. Dubyak, Department of Physiology and Biophysics

High-Speed Video Analysis of Jumping Strategy in Cats and Dogs

Zach Christoff, Department of Biology

Jumping is a very important behavior for many animals, whether for hunting, escaping, or normal locomotion. Jump height and angle are dependent on both the anatomical structures that allow an animal to lift off the ground and the strategy used to jump. In general, these strategies include a rapid bilateral extension of the hind legs. Specific strategies consist of the movement of particular leg joints during the jump and the timing in which these movements happen is critical to a successful movement. Animals position their bodies differently in preparation for jumps depending on the height of the target. In my project, I used a Casio EX-FC150 camera to take high-speed video at 120fps and then analyzed the video frame by frame with WinAnalyze motion analysis software to compare and contrast the jumping strategies of dogs and cats. I am focusing on the hind legs to determine the angles each joint moves in preparation for and during the jump. Additionally, I will analyze the timing of the angle changes and how the timing relates to jumping height. Preliminary data has shown that both the dog and cat use a similar two phase strategy, which includes both a crouching and heel-off stage. The movements of the trunk and joint angles during these phases determine the angle of lift-off and height of the jump.

Project Mentor: Dr. Roy E. Ritzmann, Department of Biology
Characterization of Drp-1 and mutants and development of FRET based assay for membrane binding kinetics

Matthew Cichocki, Biology Major

Mitochondria are continuously undergoing fission and fusion. Many proteins are involved in this process, but the mechanisms behind their function are still unknown. Dynamin related protein 1 (Drp-1) is a GTPase protein that acts during mitochondrial fission. I expressed this protein in *E. coli* bacteria and purified it using nickel NTA column. I introduced mutations into this protein at specific positions and used a malachite green assay to determine GTPase activity of the native and mutated proteins. A fluorescence resonance energy transfer (FRET) based assay was also developed using donor and acceptor labeled proteins or membranes to observe protein-protein and protein-membrane interaction. The membrane remodeling activity of the protein on giant unilamellar vesicles (GUVs) was also examined using confocal microscopy. We will use these experiments to determine membrane binding and protein polymerization kinetics and future research will determine where the membrane-binding region of the protein is located.

*Project Mentor: Dr. Rajesh Ramachandran, Department of Physiology and Biophysics*

Assessment of MRI morphologic characteristics with histologic profiles of surgically proven radiation necrosis versus recurrent brain tumor

Kate Clancy, Biology and Chemistry Pre-Medicine, Neurological Institute

Radiation-induced brain tissue injury (radiation necrosis [RTN]) develops in up to 50% of patients treated with radiation for a brain tumor. The distinction between RTN and recurrent brain tumor [RBT] is critical in patient management. Surgery is required to distinguish them. A noninvasive method to distinguish RTN from RBT is sought. This study seeks to determine if morphologic MRI characteristics, using a novel scoring system, can distinguish them. The aims of this study include the determination of the feasibility of applying unique MRI and histology scoring systems to discriminate RTN versus RBT in a set of patients, matched by tumor type and brain radiation, proven surgically to have RTN versus RBT. 60 cases (30 each) were required for statistical analysis. Blinded neuroradiology and neuropathology review. Statistical analysis including logistic regression, Bayesian classification, and random forest methods.

Clinical and treatment information data has been collected. We demonstrate the feasibility of applying a novel data collection system of MRI and histopathology characteristics in RTN versus RBT. The results are expected to inform as to distinguishing morphologic MRI characteristics of RTN versus RBT and correlation of these with histology. Final results will be presented.

Funded by Clinical Science Collaborative of Cleveland CTSA UL1RR024989

*Project Mentor: Lisa Rogers DO, Neuro-Oncology
Faculty Collaboration: Mark Cohen MD, Pathology; Kristine Blackham MD, Radiology; Curt Tatsuoka, PhD, Department of Statistics*

A New Crocodylomorph Skull from the Lower Belly River Group (Campanian) of Southern Alberta, Canada

Matthew Clemens – Departments of Anthropology and Evolutionary Biology

Crocodylians formed an important part of the late Cretaceous paleocommunities of Laramidia. Although at least 5 taxa are known from the late Cretaceous (Campanian) sediments, ranging from Mexico to the North Slope of Alaska, much of the material is based on isolated scutes, vertebrate, and teeth frequently recovered from microvertebrate fossil assemblages. Most taxa are known from a small number of skulls or diagnosable skull
elements, with associated postcrania being rarely recovered. I report here the first significant crocodylomorph specimens collected from the lower Belly River Group of southern Alberta. The specimen consists of a weathered partial skull comprising the posterior portion of the skull roof and the complete occipit. The specimen was surface collected from badlands adjacent to the Milk River. Although the contact for the Foremost and Oldman formations is present in the region, the coaly matrix covering the specimen indicates that it originated in the uppermost Foremost Formation. Phylogenetic analysis of the specimen indicates that it is similar to the neosuchian *Gilchrestosuchus* from the underlying Santonian-aged Milk River Formation, but probably represents a new taxon making it the first crocodylomorph to be identified from the Foremost Formation.

*Project Mentor: Dr. Michael J Ryan- Curator of Vertebrate Paleontology, Cleveland Museum of Natural History*

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**2-Axis Motion and Camera Tracking System for *Blaberus discoidalis***

*Jordan Cluts*, Department of Mechanical and Aerospace Engineering; *Henry Snow*, Department of Electrical Engineering and Computer Science

The behavior of *Blaberus discoidalis* (commonly known as the death’s-head cockroach) in a large, square, lit arena is of interest for understanding their decision making. Their behaviors resulting from tactile antenna input are of particular interest in this project. Due to size, antennae are difficult to observe in free-ranging animals, thus a high-resolution, close-up aerial view is required. Tracking cockroaches is challenging. They are capable of 50cm/s velocities and accelerations above 1g. They are also very sensitive to outside stimuli such as shadows, motion, and vibration. In order to solve the problem of unnoticed observation of free-ranging insects roaming an arena, a 2-axis motion system with a mounted high-resolution camera has been designed.

This gantry-style motion system uses industrial aluminum t-slot extrusion for both the major structure and track. Linear motion is accomplished through roller wheels designed to pair with t-slot rails and power is provided by two 1/8th horsepower DC electric motors. The chosen motors are capable of providing both the acceleration and velocity required to keep pace with the cockroaches. Visual tracking of the cockroach and positioning of the camera is performed on a National Instruments EVS-1464RT. In the future, the system could be expanded to allow for electrical recording of nerve impulses in free-range cockroaches.

*Project Mentors: Professor Roger Quinn, Department of Mechanical and Aerospace Engineering; Professor Roy Ritzmann, Department of Biology*

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**Understanding Quasicrystals**

*Brian Cox*, Department of Mathematics

Quasicrystals have been observed in a variety of metallic systems and recently also in simulations of hard tetrahedra. In quasicrystals atoms are arranged in such a way that the Fourier transform of the positions of their centers, or indeed of any characteristic of the structure has sharp peaks at a number of points. These peaks cannot be indexed by a simple three dimensional lattice but are indexed by a higher dimensional lattice, with the height of the peak related to the index of the lattice. Such lattices also contain many tetrahedra and dense structures of Bernal or tetrahelices, in which the position and orientation of the tetrahedra rotate in a periodic fashion. We have examined the possibility that a better understanding of quasicrystals can be based on Fourier transforms of the spherical harmonics associated with the orientation of the tetrahedra, rather than a Fourier transform of the locations of the centers or corners of the tetrahedra. We find that some orientation peaks have significantly higher brightness when the quasicrystal forms. This demonstrates that, among quasicrystals, at least the hard tetrahedra approximate is better understood as a condensed orientation wave than a condensed position wave.

*Project Mentor: Professor Rolfe Petschek, Department of Physics*
**Thermal Gradient Growth of Indium Nitride**

Jonathan Crawford, B.S.E. Engineering Physics; Paul Quayle (Graduate Student), Department of Physics

Indium Nitride (InN) is an important group III nitride semiconductor; it has a small bandgap of around 0.7 eV. Studying InN is vital because of its potential applications in optoelectronics, solar cells, high-speed electronics, transistors, blue LEDs, and UV detectors. The purpose of this experiment is to construct a thermal gradient across a melt of Indium Nitride. The surface of the melt will be exposed to a nitrogen plasma. We will grow a single crystal of high quality InN. In addition, the thermal gradient growth method will be analyzed.

Prior to growing the InN crystal, the entire apparatus system needs to be leak checked by inputting helium. A computer software called EasyView will be used to check the leakage of helium. After that, a perfect vacuum will be created in the system. The indium sample will be cleaned with a hydrogen plasma. A quartz reactor will be used to deliver the hydrogen and nitrogen plasma to the metal sample. Once the plasma sources are turned on, we must wait couple of hours for the InN to be formed. The InN crystal can be distinguished by its shiny characteristic with a smooth outer layer. Lastly, the entire apparatus system can be cooled down externally by a set of fans and a water-cooling system.

We expect to successfully grow several samples of Indium Nitride. The expected characteristic of the InN is shiny with smooth outer layer. We also expect to analyze the quality of the thermal gradient growth method.

*Project Mentor: Dr. Kathleen Kash, Department of Physics*

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**Modulation of Breathing Rhythm Requires NMDA and Purinergic P2Y1 receptors in Neonatal Rat.**

Vikas Dalwadi, Department of Cognitive Science; Paulina Getsy, Department of Pediatrics; Dr. Christopher Wilson, Department of Pediatrics

Breathing rhythm is generated and regulated by a neural network within the medulla oblongata. Recently, astrocytes have been found to modulate neural activity at the synapses. Gliotransmission is a process through which the release of canonical neurotransmitters, such as glutamate, are released by astrocytes as gliotransmitters modulating neural activity at synapses. Glia are believed to be involved in the process of regulating the respiratory rhythm, the specific role and mechanism through which this occurs is unclear. Astrocyte-mediated potentiation of excitatory transmission in other regions of the CNS occurs through purinergic P2Y1 receptors. P2Y1 receptors in conjunction with N-methyl-D-aspartate receptors (NMDARs) and tumor necrosis factor-alpha (TNFα) are responsible for astrocytic modulation of synaptic activity. We hypothesized that P2Y1 receptors are necessary for appropriate synaptic modulation of the inspiratory rhythm generating neural circuit. Recordings were made from 500–600µm in vitro slices of rat (postnatal day 0–5) brainstem containing the necessary and sufficient neural circuitry to generate inspiratory activity. Hypoglossal (XII) neural activity recorded from the XII rootlet, corresponds to inspiratory activity in young mammals. In order to test the role of P2Y1 receptors in inspiratory rhythm regulation, we blocked these receptors, which decreased XII fictive inspiratory frequency while after recovery from blockade we observed rebound excitation that increased hypoglossal frequency over the baseline before P2Y1 antagonism.

*Project Mentor: Dr. Christopher Wilson, Department of Pediatrics/Neonatology and Neurosciences*
*Faculty Sponser: Dr. Anthony Jack, Department of Cognitive Science*
Alzheimer’s disease Pathology: New Evidence Link β-Amyloid and Tau proteins to Abnormal Ion Concentrations in Cells

David N. Dang, Department of Biology

Alzheimer’s disease (AD) is the most common form of dementia that causes problems with memory, thinking, and behavior. It is a degenerative brain disease that is not a normal part of the aging process. People who are diagnosed with AD have symptoms that first develop slowly and then become progressively worse over time. It is estimated that 5.4 million Americans are living with AD and is the 6th leading cause of death in America today. Currently, there is no known cure because the pathology behind AD is still unclear. There are on the other hand available drug treatments that are believed to slow AD symptoms. Two research experiments will be presented on amyloid beta (Aβ) and tau proteins, which are known to cause plagues and tangles in the central nervous system. The results from these two experiments reveal that Aβ is involved in abnormal calcium ion concentrations within the cell and that the tau protein in conjunction with Aβ is responsible for advancing AD symptoms. In addition, a current finding by Case School of Medicine using the skin cancer drug Bexarotene will be discussed as a new treatment for AD. The results from these three experiments will help in gaining a clearer understanding of AD pathology and further improve current AD drug treatments.

Project Mentor: Dr. Claudia Mizutani, Department of Biology

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Modeling the Destruction of Forests Created by Natural Gas Wells in Ohio

Dylan Davis, Department of Geology

Shale layers that contain natural gas are broken up by way of hydraulic fracturing and the natural gas is captured as it escapes the shale layer. The new technique of horizontal drilling is being used to fracture large areas of shale but more area is also needed at the surface for the well. An area of approximately 3.1 acres needs to be cleared on the surface for the well pad and additional area is often cleared for infrastructure (roads and pipelines to access the natural gas). GIS mapping software in conjunction with population projection software is used to project future well locations, in the State of Ohio. Well projections are based on the depth and thickness of the shale, proximity to roads, percent slope of the ground surface, and the locations of wells that have already been drilled in Ohio. The GIS mapping software shows where potential well sites will intersect with forested area. Then a total for cleared forested area is calculated based on the number of wells and the area needed to be cleared at each site. Adjacent lands can also be impacted, even if they are not directly cleared, because wells can cause fragmentation of forest and expose new edges of interior forest.

Project Mentor: Professor Beverly Saylor, Department of Geology
High Intracellular Magnesium Ion Concentration Inhibits Hepatic Inflammation as a Result of Ethanol Exposure

Neal D. Dharmadhikari, Department of Biochemistry; Ali Azeem, Department of Nutrition; Laura E. Nagy, Ph.D., Cleveland Clinic Department of Pathobiology; Helene Bernstein, M.D., Ph.D., Department of Reproductive Biology; Andrea Romani, M.D, Ph.D., Department of Physiology and Biophysics

In Alcoholic Liver Disease (ALD), alcohol leads to inflammation and fibrosis of the liver, which ultimately results in liver cirrhosis. Alcohol metabolism in the hepatocyte can lead to the release of reactive oxygen species (ROS), acetaldehyde, and lipid peroxidation products. These metabolites can stimulate hepatic stellate cells (HSCs) to produce collagen. Additionally, reactive oxygen species and alcoholic liver damage can drive Kupffer cells, resident macrophages of the liver, to produce pro-inflammatory cytokines, which lead to inflammation and also activate HSCs to produce collagen leading to fibrosis. We have discovered an inverse relationship between magnesium ion (Mg^{2+}) concentration and the production of cytokines by Kupffer cells. In this study, we hypothesize that high intracellular [Mg^{2+}] inhibits hepatic inflammation following ethanol exposure. We attempt to prove this hypothesis by addressing three objectives: 1) to assess the potentiating effect of Mg^{2+} deficient diet on ethanol-mediated Kupffer cell activation; 2) to elucidate the cellular mechanism through which Mg^{2+} modulates pro-inflammatory cytokine production in Kupffer cells; and 3) to test the hypothesis that exposure to low Mg^{2+} promotes cytokines production via increased generation of reactive oxygen species. The studies proposed here would help us understand the potential therapeutic effects of Mg^{2+} in ALD and its role as an immunoregulatory agent in inflammatory responses.

Project Mentor: Andrea Romani, M.D., Ph.D, Department of Physiology and Biophysics

Investigating the Effects of Leptocheirus plumulosus and Yoldia limatula on Sediment and Solute Flow

Jamie Dietz, Department of Earth, Environmental, and Planetary Sciences, Julia Kramer, Department of Earth, Environmental, and Planetary Sciences, Gerald Matisoff, Department of Earth, Environmental, and Planetary Sciences, Peter McCall, Department of Earth, Environmental, and Planetary Science

The research characterizes the effects of the Yoldia limatula and Leptocheirus plumulosus and their interaction with the sediment. The objective of the research was to increase the accuracy of The Army Engineer corps’s exposure assessments for contaminated sediment by developing a more complete understanding of the interaction of these benthic organisms with sediment particles, pore water and overlying water. This research provides quantitative information for cleanup decisions of contaminated sediments at military base sediment sites. The Army Engineer Corps personnel can use this research as background and additional information for determining the uptake of toxic substances on these bases. The experiment provides data about Yoldia limatula and its effects on solute movement using $^{22}$Na as a tracer, and about Leptocheirus plumulosus and its effects on particle movement using $^{137}$Cs as a tracer as well as solute movement using the $^{22}$Na. The Leptocheirus plumulosus was measured in three distinct soils, an uncontaminated silt-clay mud, uncontaminated sand, and contaminated mud from three different sites. It took into account the organism’s effects on sediment porosity by measuring the transparency of sediment microcosms to the penetration of gamma radiation, with Cd-109 as a source. This experiment is done by calibrating a gamma radiation penetration to water content/porosity of test sediments and then measuring passage of Cd-109 radiation through microcosms in 0.1cm intervals from 0-5 cm below the sediment-water interface.

Project Mentor: Dr. Peter McCall Department of Earth, Environmental, and Planetary Sciences, Dr. Gerald Matisoff, Department of Earth, Environmental, and Planetary Sciences.
Enhanced Brain Connectivity and Function in the Mathematically Gifted

Cynthia Dines (B.A. Cognitive Science and Psychology) and Rohit Mathew (B.A. Biology and Chemistry)

Recent fMRI studies indicated that students with superior mathematical abilities have enhanced brain activation in the right parietal lobe (spatial ability). Previous studies however, have failed to connect mathematical achievement and enhanced spatial abilities. The aim of this study is to further explore potential connections between mathematical and spatial abilities by administering a broader group of spatial ability tests to mathematicians from different disciplines. A secondary goal of this study is to identify immune ping neuronal activation in mathematicians of different specialties. The experimenters investigated how different mathematicians employ specific regions of the brain by using fMRI and diffusion tensor imaging to monitor them performing calculations specific to their discipline. In addition, they were monitored while undertaking general mathematical calculations in order to determine whether distinct brain regions were employed to perform each task. The general mathematical calculations were standardized to find a baseline. The data was then contrasted between specialties to determine whether there is a distinguishable alteration between the regions of the brain that are utilized. The primary purpose of this first experiment was to determine whether a high degree of correlation could be found between those with exceptional mathematic ability in a distinct field and a specific region of the brain or enhanced connectivity between two regions of the brain at the neural level. Enhanced connectivity pathways may indicate distinct features of the mathematically gifted brain. The researchers then compared the mathematician’s performance during various spatial ability tests to explore potential relationships between mathematical and spatial ability gifts.

Project Mentor: Dr. James Zull, Department of Biology

* Determination of The Differentiation Potential of Human Neural Stem Cells in The Mouse Brain

Sean Dwijendra¹, Ji-young Lee², Haleigh Golub², and Hoonkyo Suh²

¹Departments of Biochemistry & Cognitive Science, Case Western Reserve University, ²Department of Stem Cell Biology and Regenerative Medicine, Cleveland Clinic

Neural stem cells (NSCs) are specialized cells that have the capacity to self-renew and differentiate into neurons, astrocytes, and oligodendrocytes. The hippocampus is one of two brain structures where continuous neurogenesis from neural stem cells is evident. This persistent generation and integration of new neurons (granule neurons) into the hippocampal circuitry plays an important role in hippocampus-dependent functions, such as learning and memory. Disruption in adult neurogenesis has been associated with cognitive deficits in neurodegenerative diseases and psychological disorders. In particular, hippocampal granule neurons are the primary target of Alzheimer’s disease. This observation has raised the possibility that replacement of degenerating granule neurons with neural stem cell-derived neurons may alleviate or reduce the symptoms present in Alzheimer’s patients. To test this hypothesis, we used human neural stem cells and tested their potential to differentiate into hippocampal granule neurons. 10⁵ GFP-labeled human neural stem cells were transplanted, via stereotaxic surgery, into two regions of 5-week-old NOD-SCID (immune-compromised) mice brains – the hippocampus and striatum. These mice were sacrificed 1, 2, and 4 weeks post the surgery to harvest the brains. A qualitative imaging analysis showed that over time, there is a decline in stem-cell-character and progression towards a more neuronal fate. The transplanted cells, while positive for immature neuronal markers, were negative for mature neuronal markers. We infer that these cells are confined to a juncture in between the immature and mature stages. Future directions in this research include titration of the cell count during injections, the usage of transcription factors (such as NeuroD1 and Prox1) via expression vectors to instruct the fate of these cells, and allowing the cells to develop for longer periods of time.

Project Mentor: Dr. Hoonkyo Suh, Department of Stem Cell Biology and Regenerative Medicine, Cleveland Clinic Lerner Research Institute

This is a Michelson-Morley Research Competition Presentation
The protective effects of pre-natal exercise against hippocampal loss in the face of maternal deprivation in rat pups

Alex Han, Department of Biology; Roseanne Ebel, Department of Biology

Aerobic exercise has been found to increase brain-derived neurotropic factor (BDNF) and neurogenesis in the hippocampus, resulting in positive effects on memory and spatial learning. Additionally, exercise in pregnant rats has been shown to increase neurogenesis, spatial learning, and memory performance in their post-natal pups. Pre-natal maternal exercise has been demonstrated to have a protective effect against neuronal loss when post-natal pups are exposed to hypoxic conditions. We propose an experiment to measure whether exercise during pregnancy can protect against the negative effects of postnatal stress on the pup in the form of maternal deprivation. The rats would be divided into four groups: (1) control, (2) maternal deprived, (3) prenatal exercise, (4) deprived and prenatal exercise. Groups 2 and 4 would be deprived for 3 hours/day for the first ten days after birth. Maternal groups would be forced to run on a treadmill at a mild-intensity for 30 minutes a day beginning on the 15th day of pregnancy. At adulthood, the rats’ memory would be tested by water maze and inhibitory avoidance tasks. Additionally, neurogenesis in all groups would be measured by BrdU immunohistochemistry in the dentate gyrus, CA1, CA2, and CA3 regions of hippocampus. We predict that maternal deprivation will be correlated with decreased performance in both tests and less neurogenesis, but will be less dramatic in group 4 due to the protective effects of exercise. These results would support the idea that mothers who exercise in pregnancy will provide an advantage to their offspring in the case of maternal separation.

Faculty Mentor: James Zull, Department of Biology

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Removing Sunscreen Estrogen Antagonists from Pool Water using Poly(ethyleneimine) Aerogel Filters

John F. Edelbrock V, Department of Macromolecular Science and Engineering. Henry W. Milliman, Department of Macromolecular Science and Engineering.

Aerogels, with their high porosity and robust mechanical properties, have great potential for use as filtration media. Poly(ethyleneimine) (PEI) aerogels cross-linked with 1,4-butanedioldiglycidylether (BDGE) were investigated as filters. As a proof of concept, sunscreen was chosen as the contaminant to be removed from water. UV Active molecules used as active ingredients in sunscreen have been shown to pose developmental toxicity [1-3]. When a sunscreen wearer exits a pool, some of these UV active molecules remain in the pool water. Traditional pool filters do not remove these molecules. Testing sunscreen allows evaluation of traditional filtration via removal of inorganic particulate matter while also allowing evaluation of microscopic filtration via removal of easily located UV active molecules. After filtering sunscreen-water solution through each filtration media, the filtrate was qualitatively assessed for turbidity, and assessed for UV active content via UV/VIS spectroscopy. Filtrate from PEI aerogel filters showed lower turbidity than filtrate from FisherBrand P4 filter paper, and similar UV active content. With additional modification via functionalization of PEI amino groups, the effectiveness of aerogel filters could be improved dramatically. These results open the door for exploration of aerogels as filters in various applications.

Project Mentor: Dr. Henry W. Milliman, Department of Macromolecular Science and Engineering
Project Advisor: Professor David A. Schiraldi, Department of Macromolecular Science and Engineering

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Zero Modes on Curved Surfaces

Jacob Emmert-Aronson, Department of Physics and Department of Mathematics

The possibility for particles to bind to a surface plays an important role in both the study of topological insulators in condensed matter physics and cosmological domain walls. One of the key elements of both
these systems is that, while particles in the bulk are typically massive, the bound states, known as zero modes, are massless. In both cases, understanding the properties of these bound states is crucial to determining the properties of the system as a whole. While zero modes bound to flat surfaces are well-studied, very little attempt has been made to understand the effects of curvature in the surface, which is needed to understand both the effects of surface roughness in topological insulators and the dynamics of cosmological domain walls. Fortunately, the similarity of the two systems allows both to be treated via a single model, the free-particle Dirac equation with spatially-varying mass. We focus in particular on the case in which the mass changes rapidly near the domain boundary and is nearly constant away from this surface. In this limit, the Dirac equation separates into an equation for the coordinate perpendicular to the boundary, which contains a bound state with zero energy, and a curved-space free-particle equation governing the propagation of particles along the domain wall. A particular subtlety of the approach lies in determining the correct boundary conditions, which are not as would be expected from a naive approach.

*Project Mentor: Associate Professor Harsh Mathur, Department of Physics*

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**Heat it to Freeze it: Utilizing Methylcellulose’s Unusual Thermal Properties in Materials Processing**

**John Enevoldsen**, Department of Chemical Engineering

Methylcellulose possesses unusual properties that have potential advantages in materials processing. Methylcellulose is a solid that will dissolve in cold, but not in hot, water, due to the thermodynamics of the interaction of this molecule with the solvent. Methylcellulose has a lower critical solution temperature (LCST); when the temperature is below the LCST it is soluble in water, however, it will undergo a thermal transition and precipitate out if the temperature rises above the LCST. When the latter happens, the solution of methylcellulose can turn into a solid gel (e.g., it freezes upon heating). The material will remain solid as long as the temperature exceeds the LCST; it will turn into a liquid if it is allowed to cool down below the LCST. While the thermal gelation takes place the solution’s appearance changes from transparent to opaque. Our current knowledge of the transition conditions is based on observing the solution transparency but work is being done to better refine when the transitions happen. The long range goal is to find a mathematical model for the thermal transition conditions based on the molecular weight and concentration of the methylcellulose. It has been found that time of heating has a significantly lesser effect on when the transition occurs. Utilizing this transition, methylcellulose can be used as an additive in ceramic slurries to create handleable greenbodies. This additive shows great promise in expediting various sorts of materials processing.

*Faculty Mentor: Professor Donald Feke, Department of Chemical Engineering and Vice Provost*

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**Graph-theoretical algorithms for functional interpretation of genetic interactions**

**Ye Fang** and Marziehossadat Ayati, Department of Electrical Engineering & Computer Science

Synthetic Sick or Lethal interactions (SSL), a subtype of genetic interactions in which the co-occurrence of two genetic mutations is lethal, captures the functional redundancy of genes in model organisms. These interactions have long been studied in model organisms as a means of identifying functional relationships among genes. However, SSL is costly to be detected experimentally due to the large number of possible combinations of gene pairs. In this research, we focused on Synthetic lethal pairs (SL) and tried to capture the topological features of SL pairs in Protein-Protein-Interaction networks (PPI), which has been well studied especially in yeast. Our objective is to find signatures of SL interactions in the PPI network, which will be useful in predicting SL pairs. For this purpose, we develop a method for computing the parallelism between two nodes in a given network. Our experiments show that the parallelism between SL gene pairs is different as compared to the other pairs of nodes in yeast PPI network.

*Project Mentor: Mehmet Koyuturk, Department of Electrical Engineering and Computer Science*
The Effects of Corpus Callosotomy on IQ in Children

Anirudh Patel, Departments of Biology and Anthropology; Gina Ferris, Departments of Chemistry and Cognitive Science; Dr. James Zull, Department of Biology

In patients who have atonic, myoclonic, or absence seizures, corpus callosotomy is the preferred treatment option after anti-epileptic drugs no longer help. A corpus callosotomy (CC) can be performed by the complete or partial opening of the corpus collosum, which completely or partially separates the brain hemispheres from one another. Prior research has shown that seizure control in patients who had complete CCs is better than in patients who have had partial CCs. To date, the effects of such surgeries on intelligent quotient (IQ) in patients have not been investigated. The goal of this study is to compare how complete or partial CCs affect IQ in children younger than twelve years of age. We hypothesize that IQ in patients who receive partial CCs will be higher due to the corpus callosum remaining partially intact. Experimental design includes a group of patients (N ≥ 30) collected over a period of ten years. Arm 1 consists of patients receiving a complete CC, and Arm 2 consists of patients receiving a partial CC. IQ tests will be given at time points of 1) within one month prior to surgery, 2) one month post-operatively, 3) three months post-operatively, and 4) twelve months post-operatively. Additionally, Diffusion MRIs will be performed at the same time points as above for seizure activity and control. The significance of this experiment for the future is that families of patients who are candidates for CC will have information available to them about effects of CC on intelligence quotient, which could help in decision making processes for which type of CC to have.

Project Mentor: Dr. James Zull, Department of Biology

Accounting for the Sun's Gravity in Dark Matter Detection

Bill Flaherty, Department of Physics; Glenn Starkman, Department of Physics; and Craig Copi, Department of Physics

Dark matter is thought to compose a large fraction of the energy density of the universe, particularly our galaxy. The favored candidate for dark matter is weakly interacting massive particles (WIMPs), particles tens to hundreds of times the mass of protons. Scientists have built and are building detectors to look for such WIMPs passing through the Earth. An important factor in determining the signal of the WIMPs is their velocity distribution. It has also been noted that as the earth moves around the sun, the velocity of the Earth through the galaxy adds to the sun's or subtracts from it, depending on the time of year. This modulates the actual velocity distribution of the WIMPS passing through the Earth, and our detectors. The fact that WIMPs approaching the Earth must fall deep into the Sun's gravitational potential well must also be taken into account in determining the WIMPs' velocity distribution. Since that should cause an approximately few to ten percent change in the WIMP velocity it is not a negligible effect. In particular since it will increase the velocity of the fastest WIMPs, it should increase the detectability of WIMPs. It may also increase the detectability of the annual modulation of the WIMP signal as the Earth moves around the sun. This project calculates the effect of falling into the Sun's gravitational well on various possible WIMP velocity distributions as seen by an observer on the Earth.

Project Mentor: Glenn Starkman, Department of Physics

Resources for the in vivo investigation of alternative splicing in C. elegans

Charles Fulco, Case Western Reserve University Departments of Biology and Biochemistry; John Calarco, Harvard University FAS Center for Systems Biology

Alternative splicing, the process by which multiple messenger RNAs are generated from precursor transcripts of a single gene, plays an important role in generating proteomic diversity. Additionally, alternative splicing is tightly regulated temporally and spatially during development, and mis-regulation of splicing has been implicated in a myriad of human diseases, including cancer and neurodegeneration. An understanding of the molecular basis of splicing regulation may provide insight into therapeutic, preventive, and diagnostic opportunities.
for many diseases. Most prior research has been unable to analyze splicing in individual cells in vivo. We created fluorescent reporters enabling visualization of alternative splicing events in vivo in the nematode worm *Caenorhabditis elegans*. These constructs can be used as reporters in mutagenesis screens to identify novel factors that control splicing and as tools to investigate the role of alternative splicing in physiology. We also characterized the function of specific splice variants of the gene *unc-62*, a transcription factor known to regulate lifespan and contribute to several developmental and behavioral phenomena, including posterior morphogenesis in the embryo and coordinated locomotion. We compared wild type and mutant worms in thrashing and egg-laying assays, and found a specific isoform injected into mutant worms is sufficient to rescue their phenotype, returning them to normal functioning. In vivo studies such as this will be invaluable resources for identifying splicing regulators and studying the physiological and pathological role of alternative splicing.

*Project Mentor: John Calarco, Harvard University FAS Center for Systems Biology*
*Faculty Sponsor: Robin Snyder, Department of Biology*

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**In vivo visualization of cell-specific alternative messenger RNA splicing in *C. elegans***

**Charles Fulco**, Case Western Reserve University Departments of Biology and Biochemistry; John Calarco, Harvard University FAS Center for Systems Biology

Alternative splicing, the process by which multiple messenger RNAs are generated from precursor transcripts of a single gene, plays an important role in generating proteomic diversity. Additionally, alternative splicing is tightly regulated temporally and spatially during development, and misregulation of splicing has been implicated in a myriad of human diseases, including cancer and neurodegeneration. An understanding of the molecular basis of splicing regulation may provide insight into diagnostic, therapeutic, and preventive opportunities for many diseases. Most prior research has been unable to analyze splicing in individual cells in vivo. Here, fluorescent reporters enable visualization of alternative splicing events in vivo in the nematode worm *Caenorhabditis elegans*. These constructs are being used as reporters in a mutagenesis screen with the goal of identifying novel factors that control splicing and as tools to investigate the role of alternative splicing in physiology.

*Project Mentor: John Calarco, Harvard University FAS Center for Systems Biology*
*Faculty Sponsor: Robin Snyder, Department of Biology*

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**Reading True Stories: Undergraduate Experiences with Literary Journalism**

**Alexis Parisi**, Department of English & Department of Chemistry; **Nicholas Rossi**, Department of Mechanical Engineering; **Lisa Viers**, Department of English & Department of Philosophy; **Indira Samuels**, Department of Sociology; **Bryden Spevak**, Department of English & Psychology; **Anthony Gatti**, Department of Economics & Political Science

For five semesters, the course “Literary Journalism in America” has been offered in the SAGES Seminar Program at Case Western Reserve University, a program which is the university’s proxy for composition instruction. As a panel comprised of takers of this course, we will offer a “reverse-pedagogy” analysis of the experience of reading and writing about literary journalism (often as non-majors). Our panel has four primary focuses: 1) We will talk about the ways in which studying literary journalism has impacted our reading and writing in other classes at primarily a science and technology oriented university. 2) We will also offer our critical opinions on the efficacy of canonical literary journalism texts, ranging from Hersey to Didion to Paterniti. 3) We will discuss the paradoxical role that social media plays in both the propagation and potential decline of literary journalism. 4) And we will discuss the objectivity / subjectivity debate, identified by Norman Sims in “The Problem and the Promise of Literary Journalism” as one of the key issues for the future of literary journalism study. This panel will be instructive to
members of the literary journalism community because of the opportunity to converse with students outside of the classroom about their acquired knowledge of the topic. We will send out a survey and solicit questions from IALJS members regarding questions they would like to hear students talk about which will be incorporated into the presentation, while also presenting quantitative data from a five-semester, 100 student sample, of favorite and least favorite texts.

Project Mentor Dr. Joshua M. Roiland, Department of SAGES

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**Plasmodium falciparum’s Response to a Rotating Magnetic Field**

Rebecca Gilson, Department of Physics; D’Arbra Blankenship, Center for Global Health and Disease; Robert Diessler, Department of Physics; Robert Brown, Department of Physics; Brian Grimberg, Center for Global Health and Disease

Malaria causes over one million deaths per year and *Plasmodium falciparum* is the most deadly of the five types of human malaria. To prevent the build up of toxic heme as a result of hemoglobin digestion, the parasite sequesters the free heme into a lipid body where it forms the inert paramagnetic crystal hemozoin. We sought to determine if applying a strong rotating magnetic field to *P. falciparum* would affect the growth of the parasite. It was thought that this external magnetic field would prevent the parasite from creating hemozoin crystal or that the field would cause the hemozoin to damage the parasites digestive vacuole. We applied a rotation magnetic field of 0.4T to cultures of rings, trophozoites, schizonts and mixed stages at three frequencies ranging from 1 Hz to 10Hz for forty-eight hours, counting the number of parasites every 24 hours via flow cytometry. Preliminary results show reveal that at 5.5 Hz the trophozoite and schizont life stage of the parasite are being killed while the ring stage, which has no hemozoin, is not being effected. In the future, we will continue to test the affect of frequency of the rotation and the magnitude of the magnetic field.

Project Mentor: Professor Brian Grimberg, Center for Global Health and Disease; Professor Robert Brown; Department of Physics

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**The effects of flexible side chains on the behavior of ions within a Nafion membrane**

Wesley Gould, BA in Physics and Computer Science

NafionTM membranes have been known for years to hold potential for use in hydrogen fuel cells, as well as in some battery technologies. Currently the inner workings of NafionTM, as used in fuels cells, are not as well understood as would be desired. The water channel model has NafionTM forming parallel networks of approximately cylindrical pores about 2 nm in radius. In previous work, Gould and Taylor simulated the ion concentration and electric potential within these pores and compared them against theoretical predictions. These simulations were done with sulfonate groups arranged in a fixed lattice grid that was not allowed to move. Our recent work on this Senior Project has extended our previous studies. Furthermore, we have compared our results with the recent theoretical predictions of Berg and Findlay [1] The extensions will involved adding the effects of flexible side chains on the behavior of ions within a Nafion membrane. That is to say, the sulfonates are now no longer be in fixed positions. We have also modelled the current of ions under various conditions of proton concentration gradient and applied field.

References
[1] Berg, Peter and Findlay, Justin

Project Mentors: Philip Taylor, Department of Physics; Elshad Allakhyarov, Department of Physics
Mechanisms Causing Neuronal Dieback Associated with Cortical Implants

Daniel J Hageman, Department of Biomedical Engineering; Madhumitha Ravikumar, Department of Biomedical Engineering, Jeffrey R Capadona, Department of Biomedical Engineering

Recent advances in brain-machine interfaces show promise in restoring basic functions for individuals suffering from paralysis. Specifically, intracortical micro-electrodes can record brain signals that ordinarily accompany movement, translating one’s ‘thoughts’ into functional outputs. However, widespread clinical use of this technology is hindered due to variability and lack of reliability of chronic recordings. These limitations are most often attributed to the inflammatory response at the tissue-electrode interface, where neuronal die-back can be correlated to the loss of recorded signals around the implant. Recent literature suggests that microglia activation around the electrode creates a neurodegenerative state that is directly toxic to surrounding neurons. To this end, we hypothesize that endotoxins present on the electrode surface can cause microglia activation, which may contribute to neurodegeneration at the tissue-electrode interface. Here we show the tissue response two weeks post implantation for three different methods of endotoxin removal from the electrode surface: autoclaving, dry heating, and ethylene oxide sterilization. Briefly, C57/BL6 mice were implanted with chronic electrodes and allowed to survive for two weeks. These mice were then perfused transcardially, fixed in 4% paraformaldehyde, and sliced into 16µm sections using cryopreservation. Tissue sections were then stained using immunohistochemistry for each of the following cellular markers: NeuN (Neuronal Nuclei), GFAP (Astrocytes), ED1 (Activated Microglia), and IgG (Blood Brain Barrier Disruption) to study the extent of the inflammatory response at the interface. Expression of cellular markers was assessed up to 1200µm around the interface, and intensity profiles were compared for each method of sterilization using MATLAB. Our results show a gradient response between the extent of endotoxin removal from the surface and the inflammatory response around the electrode. These data suggests that removal of endotoxins from the electrode surface may be crucial in attenuating neuroinflammatory events at the interface, especially at early time points.

Project Mentor: Madhumitha Ravikumar, Department of Biomedical Engineering; Professor Jeffrey Capadona, Department of Biomedical Engineering
Faculty Advisor: Professor Jeffrey Capadona, Department of Biomedical Engineering

Endothelial Krüppel-like Factor 4 has potent anti-inflammatory and anti-coagulant effects

Andrew T. Hale1, 2; Stephanie Cabler2, 6, Hongmei Tian2, Lalitha Nayak2, 5, Mukesh K. Jain2, 3, 4, Anne Hamik2, 3, 4.

1Department of Biochemistry, Case Western Reserve University School of Medicine; 2University Hospitals Harrington Heart and Vascular Institute and Case Cardiovascular Research; 3Department of Medicine, University Hospitals Case Medical Center; 4Department of Physiology and Biophysics, Case Western Reserve School of Medicine; 5Hematology and Oncology, University Hospitals Case Medical Center; 6Case Western Reserve University School of Medicine.

The vascular endothelium plays a critical role in vascular homeostasis and quiescence. Research over the last decade by our laboratory and others has implicated the Krüppel-like factor (KLF) family of zinc-finger transcription factors as key regulators of endothelial biology. One member of the KLF family, KLF4, is widely expressed in endothelial cells in both arterial and venous vascular beds. In vitro assays performed in our laboratory suggested that KLF4’s primary functions include modulating vascular tone, mediating endothelial inflammation, and regulating thrombosis-associated gene targets. We have generated two strains of mice that allow for the assessment of the endothelial-specific actions of KLF4 in modulating thrombosis. The KLF4 transgenic mouse (Tg) exhibit increased endothelial-specific expression of KLF4, driven by the VE-cadherin promoter. On the other hand, floxed KLF4 x VE-cadherin driven Cre mice (flox/Cre) mice have endothelial-specific KLF4 knockout. Preliminary in vitro studies suggest that KLF4 may regulate critical endothelial functions. Thus, these studies are extended to focus on ex vivo and in vivo models to define the role of endothelial KLF4 in mediating coagulation, inflammation, and vascular
homeostasis. Herein, we show that endothelial KLF4 exhibits anti-inflammatory properties by controlling expression of inflammatory-associated gene products. Furthermore, we show that endothelial KLF4 promotes an anti-coagulant environment, endothelial KLF4 deficiency decreased time to clot formation in TNFα-treated HUVEC and primary murine endothelial cells, and finally that after carotid laser injury, KLF4 Tg mice had increased and KLF4 KO mice had decreased time to occlusive thrombus formation. In sum, endothelial KLF4 demonstrates potent anti-coagulation properties in vivo.

Project Mentor: Dr. Anne Hamik, University Hospitals Harrington Heart and Vascular Institute and Case Cardiovascular Research; Department of Medicine, University Hospitals Case Medical Center; Department of Physiology and Biophysics, Case Western Reserve School of Medicine.

Regulation of Angiogenesis by Endothelial Krüppel-like Factor 4

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Localized tissue hypoxia is a consequence of vascular dysfunction or rapid cellular proliferation. Hypoxia is also a potent inducer of angiogenesis - the formation of blood vessels from pre-existing vessels. The oxygen-sensitive and canonical angiogenesis-related gene product, Vascular Endothelial Growth Factor (VEGF), is highly inducible in endothelial cells and modulates vascular growth, response, and differentiation. Our group and others have implicated Krüppel-like Factors (KLFs) to play a similarly indispensable role in regulation of various aspects of vascular and cardiovascular biology. Furthermore, our laboratory has shown that Krüppel-like Factor 4 (KLF4) is expressed in endothelial cells (ECs) derived from both arterial and vascular beds. However, the role of KLF4 in angiogenesis has not been elucidated. In the presence of hypoxia, endothelial KLF4 potently induces VEGF expression, suggesting a role for KLF4 in angiogenesis. Using cultured ECs, we show that KLF4 regulates angiogenesis and also vascular permeability. To assess the role of endothelial KLF4 in vivo, we developed mouse lines with either endothelial-specific overexpression of KLF4 (Tg) or KLF4 deficiency (floxed KLF4/cre). KLF4 Tg mice were implanted with BF16-F10 melanoma cells in order to assess the role of endothelial KLF4 in modulating tumor angiogenesis. Tumors implanted in KLF4 Tg animals showed smaller tumors by mass, but increased vessel density, decreased vascular perfusion, enhanced markers of hypoxia, and no difference in pericyte coverage. Examination of the literature shows that this phenotype has been recapitulated in a haploinsufficient Dll4 (a Notch ligand) mouse model, leading to further investigation of the interrelationship between KLF4 and Notch. We show that KLF4 has a complex relationship with regulation of the Notch pathway. Analysis of KLF4 in cultured EC shows that KLF4 inhibits upregulation of Notch-activated Dll4, upregulates Dll1, and inhibits activity of the Notch activating peptide on Notch target promoters. We show here that EC KLF4 has functions consistent with an angiogenically active factor, EC KLF4 overexpression inhibits tumor angiogenesis, and EC KLF4 differentially regulates expression of Notch family members.

Project Mentor: Dr. Anne Hamik, University Hospitals Harrington Heart and Vascular Institute and Case Cardiovascular Research; Department of Medicine, University Hospitals Case Medical Center; Department of Physiology and Biophysics, Case Western Reserve School of Medicine.

This is a Michelson-Morley Research Competition Presentation
Lessons in Microenvironment Effects for Field Trials of Crops in Small Scale Agriculture

Eric S. Hamilton, Department of Biology; Christopher Bond, University Farm; Jean H. Burns, Department of Biology; Joseph F. Koonce, Department of Biology; Ana B. Locci, Department of Biology, University Farm

Crop yields are largely limited by available soil nutrients. Farms typically apply inorganic fertilizers to improve yields, yet the downstream effects of nutrient overload on watersheds are undesirable, as are purchasing costs. Organic fertilizers and compost may also be used as amendments, although this may result in lower yield. We grew tomato and squash plants under field conditions at the CWRU farm that were amended with conventional inorganic fertilizer, organic fertilizer or on-site generated compost. We hypothesized that the conventional fertilizer would produce the highest yield, but that organic fertilizer and compost may serve as useful amendments as well, providing alternatives for the farm’s food program. Surprisingly, there was no difference in cumulative yield for tomatoes between the conventional fertilizer and the control receiving no treatment. Equally surprising, both the organic and compost amendments performed significantly worse against the control in yield for tomatoes. This, despite organic and conventional treatments being matched for total nitrogen. These results and others strongly suggest that our plots experienced a heterogeneous environment that contributed to apparent treatment effects and confound our amendments study; yet, these results prove useful for understanding the difficulties of field trials in recently tilled plots and inform future studies to be done at University Farm.

Faculty Mentor: Ana B. Locci, Department of Biology, University Farm

This is a Michelson-Morley Research Competition Presentation

Determining the Structure of the Agn43 Leader RNA

Disha Haque, The Department of Biochemistry; Dr.Pieter de Haseth, RNA Molecular Biology Center; Heather Oreh, RNA Molecular Biology Center

The overall goal of our project is to determine how Agn43 expression continues despite the presence of a classic transcription terminator upstream of the coding sequence. Agn43 is an outer membrane protein, coded for by the agn43 gene, found in gram negative bacteria. This protein plays a significant role in the formation of biofilms or dense cultures of multiple bacterial species. Biofilms can form on the urogenital tract, teeth, artificial heart valves, and catheters to name a few surfaces. The first goal of our project was to confirm the possibility of a transcription terminator in the Agn43 secondary structure using bioinformatic techniques. From there the amount of Agn43 DNA was amplified using Polymerase Chain Reaction. The PCR product was purified and then transcribed using T7 RNA polymerase in order to generate RNA for structural analysis. Now ribonucleases will used to cut the RNA in order to determine which regions are single stranded and which are double stranded. The generated fragments will then be compared to a computer generated model of the Agn43 leader RNA. The future aims of this project are to use this data to confirm the presence of a transcription terminator and determine the mechanism of Agn43 expression control via antitermination.

Project Mentor: Dr. Pieter de Haseth, RNA Molecular Biology Center

Design of a Spin Top using 3D CAD Modeling and Utilizing Resources in Think[box]

Rikhabh Jain, Department of Biomedical Engineering, Michael Harkins, Department of Engineering, Sonny Li, Department of Engineering, Ashley Killian, Department of Biomedical Engineering

Think[box] is a developing CWRU facility, currently located in Glennan, that provides students and faculty with tools to design and fabricate ideas. This project is focused on the design and construction of a memento that
could potentially be gifted to donors and visitors to remind them of the wonders of think[box]. The design incorporates the various resources and amenities available in think[box]. Our design group has taken advantage of the childish nature of individuals to attract their attention through a spin top. The sleek design incorporates three rings surrounding a central immobile shape, engraved with the letters of “think[box]” and “CWRU”. As the top spins the rings will move at a high velocity enabling the user to read the letters on the internal static shape. Included in this design is a customizable triangular stand that includes a business card tray, name plaque, and the word “think[box]” on each side. The goal is to finish the design and manufacture to test market the product to students and faculty by the end of the semester.

Project Mentors: Professor Malcolm Cooke, Department of Mechanical and Aerospace Engineering, Professor Patrick Crago, Department of Biomedical Engineering

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Genome-wide comparison among melanogaster sibling species reveals candidate genes involved in myogenesis Diversification

**Ryan M Haskins**, Department of Biology; Yunyi Yang, Department of Biology; Juan S Chahda, Department of Biology; Joseph Schinaman, Department of Biology; Mirela Belu, Department of Biology; Youngmin Chu, Department of Biology; Lyndsie Haefke, Department of Biology; Rui Sousa-Neves, Department of Biology; Claudia Mizutani, Department of Biology

*D. melanogaster, D. simulans and D. sechellia* are three sibling species that exhibit significant developmental and behavioral differences despite their recent divergence. To begin probing these differences and gain a better understanding of the mechanisms that operate in species differentiation, we reconstructed the genomes of *D. sechellia* and *D. simulans* and made pair-wise BLAST analysis of coding sequences against the *D. melanogaster* genome (Sousa-Neves, R. and Rosas, A., 2010). By selecting the group of genes that are most similar between *D. simulans* and *D. sechellia*, but most divergent in *D. melanogaster* (i.e. ancestral alleles of *D. simulans* and *D. sechellia*), we expected to identify genes that distinguish these two newer species from *D. melanogaster*. In this work, we screened for candidate ancestral alleles to be involved in a novel phenotypic variation of myoblast fusion that distinguishes *D. melanogaster* from its sibling species. We selected genes expressed in a narrow window of embryonic development when myogenesis takes place. Our screening led to the identification of two novel genes: *snail-minded (sami)*, and *faulty attraction*. *sami* is expressed in the presumptive mesoderm and mesodectoderm, in a combined pattern of both *single-minded* and *snail*, an essential gene for muscle development. *faulty attraction* encodes a predicted EGF-like secreted protein that initiates expression during somatic myoblast fusion and remains exclusively expressed in the somatic body muscle fibers. Functional analyses of these genes are currently under way. The screening method presented here could theoretically be applied to any biological processes relevant to the diversification of this group of species, and may provide a valuable tool in addition to classical mutagenesis screenings to identifying novel developmental genes.

Project Mentor: Claudia Mizutani, Department of Biology

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Error Correction in CPG Gait Control of Cockroach and Rat Models by Characterizing PID like Neural Response in Simulation

**Jessica Hatch**, Engineering Physics BSE, Center for Biologically Inspired Robotics Research, Department of Physics

The Center for Biologically Inspired Robotics Research is building a computational neural system for leg coordination into gaits that automatically adapt to irregular terrain for modeling animals and for control of legged robots. To construct this biologically-based simulation, a complex system of components modeling muscles, sensors, and neural-networks is used. To ensure a smooth walking pattern, there is a need for a sub network of neurons that acts as feedback loop for the Central Pattern Generator. There is biological evidence to suggest that
there is a proportional-derivative type controller that acts as the check between joint motions and commands issued by the central nervous system. In order to build this network the response of single neurons and combinations of neurons must be explored and compared to proportional, derivative, and integral responses of the test inputs. Three different inputs were used: a tonic, burst, and repetitive current, and eight neurons were characterized. The ultimate goal is to use these characterized responses to create a dynamic model that optimizes behavior and performance, and further research is needed to build and test the PID controller from the available neurons.

*Faculty Mentor: Dr. Roger Quinn, Department of Mechanical and Aerospace Engineering, Center for Biologically Inspired Robotics Research*

**Effect of the Physical Parameters of Nanoparticles on Their Margination In vitro**

**Elliott Hayden**, Department of Biomedical Engineering; **Randall Toy**, Department of Biomedical Engineering; **Christopher Shoup**, Department of Biomedical Engineering; **Efstathios Karathanasis**, Department of Biomedical Engineering, Department of Radiology

Advances in nanotechnology have allowed the development and fabrication of numerous types of nanoparticles with direct imaging and cancer therapy applications. Nano-fabrication techniques provide the ability to design nanoparticles with very different characteristics including size, shape, density, and surface chemistry. Liposomal nanoparticles provide an improved mode of delivery of therapeutics into tumors by escaping through leaky tumor vasculature allowing direct access to tumor cells. Functioning as cancer therapeutics, it is critical that these nanoparticles are able to marginate toward the blood vessel wall, escape the leaky tumor microcirculation, and interact with cancer cells in the tumor interstitium. This research is primarily concerned with the first step in the transport of nanoparticles through tumor microenvironment; margination toward the blood vessel wall. Through the use of microfluidic channels replicating the dimensions of a small vessel we were able to test the margination and wall deposition of different types of nanoparticles. In this work, we evaluated the effect of critical physical characteristics such as the particle shape, size and density on a nanoparticle’s tendency to marginate towards the vessel walls in microcirculation using an *in vitro* model.

*Project Mentor: Professor Efstathios Karathanasis, Department of Biomedical Engineering, Department of Radiology*

**Role of Cited2 in Lung Tumorogenesis**

**Yiran He**, Department of Biology

The process that causes cancer involves a problem with the function of a cell’s DNA. Cited2 (CBP/p300-interacting transactivators with glutamic acid (E) and aspartic acid (D)-rich tail 2) is a transcriptional modulator mapped to human chromosome 6q23.3, within the proposed locus for lung cancer 1 gene. Dr. Yang’s lab previously reported that Cited2 is required for fetal lung maturation by regulating C/EBPα expression, a key regulator in airway epithelial maturation and lung carcinogenesis. The purpose of our experiment is to test the hypothesis that Cited2 gene can suppress lung cancer development. Two groups of mice, wild type +/+ mice and Cited2 knocked out +/- mice, were prepared in Dr. Yang’s lab. They were injected with urethane to induce tumors. Lung tissues were fixed in 4% formaldehyde and kept in 30% sucrose at four degrees Celsius. We embedded the tissue in OCT, and cut the embedded tissue in a Leica cryostat machine. Each section is 8 µm in thickness. We collected one section for every 144 µm to get representative samples of the tissue block. Those sections were stained in hematoxylin and eosin. The experiment is ongoing, and next the samples will be digitalized with a Leica SCN400 at 20x magnification. We will then quantify the tumor numbers, tumor distribution, and tumor sizes in digital images. We expect Cited2 knocked out mice will have more tumor cells than the wild type mice. Such evidence will indicate that the cited2 gene may be a potential tumor suppressor gene.

*Project Mentors: Professor Hue lee Kaung, Department of Anatomy, Professor Ronald Oldfield, Department of Biology; Professor Yu-Chung Yang, Department of Biochemistry.*
Gene Delivery Using Polyelectrolyte Complexed Chitosan-Alginate Nanofibrous Scaffolds

Michael Hill, Department of Biomedical Engineering; Sung In Jeong, Department of Biomedical Engineering; Eben Alsberg, Departments of Biomedical Engineering and Orthopaedic Surgery

Delivery of genetic material from biopolymer scaffolds is a promising approach for tissue regeneration or treatment of certain diseases, as regulation of protein expression can promote regenerative processes or inhibit those that are detrimental to healing. Some current avenues of investigation in gene delivery are centered on achieving sustained and controlled release while simultaneously preventing degradation of the gene molecules, in order to avoid a high number of repeated doses and ensure that the molecules remain bioactive for the duration of delivery. In this study, an electrospun nanofibrous mesh consisting of two natural polymers, chitosan and alginate, was used as a delivery vehicle for genes regulating green fluorescent protein (GFP). The association of gene molecules to the scaffold’s surface was demonstrated qualitatively through fluorescence microscopy. Flow cytometry showed sustained effects on GFP in cells for at least three days, and sustained release was demonstrated over a seven day period. This system contains numerous advantages over existing technologies, including topographical cues from the nanofibrous structure that promote cell attachment and proliferation, a natural polymer composition whose byproducts of degradation are easily cleared by the body, and a polyelectrolyte interaction between the chitosan and alginate that eliminates the need for a crosslinking agent, while allowing for the binding of gene molecules through charge association. Future work will examine the extended release profile and bioactivity of released gene molecules, quantify the initial loading, and expand this gene delivery system to other electrospun polymeric platforms.

Project Mentor: Professor Eben Altsberg, Departments of Biomedical Engineering and Orthopaedic Surgery

The Impact of Technology on the Pre-Frontal Cortex

Howard Hu, Department of Chemistry, Neha Kapasi, Department of Biology

Smartphones, instant messaging, and Internet make large amounts of information available and easily accessible. The human brain has long been able to change and adapt, but does it have its limit specifically in the pre-frontal cortex, the decision-making region of the brain? The impact of overstimulation from technology may be affecting decision-making processes at the level of brain development.

The focus of this study is to see how technology affects pre-frontal cortex neuronal branching and if the shift towards the use of technology in education for the best. Our hypothesis is that technology inhibits branching in the pre-frontal cortex, therefore affecting social behaviors.

There are a couple different experiments that can be used to find a correlation. Myelination in the brain appears as white matter; white matter tracks can be observed through Diffusion MRI. We hope to observe the white matter tracks in two very distinct groups of children: technology savvy and technology naive. Comparing white matter track branching may lead a better understanding of technology’s impact on brain development. Using these two groups, we also would preform fMRIs in order to view pre-frontal cortex activity, to see which group had a more active pre-frontal cortex.

The significance of this research can be taken in a few different directions. If the pre-frontal cortex activity decreases due to technology, the effect of technology on education would be worth researching. Additionally, high-risk behaviors may be correlated to technology at the level of the brain.

Project Mentor: Professor James Zull, Department of Biology
Amylin treatment regulates neuronal signaling associated with synaptic plasticity

Jessica Hwang, Department of Chemistry; Brittany Adler, Department of Neurosciences; Jaewon Chang, Department of Neurosciences; Hyoung-Gon Lee, Department of Pathology; Xiongwei Zhu, Department of Pathology; Gemma Casadesus, Department of Neurosciences

Current data suggests that metabolic alterations such as diabetes or obesity may lead to Alzheimer’s disease (AD) development. Amylin is a critical hormone for weight/insulin control that we have shown to also regulate learning and memory function and to be reduced in AD patients compared to controls. Thus, to elucidate the mechanisms involved in amylin’s ability to modulate memory function we determined whether amylin was able to activate signaling pathways associated with learning and memory function and AD pathogenesis in a mouse model of age-related Alzheimer’s disease (SAMP8). Furthermore, we also determined the ability of amylin to regulate neuronal plasticity mechanisms such as hippocampal neurogenesis in wild-type C57/B6 mice, a known mechanism of learning and memory. Our data indicates that amylin increases neurogenesis and in addition, our data also indicates that our treatment differentially regulates cognition-associated signaling proteins in the SAMP8 mouse. Taken together, our results demonstrate that amylin is a powerful modulator of mechanisms associated with cognition and suggest that amylin treatment could provide a novel strategy to combat the development/progression of AD.

Project Mentor: Dr. Gemma Casadesus, Department of Neurosciences
Faculty Sponsor: Professor Michael Kenney, Department of Chemistry

Dental Malocclusion and Stress

Ji Young Hwang (B.A Biology)

The importance of healthy teeth has long been emphasized across both Eastern and Western countries. It is widely accepted today that dental malocclusion is related not only with temporomandibular joint (TMJ) pains but also with certain chronic illnesses. The importance of the well-balanced masticatory system in general health problems was addressed in the past literature. Dental malocclusion alters the performance of mastication, which affects the temporomandibular joint and their supporting tissues along with other structures of head, vertebrae, and pelvis that can cause painful syndromes in these and even distant parts and general health problems. Dental disorders including dental malocclusion contribute to so-called the TMJ syndromes which include TMJ pain, headaches, and auditory dysfunction such as hearing loss, ear pain, tinnitus, and certain chronic minor illness. Some experimental studies reported the stress-induced increase of cortisol and costicosterone levels in animals with dental malocclusions induced by the insertion of sprint or occlusal reductions and suggested that dysfunctional occlusal relationship can provoke an endocrine response.

Project Mentor: Richard Drushel, Department of Biology

Correlates of Empathy and Callousness in Brain Morphology of Normals

Brian Hysell, Department of Cognitive Science

The neural underpinnings of empathy and a lack thereof – i.e., callousness – have been examined on both functional and structural bases. However, with respect to the latter, structural studies have so far focused on diseased populations. Here we examine the structural correlates of empathy and callousness in neurotypicals. Using voxel-based morphometry of T1-weighted MRI images we will perform multiple regression analyses contrasting Interpersonal Reactivity Index (IRI) Empathic Concern, IRI Perspective Taking, and Self-Report Psychopathy Scale III Callousness scores of 135 neurotypical subjects against gray matter structure. In doing so we will clarify the roles and importance of neurological structures highlighted in studies of diseased individuals.

Faculty Advisor: Anthony I. Jack, Department of Cognitive Science
Characterization of Medical Plastics by Thermal Analysis of Nylons

Michelle Song, Department of Macromolecular Science and Engineering; Linda Relson, Undecided; and Paul Hyun, Undecided

In our study, nylon 6 and 66 were selected as models for medical device selection based on their quality properties. The glass transition of Nylon 6 is 111 °C. It melts at 220 °C. Long molecular chains of nylon 66 with multiple hydrogen bond sites make this synthetic material resilient and dense. The structure results in a high melting point of 260 °C. The glass transition temperature is around 50°C. In 33% glass filled Nylon 6, fibers give a tensile strength that is 200% higher than that of nylon 66 (32,000 psi), a heat deflection that is 260 °C (compared to 71°C), and has a melting point of about 280°C. When one selects a nylon for a medical device, nylon 66 is highlighted based on its higher (DSC, TGA) stability. Nylon 6 had lower Tg and Tm values than Nylon 66. Amorphous nylon is not considered based on its lower stability and detected clearly by TGA. The dielectric behavior of nylon 66 reinforced our conclusion that it is the most stable in this study group. DEA of fiber reinforced (glass) nylon 66 was measured to have even a higher stability. A macro-photographic image of 4 nylons in the study pointed out that the three were crystalline by their opaqueness and one was amorphous by its transparency. Nylon 6 in this study was not as stable but is much more stable than polyolefins. The dielectric behavior of amorphous sample indicates that it is more flexible than the rigid nylon structure based on its activation energy of charging.

Project Mentor: Professor Alan Riga, Department of Macromolecular Science and Engineering

* “Wanting to create programs to enhance the quality of life for those with hearing loss? Find a closer focus in the issue so as to better help them from these research results.”

Brittany E. Immormino, Department of Communication Sciences and Sociology

The research that will be conducted will prove if there is more to look at other than just “hearing loss” when designing quality of life programs for the hearing impaired and will show if there is significance to understanding how to care for others who have hearing loss. To test this, the study will be conducted within three main parts. First, scores from three different questions on the Hearing Handicap Inventory for the Elderly (HHIE-S) will be gathered from the VA Hospital in Cleveland, Ohio. The patients will remain anonymous but there are requirements for which patients’ data can be collected. There will be two groups of subjects: one group with a flat hearing loss and the other with a high frequency hearing loss. Each group can have no more than a moderately severe hearing loss. The second part of the research consists of analyzing the data using SPSS to see if there is any particular range of frequencies that correlate to any specific quality of life differences. Part three of the research simply looks at making conclusions about the similar or different result findings from part two. These conclusions will prove or disprove if there really is an importance to looking at the different frequencies of hearing loss and not hearing loss as a whole. The hypothesis suggests that there are differences in how individuals experience a handicap based on the frequency range of hearing loss that they have. The ways in which it affects these individuals’ lives is important to recognize so each of their handicaps can be treated uniquely and not grouped in a general category; rather, grouped in a range.

Project Mentor: Darlene Moenter-Rodriguez, PhD., Adjunct Assistant Professor Communication Sciences

Faculty Advisor: Barbara A. Lewis, PhD., Department of Psychological Sciences
Studying the Magnetic and Optical Properties of Malaria for Use in Early Detection

Jason Jones, Department of Physics; Robert Deissler, Department of Physics; Brian Grimberg, Department of Global Health; Robert Brown, Department of Physics, William Condit, Not Affiliated

When the Malaria parasite ingests the hemoglobin of the red blood cell, it sequesters the toxic iron inside of its abdominal vacuole for safety. The iron atoms reside in a carbon structure to make up the hemozoin crystals. The iron structure of the hemozoin form thin needle shapes, leading to a noticeable paramagnetism. This project has studied the effect of magnetic fields on the alignment of the hemozoin. Hemozoin blood samples have been subjected to a polarized laser beam in combination with a time-varying external magnetic field produced by moving magnets. Using the optical dichroism of the aligned crystals, the relationship between the magnetic field strength, the polarization of the laser and the transmitted intensity has been investigated. A still-current goal of the project is to develop a detection device sensitive to the concentration levels relevant to infected blood that can be used in a field setting quickly and efficiently.

Project Mentors: Professor Robert Deissler, Department of Physics; Doctor Brian Grimberg, Department of Global Health and Disease

Ultrasonically assisted crystallization processes

Aaron Keith, Department of Chemical Engineering

Supersaturated solutions contain a higher concentration of solute than is thermodynamically stable in the solvent. Such solutions can be obtained when a saturated solution experiences a change in temperature, volume, or pressure in a gentle manner that does not initiate the nucleation and growth of precipitates. Once a supersaturated solution is made it is relatively easy to turn it back into a saturated solution. For example, physically shaking the system will provide enough energy to initiate the precipitation process, thus turning the solution back into a saturated state. This research is concerned with using ultrasound technology to “kick-start” the nucleation and precipitation process, and to observe the morphology of the solids that result. Using ultrasound technology may lead to improved performance as well as provide additional information useful to optimize crystallization processes.

Project Mentor: Dr. Donald Feke, Department of Chemical Engineering

A Comparative Study of Arboreal and Terrestrial Squirrel Locomotion

Cameron Keller, Department of Biology

The fox squirrel, a tree squirrel, is a unique mammal for studying locomotion due to its use of differing gaits and its ability to travel on multiple substrates. In this research, I looked at the differences of the fox squirrel’s locomotion as it traveled on the ground and in a tree. The tree squirrel is able to travel safely and swiftly while moving horizontally and vertically up and down on a tree. I compared the gait patterns and leg joint kinematics as it traveled on its arboreal and terrestrial substrates. In order to analyze the tree squirrel’s locomotion patterns, I used a high-speed camera at 120 or 240fps and the motion analysis software, WinAnalyze. Using the software, the stance and swing phases of the squirrel were examined to create gait analyses and to see whether each leg was in phase with one another. The joint angles of the squirrels were calculated during locomotion to analyze the flexion and extension of the joints while traveling. The results from these methods can be compared to see the locomotion differences between terrestrial and arboreal gaits. I am testing the assumption that the fox squirrel’s locomotion patterns and leg kinematics will differ on the ground and on a tree in order for the tree squirrel to be able to continue to move swiftly and securely on the various substrates.

Project Mentor: Dr. Roy Ritzmann, Department of Biology
Are you addicted? The neural mechanisms behind drug, technology, and behavioral addictions.

**Hanna Kim** (B.A. Biology) and **Shana Patel** (B.A. Biology and Economics)

Addiction is considered to be a psychological or physical dependence on a particular substance, entity, or activity. There has been an increase in the prevalence and diagnosis of addictions. The occurrence of all addiction ranges from 15% to 61% among U.S. adults. In addition, 47% of the U.S. adult population suffers from maladaptive sign of an addictive disorder within a year. There have been many problems with the fact that diagnosing addiction is difficult because there has only been speculations about the neuromechanisms that are involved within the addiction process. In the recent years, an important conceptual advancement has been understanding the neurochemical processes within the reward learning system that underlie the causes of addiction. Particularly, two neurotransmitter systems, dopamine and glutamate, that circulate through regions of the forebrain, limbic system, and basal ganglia play a key role in regulating adaptive behavior. In this study, we compare and contrast the different neural mechanisms that occur specifically between cigarette, food, and Internet addiction. Experiments that have been reviewed suggest that these addictions differ in cognitive inputs but have similar connections to behavioral outputs. In general, the consensus seems to be that there is a correlation between addiction and the shift of neural control from the pre-frontal cortex to the dorsal striatum. We will review available studies into the different addictions to understand the general mechanism, which will provide a biological basis into the diagnosis of addictions.

*Project Mentor: James Zull, Department of Biology*

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**Interleukin-6: A target in diet-induced tumor progression?**

**Justine Ko**, Department of Biology; **Stephanie Doerner**, Department of Genetics

Interleukin-6 (IL-6) is a cytokine that is often involved in the pro-inflammatory immune response during injuries and healing. Additionally, it has been known to be involved in complex diseases like obesity and aid in the tumor progression of many cancers. Research from the Nadeau Lab has shown that high-fat diets increase polyp numbers in the intestinal neoplasia mouse model, Apc<sup>Min/+</sup>. It is also known that the pro-inflammatory immune response has a role in dietary-induced inflammation. This study will focus on how IL-6 may be a target in diet-induced tumor progression in Apc<sup>Min/+</sup> mice. These mice are prone to small intestinal polyps, and after being placed on high-fat diets, they show increased polyp numbers after just 30 days. The goal of this study is to determine whether inactivation of the IL-6 gene can placate this diet-induced tumor progression and reduce polyp numbers. By breeding knockout IL-6 mice with the tumor susceptible Apc<sup>Min/+</sup> mice, the pro-inflammatory function of IL-6 will be inhibited, thus reducing tumor growth. As a result, it is hypothesized that a decrease in polyp numbers in knockout IL-6<sup>-/-</sup>; Apc<sup>Min/+</sup> mice treated with the high fat diet will be seen when compared to normal Apc<sup>Min/+</sup> mice fed the same diet. This result would indicate that IL-6 plays a crucial role in diet-induced tumor progression and could be a potential target against it. Experiments and data analysis are currently still underway for this study.

*Project Mentor: Stephanie Doerner, Department of Genetics
Faculty Mentor: Richard Drushel, Department of Biology*

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**Applying Solar Pyrometallurgy to the Recovery of High-Value Metals from E-waste**

**Michael Kottman**, Department of Materials Science and Engineering.

Electronic waste poses a large environmental problem to many areas that do not have the technology or infrastructure to properly recover the contained materials. It is hoped that by employing solar pyrometallurgy techniques these regions would be able to recover the materials without the use of open acid baths or uncontained...
fires, which release hazardous byproducts. To optimize the effectiveness and ease of operation, a two-mirror configuration consisting of a primary parabolic mirror and an undesignated secondary mirror was chosen so as to produce a focal point that would be easy to access. The design the project was investigated using ray-tracing software to simulate various solar concentrator designs and determine the optimal configurations. The secondary reflector designs simulated were hyperbolic, flat, spherical, and parabolic mirrors. While a hyperbolic secondary reflector produced a narrow focal point, they were less appropriate when the mirrors could not be well aligned with the sun due to an increased chance of burning out panels on the parabolic mirror. In contrast, the spherical reflector did not produce a solitary focal point, but resulted in a beam that dispersed the energy over a wider area; this allows the same amount of energy to be concentrated on the furnace, but with a lower risk of unintentional damage resulting from a misaligned mirror. The furnace for the e-waste was chosen to be a fireclay crucible suspended in a fused silica tube for the thermal shock resistance provided, and a previously researched three-stage refinement process was modified for investigation.

Project Mentor: Dr. James McGuffin-Cawley, Department of Materials Science and Engineering

High- and Low- Level Autonomy for Complete Coverage Robotic Path Planning

E.J. Kreinar, Department of Electrical Engineering and Computer Science; Bradley Hughes, Department of Electrical Engineering and Computer Science; Henry Snow, Department of Electrical Engineering and Computer Science; Andrew Smith, Department of Mechanical Engineering; Jonathan Hall, Department of Electrical Engineering and Computer Science; Dr. Roger Quinn, Department of Mechanical Engineering

Complete coverage robots such as a robotic lawnmower present a challenge for autonomous navigation because any unplanned deviation results in a portion of the area being uncovered. Therefore, the two significant problems with complete coverage path planning are that A) planning needs to dynamically account for unknown obstacles, either permanent or temporary and B) planning should correct for discrepancies between the projected path and the actual travelled path. A competitive autonomous lawnmower needs to include an advanced system for higher level autonomy (long term dynamic path planning) as well as robust lower-level autonomy (mower controls, basic reflexes, etc) to ensure desired performance with limited human interaction. This research investigates and simulates an “ad hoc” solution of the dynamic path planning problem. A complete-coverage path planning program is developed which can effectively plan paths assuming total knowledge of an area and internal obstacles. In addition, a contact sensor is created which allows the robot to effectively avoid obstacles with light “bumps.” The research uses the CWRU Cutter autonomous lawnmower as a platform for testing and simulation.

Project Mentor: Professor Roger Quinn, Department of Mechanical Engineering

Feasibility of Solar Thermal Water Heating Systems on Case Western’s Campus

Steve LaDelfa, Department of Chemical Engineering, Matthew Moss, Department of Philosophy

Solar energy is an abundant and free resource that is available to all who have the space and capital to install the appropriate system to capture and convert the energy into a useable form. Solar thermal water heating systems are one way to use the thermal energy from sunlight to heat domestic water for a variety of uses. Current conventional systems that utilize coal or gas generate significant amounts of pollution that can be offset or even eliminated by this technology. Solar thermal systems can be expensive and complicated to install, and as such, require in depth analysis, significant preparation, and proper planning ensuring effective use of such technology. In order to determine the feasibility and cost-effectiveness of a solar thermal system on Case Western Reserve University’s campus, we conducted an investigation into a variety of collectors and a detailed analysis of the potential performance of such systems using simulation software and firsthand accounts of professional installers and manufacturers. In addition, we also questioned companies with functioning solar thermal systems on the efficacy of their installed systems. We found that the technology was feasible for our location (Cleveland, OH), and the effectiveness (and return on investment) of solar
thermal depended upon the average daily hot water demand and specific method of water heating in the desired building. Thus, we conclude that this technology is potentially beneficial in the long run pending hot water metering and specific site evaluations conducted by the appropriate professionals. Case is currently looking into an installation this spring.

Project Mentor: Gene Matthews, Facilities Services
Faculty Advisor: Dr. Philip Taylor, Physics Department

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Electrochemical Stabilization of Low-Strength Soils for Landslide Prevention in Ohio

Emily LaPietra, Department of Geological Sciences and Mechanical Engineering; Dr. Beverly Saylor, Department of Geological Sciences; Dr. Joseph Prahl, Department of Mechanical Engineering; Dr. Xiong Yu, Department of Civil Engineering

Each year, the Ohio Department of Transportation spends about $40 million to remedy problems caused by landslides in areas of low-strength soils and shales. Due to the costly and repetitive nature of remedial solutions, research into preventative and permanent methods, such as electrochemical stabilization, has become necessary. Electrochemical stabilization is a technique in which an electric potential placed across a moist, electrolyte-seeded soil induces fluid flow from the anode to the cathode and precipitation of new minerals that cement the treated sample together. Past research has determined excellent options for electrode materials and electrolyte chemical compositions, however standards for current density, water content of the sample and harmful changes in pH as a result of this technique are not well documented, especially not for large-scale applications such as landslides. This study strives to effectively strengthen Ohio soils in a manner than can be scaled up for use on slopes and around support structures, as well as provide a preliminary standard on which further research can be built. Samples used in this study include pure bentonite clay, a blue marly clay from a landslide area along northern Martin Luther King Jr. Drive in Cleveland, OH, as well as the Cleveland Shale from a landslide event along southern Martin Luther King Jr. Drive that occurred in the Summer of 2011.

Due to the remoteness of some landslides and the need for a decent amount of power for electrochemical stabilization, a photovoltaic power source for the purpose of large-scale electrochemical stabilization is also being developed. Power-draw using a conventional power supply in the small-scale laboratory tests will be scaled and limited based on the power specifications of commercially available solar panels. Techniques that help make electrochemical stabilization more energy-efficient will also be investigated in this concurrent study.

Project Mentor: Dr. Beverly Saylor, Department of Geological Sciences

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Genetic Factors in the Progression of Alcoholic Liver Disease

Peter Lee, Department of Physics; Dave DeSantis, Department of Nutrition; Dr. Colleen Croniger, Department of Nutrition

Alcoholic liver disease (ALD) is the leading cause of illness and death from liver complications in the United States. Specifically, alcoholic steatohepatitis (ASH) is a type of liver disease characterized by the accumulation of fat in liver (steatosis) in conjunction with liver inflammation (hepatitis). ASH is also a precursor to severe liver complications such as fibrosis and cirrhosis. Previous studies have shown that the development of ASH varies greatly in different genetic populations. Recently, we have identified a target gene (Nlrc4) that may play an important role in ASH progression. We have seen that Nlrc4 expression levels vary greatly between different strains of mice, and that Nlrc4 expression is regulated by transcription factor Cdx1. In this project we examine the role of Nlrc4 in the progression of ASH, and the effect of a single nucleotide deletion at the Cdx1 binding site of Nlrc4 on the gene’s expression levels in the liver. We found that Nlrc4 is involved with the inflammatory response. Elevated levels of Nlrc4 resulted in increased cell apoptosis. It was also seen that a single nucleotide deletion at the Cdx1 binding site of Nlrc4 resulted in down regulated Nlrc4 expression in hepatocytes, and up regulated Nlrc4 expression in liver macrophage cells. We believe that this deletion mutation has a protective effect by reducing hepatocyte death in conjunction with reduced inflammatory marker release from liver macrophages.

Project Mentor: Dr. Colleen Croniger, Department of Nutrition
The Effects of Substrate Temperature and Oxygen on Transparent Conductive Oxide Material Properties

Heather Lemire, Department of Chemical Engineering

Transparent conductive oxides (TCOs) are used as the top layer to thin film solar cells, creating an electrical contact while allowing sunlight to reach the absorber layers below. Indium-doped tin oxide (ITO) is widely used, but undesirable due to the high cost of In. Aluminum-doped zinc oxide (AZO) is an alternate TCO, but typically does not perform as well as ITO. In this study, both ITO and AZO have been deposited using sputter deposition, and the resulting electrical and optical properties have been optimized by controlling the deposition temperature and the percent O₂ in the deposition environment. The thickness, electrical resistance, and transparency of the samples were recorded and compared to determine the optimal parameters for deposition of each material. Future studies will be concerned with the degradation of the TCO layer, which has been found to be a primary contributor to cell and module failures. The properties of commercially available ITO will be observed throughout exposure studies in both damp heat and an outdoor environment. Silane coatings will then be applied to the ITO and the degradation studies performed again, to improve the interface between the TCO and the bulk absorber and retard the degradation processes. A degradation study for commercially available AZO will also be considered in the research.

Project Mentor: Dr. Ina Martin, Department of Physics, Professor Ken Singer, Department of Physics
Future Studies: Dr. Ina Martin, Department of Physics, Dr. Roger French, Department of Materials Science and Engineering.

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Optimization of the Static First Hyperpolarizibility of One or Many Non-Interacting Fermions in One Dimension

Joseph Lesnfsky, Department of Physics, Case Western Reserve University; Rolfe Petschek, Department of Physics, Case Western Reserve University, Tim Atherton, Department of Physics, Tufts University

Large non-linear electronic polarizabilities would be advantageous for a variety of devices and has been intensely studied for around three decades. This project will examine theoretical limits on the first non-linear electronic susceptibility of a material, β, known as the hyperpolarizability. In his paper ‘Physical Limits on Electronic Nonlinear Molecular Susceptibilities’ Kuzyk suggests that there is a theoretical maximum to the hyperpolarizability of N fermions. Numerical optimizations for a single fermion in a one-dimensional potential strongly suggest that the actual value converges to 0.708951 times the theoretical limit. We will continue the study of a single electron by modeling the potential starting from the simple quantum harmonic oscillator (SHO) and perturbing the Hamiltonian with linear combinations of Hermite polynomials to maximize the hyperpolarizability. We will then examine the Hessian curvature near the maximum to deduce what parts of the wave function and the potential are integral to attaining this maximized hyperpolarizability. The hyperpolarizability for multiple non-interacting fermions will then be investigated using similar techniques. This may suggest significantly stronger limits on the hyperpolarizability of many electron systems.

Project Mentor: Rolfe Petschek, Department of Physics, Case Western Reserve University

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From Classrooms to Communities - EWB-CWRU Students Exercise Engineering Education

Alexandra Litofsky, Department of Civil Engineering, Department of Modern Languages and Literature – Spanish; and Matthew McPheeters, School of Engineering – Engineering Physics

Engineers Without Borders - Case Western Reserve Student Chapter, founded in 2003, is part of a greater worldwide movement that is committed to the pursuit of community-based development through the design and
implementation of sustainable engineering projects. Our dream is to help create a world where every human being is able to meet their basic needs. We work towards this goal by partnering with communities around the world and pursuing projects desired and needed by our partner communities. Our chapter is currently engaged in three international projects, as well as several local projects, and is anticipating expanding our scope to include additional projects and programs. Our current international projects are in the Dominican Republic, Thailand, and Cameroon and are currently focused on providing sufficient accessible, clean, and safe drinking water in our partner communities, through the installation of wells, distribution systems, pumps, and filtration and treatment systems. To develop the designs for these systems, student members work closely with professional mentors and academic advisers, learn from other students across disciplines, and do significant self-driven research and exploration. In addition, students manage the construction and logistics on the ground required to successfully complete the implementation of their designs. This work cultivates experiential learning and the application of engineering principles outside of the classroom toward beneficial projects. Each of these projects provides students the unique opportunity to see that their designs are carried out to completion, and with that experience comes the wisdom of improved engineering intuition, the skills of working with a variety of people, and the satisfaction that these volunteer efforts are helping people in our partner communities have access to basic human needs.

*Project Mentor: Dr. Andrew Rollins, Biomedical Engineering*

**The Etiology of Spatial Visualization and its Relationship with Math Achievement**

**Sarah Lukowski, Department of Psychological Sciences**

The present study explores the etiology of spatial visualization, mathematical achievement, and the etiological overlap between these two domains. The data include 127 twin pairs (52 MZ, 75 DZ) that are participants in the Western Reserve Reading & Math Projects (WRRP). Participants were an average of 8.56 years of age and in the third grade. Univariate analyses indicate significant genetic influences on math fluency ($h^2 = 0.65$) and flexibility of closure ($h^2 = 0.55$). Shared environmental influences on computation and math problem solving approach significance. In addition, spatial $g$, which accounts for 35.8% of the variance in spatial visualization, has a significant genetic component ($h^2 = 0.58$). Furthermore, math $g$, which accounts for 68.8% of the variability in math achievement, also has a significant genetic component ($h^2 = .37$) and significant common environmental influences ($c^2 = 0.34$). Intraclass correlations suggest that there is some etiological overlap. Results are consistent with earlier findings from WRRP and other researchers. Results suggest that measures of math achievement and spatial ability have varying genetic and shared environmental influences depending on the measure used. Future research should work to further investigate the etiology of these abilities, as they are potentially important for success in school.

*Faculty Mentor: Dr. Lee Thompson, Department of Psychological Sciences*

**Analysis of Water Quality in Piang Luang, Thailand**

**Jodi Lyons, Department of Anthropology**

Clean water and adequate sanitation are both basic needs, yet nearly a billion people do not have access to safe sources of water. Approximately 80% of those with unsafe water are poor rural villagers who also have little access to health care. As a result, this is a critical problem in international health because water-borne illnesses account for approximately 3.5 million deaths each year, many of which are children. It is estimated that a child dies every 20 seconds from a water associated disease. The immediate cause of death is frequently diarrhea, a very treatable symptom. This research is concerned with the adverse effects of water quality on human health, with a focus on Piang Luang, Thailand, a rural community near the Myanmar border. This village was the site of a 3 year project by the CWRU chapter of Engineers Without Borders to improve the water supply of the village. In particular, a clean water and sanitation system was implemented at a large school affecting
approximately 1,200 individuals, including the students at the school, the teachers, and the residents of the community. Throughout the project, E. coli samples and health surveys were collected to measure initial disease loads and then used to determine the impact the water supply had on the health of its recipients.

*Faculty Sponsor: Dr. Lawrence Greksa, Department of Anthropology*

**Modulation of Fore-Hind Wing Overlap in the Moth *Manduca sexta***

Anna M. Malec, Dept. of Biology; Mark A. Willis, Dept. of Biology

Males and females of the sphingid moth *Manduca sexta* differ in a number of morphological ways; one of the most obvious, however, is the drastically increased weight of the females due to the large number of eggs that fill their abdomens. On the whole, the females are also larger in respect to wingspan and from head to tail than males, which at first glance may seem to offset the extra mass that the females must carry. My preliminary studies, nevertheless, seem to suggest that this increase in size may not completely counteract the effect of the females’ additional burden, as females still experience a wing loading about 12% greater than that of males. We hypothesized that females may alter some aspects of their flight behavior to compensate for this additional loading. As *M. sexta* are four-winged fliers, it is possible that they can adjust the overlap between their fore and hind wings to change their flight forces. To test this hypothesis, we recorded male and female *M. sexta* with high-speed video cameras as they flew through two different wind speeds. We expect to see a change in the overlap of fore and hind wings between wind speeds if *M. sexta* use this mechanism to modulate flight forces, and a difference in the change in wing overlap between males and females (adjusted for weight) if females use this mechanism to account for their increased wing loading.

*Project Mentor: Dr. Mark Willis, Department of Biology*

**Medical Anthropology and Epidemiology: From Dueling to Dual Perspectives***

Nidhi Maley, Department of Anthropology

Epidemiology and medical anthropology, though distinct, are both concerned with explaining the pattern, causes, and consequences of disease and each has “humanity at their core (Trostle, 2005, p. 4).” Despite these similarities, the two fields evolved separately with differing methodology and theory. As a result, collaboration between the fields yields a more comprehensive understanding of the relationship of disease etiology and environment. Furthermore, a critical medical anthropology framework can bridge global policies with local impacts. Case studies are used to illustrate these issues.

*Project Mentor: Professor Lawrence Greksa, Department of Anthropology*

**Design and Development of a Split Enhanced Green Fluorescent Protein-based Yeast Two Hybrid (Y2H) System***

James Maloy, Department of Biochemistry; Joseph Racca, Department of Biochemistry; and Michael A. Weiss, Department of Biochemistry

High-throughput systems, such as yeast hybrid systems, revolutionize the way that we can study many different kinds of biochemical interactions. The goal of this project was to use fluorescence-based protein engineering to more efficiently study protein-protein interactions, expanding on a traditional yeast-2 hybrid. The primary challenge
lies within the development and optimization of the system. The main contributing factors include a protein that allows for fluorescent complementation, optimization of fusion proteins, and the orientations of protein interactions. This system has potential to expedite the identification, characterization, and screening of protein-protein interactions. Such a system also has several advantages over current yeast hybrid technologies, which rely on both transcriptional activity and the expression of a reporter gene. The system also has the potential to be coupled to many types of fluorescence-based technologies.

Project Mentor: Professor Michael A. Weiss, Department of Biochemistry

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**Big Five Personality Factors as Predictors of Mindfulness Practice**

Sarah Mattila, Department of Psychology; Jessica Nasser, Department of Psychology

Mindfulness is characterized by purposefully directing one’s attention to the present moment and nonjudgmentally accepting it with an open mind (Giluk, 2009). It is a technique that is widely researched in current literature, especially with regard to its potential to alleviate a variety of psychological distresses (Brown et al., 2007). The five-factor (Big Five) model of personality includes 1) neuroticism, 2) extraversion, 3) openness to experience, 4) agreeableness, and 5) conscientiousness. Several studies have examined these personality traits as they relate to mindfulness (Baer, Smith, & Allen, 2004; Costa & McCrae, 1992; Kostanski, 2007; O'Loughlin & Zuckerman, 2008; Thompson & Waltz, 2007), and some of the traits seem to correlate more strongly with mindfulness than others. It is important to understand which types of personalities are more likely to benefit from mindfulness techniques in order for clinicians to choose accurate therapeutic methods for their clients, so that client compliance and, subsequently, therapeutic success is reached. The current study examines levels of Big Five factors in a sample of ~ 32 anxious undergraduate students. The students are then taught a mindfulness meditation technique and asked to complete daily logs describing their mindfulness practice (or lack thereof) over the next several days outside of lab visits. The daily logs are then analyzed for correlations between the students’ Big Five factor scores and their practice patterns in order to determine whether certain types of students (categorized by the Big Five factor model) are more likely to practice mindfulness and, presumably, benefit from the technique.

Project Mentor: Dr. Amy Przeworski, Department of Psychology

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**Properties of Cosmic Ray Air Showers as Measured by a Prototype Cherenkov Detector System**

Elizabeth McNany, Department of Physics; Corbin Covault, Department of Physics; Ross Burton, Department of Physics; Andrew Ferguson, Department of Physics; Daniel Pfeffer, Department of Physics

When high energy cosmic rays interact with the upper atmosphere, a shower of particles is created that generate Cherenkov radiation as they travel towards the surface of the earth. To study this radiation, a new prototype detector has been constructed with four scintillation panels and a central photomultiplier tube to detect the visible Cherenkov light. This detector will be deployed so as to collect data from real cosmic ray particle showers in the field. The results collected from this detector will be compared in detail to a computer simulation that has been designed to predict the measured properties of air showers and Cherenkov radiation. The simulation predicts the distribution of incoming particles, taking into account various sources, directions, and energies of particles corresponding to individual cosmic rays. By comparing the output to actual results we may verify the operation of our prototype. These results will ultimately be used to design and fabricate a larger detector system that can be used to study the astrophysical origin of the cosmic rays.

Faculty Mentor: Professor Corbin Covault, Department of Physics
Optical Mapping of Embryonic Heart Electrophysiology

Matthew McPheeters, Department of Biomedical Engineering; Michael Jenkins, Department of Biomedical Engineering; and Andrew Rollins, Department of Biomedical Engineering

Optical Mapping is a powerful technique for mapping conduction in the heart using a voltage-sensitive fluorescent dye to visualize changes in membrane potential. Optical mapping signals are inherently noisy due the short temporal sampling times and the need to measure small changes in fluorescent intensity. This challenge is exacerbated in the embryonic heart, which is only several cell layers thick. To increase the SNR of the signals we normalize and apply both temporal and spatial filters to the data. The processed data allows us to extract various measurements, including activation times and action potential durations. Using these measurements we create various representations of action potential propagation including isochronal activation maps and propagation velocity vectors fields. These representations allow efficient and effective analysis of optical mapping data.

Project Mentors: Research Assistant Professor Michael Jenkins and Associate Professor Andrew Rollins, Department of Biomedical Engineering

Validity and Reliability of the Direct Observation Methodology: A Focus on Ohio Local Public Health

Michelle Menegay, Department of Anthropology; Aylin Drabousky, MA, Department of Epidemiology and Biostatistics

The purpose of this study is to examine the reliability, validity, and acceptability of a novel direct observation methodology to examine the role of local health departments (LHDs) in prevention of foodborne illness. Trained public health student observers will shadow Registered Sanitarians (RS) during food inspections completing an observational form that will be the main instrument used in the analysis. Methods: Inter-rater reliability will be assessed 1) using shared viewing of an inspection video (25 responses); and, 2) through student observers functioning in pairs during early observational sessions, jointly observing the same inspections (anticipate a total of >120 observations). In addition, RS and student observers will be interviewed to determine their perceptions of the intrusiveness, effectiveness and accuracy of the direct observation methodology. Inter-rater reliability will be examined for the observations through the use of Cohen’s kappa to assess observer consensus on all observations. Interviews will be transcribed and analyzed for themes. Results: It is anticipated that there will be strong concordance on most observations, with higher levels of variability guiding changes in the observational protocol. We expect analysis to show that RS and student observers perceive the direct observation methodology as useful, unobtrusive, and accurate. Analysis will also examine the level of professional behavior among observers; whether observational bias occurs, causing changes in RS behavior; and whether error variation is reduced through direct observation. Conclusion: Direct observation is a novel methodology in the public health setting and its validity and reliability are crucial for its future application in research.

Faculty Advisor: Dr. Scott Frank, Department of Epidemiology and Biostatistics

Long Term Alcohol Abuse and Altitude

Hilary Mohs, Department of Biology, Dr. Vicken Y. Totten Department of Emergency Medicine

Chronic hypoxia can lead to mood disturbances, especially in those with emotional instability. These mood disturbances can lead to self-treatment with alcohol. Utah’s mean state altitude is 6100 ft, the third highest in the nation. Mormonism, common in Utah, discourages alcohol use. If depression combined with alcohol abuse increases suicide risk, then Utah should have a disproportionately low suicide rate. The rate of alcohol abuse related deaths (toxic liver disease, alcoholic liver disease and hepatic failure) (ICD-10 codes K71-70) on the county level
(deaths/100,000) was gathered from the CDC Wonder Mortality data (1999-2007). Mean county elevation data was gathered from the US Geological Survey and the National Elevation Database to generate a mean county elevation. Behavioral data was gathered from the Behavioral Risk Factor Surveillance System (BRFSS). Utah provides a natural experimental population; high altitude with low alcohol use rates. Statistics: Pearson Correlation and t-tests were used and two sided. Despite the fact that Utah has a significantly lower mean number of drinks per month, (Utah, 5.1 vs US 8.4; p<0.0001) and a significantly lower rate of alcohol abuse related deaths (Utah, 4.9/100,000 vs US, 5.9/100,000; p< 0.0001), the suicide rate remains significantly higher than the overall US rate (Utah, 18.15/100,000 vs US, 10.8/100,000; p=0.006). On the county level there was no significant correlation between alcohol abuse related deaths or mean number of drinks per month and mean county altitude. Low alcohol consumption does not seem to protect against suicide. Altitude has been previously known to be a predictor of suicide rates; however alcohol abuse does not appear to be the mechanism.

Project Mentor: Dr. Barry E. Brenner, Department of Emergency Medicine
Faculty Sponsor: Dr. Richard Drushel, Department of Biology

* Effects of Dual Crosslinking in Alginate Hydrogels on Material Properties and Cell Behavior

Colin Morlock, Department of Biomedical Engineering; Julia Samorezov, Department of Biomedical Engineering; Eben Alsberg, Department of Biomedical Engineering and Orthopaedic Surgery

Alginate is a hydrogel with established applications in the field of tissue engineering due to its non-toxic nature and its high water content, allowing for nutrient transport. Alginate covalently modified with methacylate groups can be crosslinked in a number of ways. It can be ionically crosslinked using divalent calcium ions and covalently crosslinked using UV light. This study is concerned with the combination of these two crosslinking methods to create dual crosslinked hydrogels. In this study, we evaluated the bulk swelling, pore size, and shear modulus of ionic, covalent, and dual crosslinked alginate hydrogels. Differential scanning calorimetry and the thermoanalytic technique of thermoporometry were used to investigate the pore size of the gels. Thermoporometry is a technique that relies on the shift in transition temperature of a confined liquid to estimate the pore size of the confining material. Mechanical properties and pore size of tissue engineering scaffolds are known to influence cell activity, such as proliferation and migration; by varying the properties of alginate hydrogels, we aim to influence cell behavior.

Project Mentor: Dr. Eben Alsberg, Department of Biomedical Engineering and Orthopaedic Surgery

* It's a Zoo Out There: Utilizing the Galaxy Zoo Morphological Classification Results in Conjunction with the Sloan Digital Sky Survey

Lauren Nicholson, Departments of Astronomy and Physics

Within the results of the Sloan Digital Sky Survey (SDSS)'s Data Release 7, a group of faint red galaxies has been found to exhibit enhanced clustering on small scales. Recent evidence suggest that these are satellites clustering in the outer, massive halos of galaxy clusters, but photometrically these satellites behave differently from both bright red and faint blue galaxies. These faint red galaxies are especially disky for similarly-colored ellipticals, with their Sersic index and shape suggesting the presence of small structures seen usually in spirals; they consistently display characteristics that fall between the traditional red elliptical and blue spiral galaxies, and we believe them to be a morphological transition phase. Using the quantitative properties observed by SDSS and the additional data provided by the Galaxy Zoo (GZ) program, we have constrained the classification of these galaxies in greater detail and with additional statistical methods than available using either system independently. Working with the Cleveland Museum of Natural History, I have also developed a planetarium program on the GZ program that is used for teaching the general public about galaxy morphology and classification.

Project Adviser: Dr. Idit Zehavi, Department of Astronomy
A Method to Study the Rayleigh-Taylor Instability at Atwood Number ~ 1

Eric Nied, Engineering Physics

The Rayleigh-Taylor instability occurs at a fluid interface that is unstable with respect to gravity. Small perturbations at the interface become amplified and grow exponentially with time before entering a non-linear then turbulent stage. The Atwood Number, a reduced density of two fluids in contact at an interface, plays an important role in the Rayleigh-Taylor instability. Theory and experiment are moderately well-developed for low Atwood Number Rayleigh-Taylor instabilities but not for high Atwood Number instabilities, which display self-similar growth and non-symmetric growth of spikes and bubbles.

It is important to study the Rayleigh-Taylor instability at Atwood ~ 1 in order for us to better understand phenomena such as a supernova exploding into a vacuum. However, no study at Atwood ~ 1 has been successfully carried out due to experimental limitations and mechanical jitter associated with past techniques.

Our group pioneered the use of magnetic levitation to study the Rayleigh-Taylor instability. This research was concerned with using magnetic levitation to obtain unprecedented control of initial conditions for an Atwood Number ~ 1 scenario. Major accomplishments include a reduction of the magnetic decay time by use of a “flyback diode” and the design of a new data collection system. Future work will include experiment and obtaining a numerical value for the linear growth rate.

Project Mentor: Charles Rosenblatt, Department of Physics, Case Western Reserve University

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Reversible UV Responsive Gelator Effects on Mechanical Behavior

Gerardo Ortega, Department of Chemical Engineering; Nicholas Wheeler, Department of Macromolecular Science and Engineering; J. Casey Johnson, Department of Macromolecular Science and Engineering

Fillers and additives are often added to polymer matrices to tailor their mechanical properties. Recent studies of a low molecular weight organic gelator (LMOG), based on dicholesteric azobenzene, have shown it to be a photoresponsive material, transitioning from a gel-like state to a liquid state upon UV radiation. Utilizing concepts from this research, we have designed a dicholesteric azobenzene LMOG to be used in photoresponsive polymer nanocomposites. Characterization techniques, such as nuclear magnetic resonance (NMR) and matrix-assisted laser desorption/ionization mass spectrometry (MALDI MS), were used to verify the synthesis of the target molecule. In the future, the compound will be incorporated into a polymer matrix to determine the effects of ultraviolet (UV) radiation on the mechanical properties of the nanocomposite.

Project Mentor: Professor LaShanda. T. J. Korley, Department of Macromolecular Science and Engineering

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Dynamics of the q-model

Ravin Pandey, Department of Physics; Dr. Harsh Mathur, Department of Physics

The q-model was introduced by Coppersmith et al. to simulate how force distributes through bead packs. Closely related models have been used to describe river networks, quantum Hall multilayers and other problems of non-equilibrium statistical mechanics. Previous work has shown that the q-model has a critical point, and, close to the critical point, exhibits scaling behavior analogous to thermodynamic critical phenomena. Lewandowska et al. obtained the dynamics of the entire distribution right at the critical point and made a scaling hypothesis about the form of this distribution close to the critical point. In this project we will study the dynamics of the entire distribution of load on a single bead by analytic and numerical methods. [References - Coppersmith et al. Physical Review E53, 4673 (1996); Lewandowska et al. Physical Review E64, 026107 (2001)].

Project Mentor: Dr. Harsh Mathur, Department of Physics
Computerized Respiratory Sound Analysis

Urvi Patel, Department of Physics

Although the presence of wheezes, crackles, and stridor sounds indicate obstructed airways and other lung problems, there currently exists no method to continuously monitor breath sounds for these abnormalities during surgery. The goal of this project is to build a non-obstructive device that can continuously monitor breath sounds in order to detect and accurately identify wheezes, crackles, and stridor sounds. We seek to record high quality breath sounds using a microphone attached to an LMA, endotracheal tube, or mask in order to automatically analyze these sounds in real time. In addition, various techniques in signal analysis, including Fourier and wavelet transforms, will be explored to efficiently distinguish the three key breath sounds (wheezes, stridor, and crackles). Finally, if possible, we hope to test the device in a clinical setting.

Project Mentors: Dr. Ronald Cechner, Department of Biomedical Engineering; Dr. Rolfe Petschek, Department of Physics

Thinking Outside the [Box] Business Card Dispenser

Mike Patterson, Biology; Derek Payne, Electrical Engineering; Derek Porto, Mechanical Engineering; Abigail Sevier, Aerospace Engineering

MAD\textsuperscript{2} Design prototyped a jack-in-the-box business card holder with removable sidewall plates, intended for mass production via the Think[Box] facility as a gift for potential donors. A 3x3x3 in scaffold cube was designed in Creo Parametric, with vertical sockets for sidewall insertion/removal, hinge interfacing for a lid, and a circular inset floor for spring attachment. Four panels were designed with four machines: a 2D vinyl/wood cutter, a 3D rapid prototyping printer, a ShopBot router, and a circuit board printer. On each panel the think[box] Logo is prominently displayed: engraved birch char, extruded 3D printed letters, inset routed letters, and copper wire path tracing the letters. A button is mounted on the front corner, controlling a latch inside the front top edge wall. When loaded with a spring, pushing the button releases the top hatch; sealing the hatch locks the latch in place again. On the hatch, the CWRU logo is large and visible. A business card holder was designed in Creo Parametric with a clear front window for displaying cards, a similar circular inset back attachment for affixing the holder to the spring, and sliding extraction from one side.

Project Mentor: Professor Malcolm Cooke, Department of Mechanical and Aerospace Engineering

Investigating Potential Small Molecule Inhibitors of Duffy Binding Protein

Alex Popko\textsuperscript{1,2}, Lenore Carias\textsuperscript{1}, D’Arbra Blankenship\textsuperscript{1}, Menachem Shoham\textsuperscript{3}, Christopher King\textsuperscript{1,4}, Radhika Atit\textsuperscript{3,5}, Brian Grimberg\textsuperscript{1}

\textsuperscript{1} Center for Global Health and Diseases, CWRU School of Medicine
\textsuperscript{2} Department of Biology, CWRU College of Arts and Sciences
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\textsuperscript{4} Veterans’ Affairs Research Service
\textsuperscript{5} Department of Genetics, CWRU School of Medicine

Unlike most malaria parasite species, the parasite \textit{Plasmodium vivax} is thought to exclusively bind to only one antigen on the surface of a red blood cell using their Duffy Binding Protein (DBP). The tight binding of the parasite to the human Duffy antigen (Fy) allows for the parasite to gain entry into the erythrocyte, where it grows and causes illness. The goal of this project is to find an effective inhibitor of this single interaction, thereby reducing infection and spread of this parasite. By using Schrödinger computer models of the parasite’s DBP we screened 1 million small molecules and identified several potential parasite-binding inhibitors based on their GLIDE score for theoretical binding to DBP. After selecting suitable compounds, we assessed the small molecule’s ability to disrupt
parasite ligand binding using an Enzyme-Linked Immunosorbent Assay (ELISA). This molecular method introduced the test compounds to recombinant ligand DBP in a 96 well microtiter plate. We then tested for any reduction in labeled recombinant Duffy receptor binding to the ligand. Thus far our screens have identified one lead compound (VS-2) which completely inhibits the receptor-ligand interaction at 100 µg/ml. With these experiments we will gain a better understanding of the DBP and potentially create small molecule treatments or identify potential vaccine targets for this species parasite.

Project Mentor: Dr. Brian Grimberg, Center for Global Health and Diseases
Faculty Mentor: Dr. Radhika Atit, Department of Biology, Department of Genetics

* Does Speaking a Second Language Affect Achievement?

Abirami Ramalingam, Department of Communication Sciences and Cognitive Science

Previous research has claimed that speaking a second language may interfere with learning. To test this claim, and to find out what effect knowing more than one language has on achievement, we compared participants who spoke only English with participants who also spoke another language as to their grades, self-control, general word knowledge, and information processing ability. The scores from all of these tests were put into a multiple regression analysis, and we found that while self-control, knowledge and information processing ability all led to better grades, speaking only English or a second language as well did not affect achievement at all.

Project Mentor: Dr. Joseph Fagan, Department of Psychological Sciences

* Structure-Based Design of Fast-Acting Insulin Analogs

Vikram Ramanujam, Department of Biomedical Engineering; Nalinda P. Wickramasinghe, Department of Biochemistry; Vijay Pandyarajan, Department of Biochemistry; Michael A. Weiss, Department of Biochemistry

Advances in the engineering of continuous glucose monitors and “smart” insulin pumps in principle will enable design of automated “closed loop” systems (i.e., an “artificial Beta-cell”) that will lead to increased efficacy of treatment for type 1 diabetics. The operation of prototype systems has to date been impeded by the slow onset of action of existing fast-acting insulin analogs. This is a result of delayed absorption that compromises the safety and efficacy of algorithm-based pump delivery. We seek to address this problem by deciphering the structural mechanisms that underlie the kinetics of insulin dissociation with a new approach – that of halogen-substituted amino acid derivatives to create novel insulin analogs with enhanced therapeutic properties. QM/MM calculations were run using the programs CHARMM, Q-Chem and Gaussian. These calculations give theoretical data about dimer stability between various types of halogenated insulin analogs. The halogenated Insulins were then prepared in vitro via semi-synthetic methods and then purified by HPLC. To assess the kinetics of insulin hexamer disassembly, an insulin hexamer assay is used. In the body insulin is held together via zinc, but zinc is not visible in spectrometry hence a cobalt hexamer assay is conducted to determine the chemical dissociation of the insulin hexamer. Preliminary data obtained in silico indicated that a para-chloro substitution on the aromatic ring of PheB24 would produce a dipole that would significantly decrease the stability of the dimer interface. This data is substantiated experimentally via spectroscopy from the cobalt hexamer assay, which showed that the para-chloro substituted insulin hexamer fell apart quicker. Additional experiments indicate native-like receptor binding and delayed fibrillation. These results indicate that this analog may be an ideal candidate for further study.

Project Mentor: Professor Michael Weiss, Department of Biochemistry
Targeting cancer cells in vitro using engineered tobacco mosaic virus nanoparticles

Lauren Randolph, Department of Biomedical Engineering; Dr. Michael Bruckman, Department of Biomedical Engineering; Prof. Nicole F. Steinmetz, Department of Biomedical Engineering, Radiology, Materials Science and Engineering

Nanotechnology has the potential to yield new treatment and imaging methods that can better diagnose and combat cancer. Nanoparticles are well suited to this purpose because they can display several different molecules at the same time. For example, these particles can be engineered with both targeting ligands and imaging molecules; this can provide increased imaging sensitivity as well as increased tissue specificity. Viral nanoparticles are ideal candidates for the development of tissue-specific imaging devices; they are naturally occurring nanomaterials and their structures are known in great detail. The goal of this project is to test the targeting capabilities of the tobacco mosaic virus (TMV) when it is conjugated tumor cell targeting peptides such as bombesin. This project involves determining the targeting efficiency of engineered TMV particles in vitro using a prostate cancer cell line (PC3); the targeting capability of bombesin-targeted, fluorescently-labeled TMV to cancer cells is evaluated. I examined whether the TMV particles were bound to or internalized in prostate cancer cells. To test this, cell binding studies were performed. PC3 cells were stained with DAPI to stain the nucleus of the cell and wheat germ agglutinin (WGA) for membrane staining. This allows localization of TMV particles in relation to the cells. Qualitative data was collected using confocal microscopy to determine whether or not the particles were present in the cells, and flow cytometry was used to quantify the amount of TMV particle present in the cells.

Faculty Sponsor: Prof. Nicole F. Steinmetz, Department of Biomedical Engineering, Radiology, Materials Science and Engineering

Classifying the Degradation of Acrylic Materials by the Bidirectional Scatter Distribution Function

Sam Richardson, Department of Physics; Roger French, Department of Materials Science and Engineering; Laura Bruckman, Department of Materials Science and Engineering

In photovoltaic (PV) power applications, it is important that modules and their systems have a long lifetime. Maintenance and replacement costs due to environmental degradation must be at a minimum in order to make PV power as efficient an option as possible. This research concerns the degradation of mirrors used in the augmentation of PV modules and clear acrylics used as protective front sheets. We use the Bidirectional Scatter Distribution Function (BSDF), a measure of the amount of light scattered at different angles, to classify degradation that occurs to samples of various types of clear acrylics and mirrors. The samples undergo environmental testing which results in surface and volumetric degradation, apparent in reflective and bulk scattering, respectively. We develop a method to quantify the scattering changes due to the degradation, and demonstrate these changes for a selection of mirrors and clear acrylics. The BSDF is also very well-suited for measuring the dominant spatial frequencies that arise in the roughness profiles of some acrylic samples.

Project Mentor: Roger French, Department of Materials Science and Engineering

Chemical Synthesis of Pristine Graphene

Andrew Richenderfer, Department of Physics; Seung Whan Lee, Department of Chemical Engineering

Graphene is a two-dimensional form of graphite made up of a single layer of carbon atoms in a honeycomb lattice that has attracted tremendous interest for its novel physical properties. A key challenge that has emerged is how to synthesize large amounts of graphene (large area or mass) at low cost. The objective of this project is to explore an entirely new method to exfoliate graphene from commercially available graphite products such as pyrolytic graphite (PG) or highly ordered thermal pyrolytic graphite (TPG). Our idea is based on electrochemical exfoliation where a current flows through an electrolyte to enhance the exfoliation of graphene flakes from graphite. A plasma is used as one of the
electrodes to amplify the electric fields that are created in solution. In this poster, we will present the new process and preliminary characterization of synthesized graphene material by Raman and UV-vis absorbance spectroscopy.

*Project Mentors: Professor Xuan Gao, Department of Physics; Professor Mohan Sankaran, Department of Chemical Engineering*

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**“A Journey to Discover the Effects of Public Art on Clevelanders”**

**Allie Rini, Department of Psychology**

As a young teenager I had the privilege to explore renowned artists Christo and Jeanne-Claude’s art installation, “The Gates” in Central Park. This was my first introduction to public art, and its simple beauty sparked a lingering interest. Influenced by my incredible experience in New York City, I decided to discover public art in Cleveland. I wondered about the impact public art had on local communities. I was more interested in the work’s subliminal effects on the city, rather than the aesthetic pleasure public art generates. Questions ran through my mind like an everlasting marquee on Broadway, “Can public art help revitalize some of Cleveland’s once thriving neighborhoods?” “Does public art create a sense of safety?” “Do Clevelanders notice public art?” Eager to find answers, I set upon my own journey to discover the effect public art has on Cleveland. Through meetings with the Non-Profit, “LAND Studio,” previously named “Cleveland Public Art,” The Cleveland Plain Dealer Journalist, Steven Litt, and numerous on sight visits and interviews with the public, I was able to further understand the relationship between public art and Cleveland.

LAND Studio focuses on specially designed landscapes and outdoor public art to transform the acres of Cleveland’s once thriving neighborhoods. However, my exploration of public art revealed that it takes much more to revamp communities such as the Slavic Village, Collinwood, and the Buckeye neighborhood. Through my first hand experiences, I concluded that public art can only help to revitalize Cleveland when paired with other concepts like lighting, design, community involvement, pride, and education. Therefore, Public art cannot be used as the sole vehicle to generate change; rather, it takes a village.

*Project Mentor: Professor Andrea Simakis, SAGES*

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**Blu-ray Wavelength Read/Write Device for Multilayer Polymer Data Storage**

**Adam Rych, Department of Physics; Cory Christenson, Department of Physics**

The production of optical data storage systems that possess storage capacities above a terabyte are increasing in demand every day. In order to meet the demands of consumers, scientists and engineers have to start to look at three dimensional optical storage systems for an increased storage capacity. Currently there are several different approaches for increasing storage capacity via 3D, or even higher dimensional optical storage devices, such as: holographic optical storage, multidimensional optical storage of bulk materials, and multilayered fluorescent optical data storage systems. The only one that currently seems economically feasible appears to be a multilayered fluorescent optical data storage system.

A multilayered fluorescent optical storage disc can be easily mass-produced at low cost and could store over half a terabyte of data. The key to unlocking this terabyte-level storage discs is the development of a reliable 3D optical data drive apparatus that can both read and write data from a multilayered fluorescent optical polymer. We propose here a device that can utilize this multilayered fluorescent polymer to create an economically viable 3D optical storage drive. Having mobility in the z-direction as well as the x and y directions is essential to accessing the many layers in a multilayered optical polymer. Using this apparatus along with a single-photon absorption technique, we plan to use photobleaching as a means of writing on such a polymer. Then using a confocal microscope setup we plan to be able to read data from individual layers of the multilayered fluorescent polymer.

*Project Mentor: Professor Kenneth Singer, Department of Physics*
The Effects of Short Term Exercise on Cognitive Function and Insulin Resistance in Obese Individuals

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Department of Gastroenterology & Hepatology, Cleveland Clinic, Cleveland, OH

Overweight/obese individuals are at higher risk for frontal subcortical dysfunction. This can lead to reductions in attention, executive functioning, and speed of processing. Although causation remains unknown, insulin resistance, a common condition in overweight individuals, may be the link between obesity and cognitive deficiencies. Short term exercise (7 day duration) can elicit a 25% improvement in insulin sensitivity in insulin resistant obese individuals independent of weight loss. We examined the effect of a short-term exercise program on cognition in 5 overweight (30±1 kg·m⁻²) adults (43±4 years). Exercise consisted of treadmill walking for 60 min per day on 7 consecutive days at ~85% of maximal heart rate. Additionally, subjects underwent a 75g oral glucose tolerance test before and after the intervention. Cognition was assessed through a neuropsychological battery composed of tests that measured attention, executive functioning, and speed of processing. Improvements in inhibition and accuracy were determined by an increase in accuracy:reaction time for the Stroop Test and a decrease in false alarm errors:reaction time for the Go No Go Test. Exercise resulted in a decrease in fasting plasma glucose (113.3±8.5 vs 106.6±7.1 mg/dL; P<0.05). In addition, exercise resulted in a trend towards an increase in accuracy:reaction time (0.0018 vs 0.0143 au; P= 0.077) and a nonstatistically significant decrease in errors:reaction time (0.015 vs 0.004 au; NS). Despite the small sample size available for analysis at this time, clear trends towards exercise induced improvements in cognition have emerged suggesting that further investigation of this phenomenon is warranted.

Project Mentor: John P Kirwan, Ph.D., Department of Pathobiology and Hepatology, Cleveland Clinic Foundation
Faculty Sponsor: Lee Thompson, Ph.D., Department of Psychology, Case Western Reserve University

Comparing Three PCR Protocols for Quantifying Strain Diversity in Wuchereria bancrofti Infections

Chad Schaber, Department of Biology; Scott Small, Center for Global Health and Diseases; Akshaya Ramesh, Department of Biology and Center for Global Health and Diseases; Peter Zimmerman, Department of Biology and Center for Global Health and Diseases

Quantifying the strain diversity of a disease-causing agent, both within individuals and among populations, is an essential part of mapping the disease’s prevalence and tracking how it spreads. One agent of concern is Wuchereria bancrofti, the parasitic organism responsible for the majority of the cases of lymphatic filariasis, a disfiguring disease that affects an estimated 120 million people worldwide. One of the primary means for characterizing strain diversity involves amplifying a polymorphic genome region via polymerase chain reaction (PCR), isolating individual amplified products via TA-cloning, and then Sanger sequencing of products. This process can quantify the number of strains present in a sample by simple examination of the number of genetically unique sequences produced. However, the standard PCR process can introduce artificial base pair changes that may cause two samples of the same strain to be interpreted as two distinctive genotypes. Here, we attempt to show how two different procedures can minimize or eliminate these artificial strains. The first involves using a high-fidelity DNA polymerase with a proof-reading function that reduces the rate of introducing artificial changes into the amplified sequences. The second consists of using a “bar-coding” protocol that incorporates a degenerate base pair region into the amplified sequence, allowing artificial changes to be identified. Our results show that the standard PCR leads to a probable over-estimation of strain diversity, as both the high-fidelity and bar-coding PCR report a reduced number of strains.

Project Mentor: Peter Zimmerman, Department of Biology and Center for Global Health and Diseases
Electrospun Polymer Scaffolds for Drug Delivery and Regenerative Medicine

Dhruv Seshadri, Department of Macromolecular Science and Engineering

Biocompatible polymeric materials are used in the human body to restore and improve physiologic function and enhance survival and quality of life with minimal cytotoxic effects. This research seeks to create and leverage polymeric scaffold structures mainly targeting the human eye, but can be adapted to other structures. The primary application seeks to incorporate and release hydrophobic drugs, such as dexamethasone, from a hydrophilic polymeric matrix produced by electrospinning. Naturally derived polymers, such as gelatin and collagen, were electrospun under various conditions to generate different fiber morphologies while synthetic hydrophilic polymers, such as polyvinyl alcohol were also electrospun. Techniques such as fluorescent microscopy, SEM, and UV-vis were used to characterize the electrospun fiber diameter, structure, and drug incorporation and kinetic release profile.

Project Mentor: Matthew Fullana, Department of Macromolecular Science and Engineering
Faculty Sponsor: Dr. Gary Wnek, Department of Macromolecular Science and Engineering

The Effects of Multi-Walled Carbon Nanotubes on the Pretilt Angle of a Nematic Liquid Crystal

Matthew Sheffield, Department of Physics; Rajratan Basu, Department of Physics; and Charles Rosenblatt, Department of Physics

We examine whether the presence of multi-walled carbon nanotubes (CNT) in the nematic liquid crystal pentylcyanobiphenyl (5CB) affects the pretilt angle associated with the liquid crystal. Here, pretilt angle is defined as the angle between the normal to the substrate and the liquid crystal director. We control the pretilt angle by coating a substrate with a polyamic acid, bake at a temperature slightly higher than recommended by the manufacturer, and rubbing the resulting polyimide with a fabric at different rubbing strengths. The increased baking temperature results in an extension of the polyimide’s backbone and partially removes the side chains, which produce competing easy axes for the liquid crystal alignment. The rubbing preferentially aligns the backbone as well as creates a slightly tilted side chain. The pretilt angle is controlled by varying the rubbing strength. Pretilt angle was measured using a HeNe laser setup containing two crossed polarizers, a Babinet-Soleil compensator and a gradiently rubbed cell. We used the compensator to measure the retardation of the sample cells at various positions along the cell (each position corresponds to a different rubbing strength), from which the pretilt angle was extracted. Results appear to indicate that the LC-CNT has a slightly lower pretilt angle than 5CB. Also, the results suggest that the CNT causes a slower rate of increase in the pretilt angle as a function of rubbing strength.

Project Mentor: Professor Charles Rosenblatt, Department of Physics

NOVO Gordian Knot

Lucas Sikina, mechanical engineering, Smrithi Sunil, biomedical engineering, Ryan Ung, biomedical engineering, Helen Zhang, biomedical engineering.

The Gordian knot is a puzzle that consists of six unique rectangular pieces. If the pieces are separate then the goal of the puzzle is to put all the pieces together in such a way that they form a cube. If the pieces are in the form of a cube then the aim of the puzzle is to separate the cube into its individual pieces. The puzzle has a particular pattern of putting the pieces together (or removing them), which consists of 69 moves in the right sequence. The Gordian knot is definitely a brainteaser and gets you thinking. It is ingenious and has a ‘wow’ factor to it. This product is designed to spark interest in individuals touring the think[box] laboratory by presenting a simple yet mindblowing concept. This product will incorporate the think[box] and CWRU logos.

Mentors: Patrick Crago, Department of Biomedical Engineering, Malcolm Cooke, Department of Biomedical Engineering.
Practicality of Renewable Energy Sources and the Bottled Water Industry

William Smythe: Department of Materials Science and Engineering

A 45-kW solar array at Oberlin College and the 100-kW wind turbine at Case Western Reserve University were analyzed. The analysis shows that the wind turbine has a shorter time for energy return on energy invested (EROEI) and faster economic payback than the solar panel. However, the economic payback times of these devices are often similar to the estimated life span of the device. These findings indicate that these renewable energy sources can be very effective to reduce society’s reliance on fossil fuels, but they are more expensive than conventional sources of electrical power. As technology progresses and these two types of renewable energy sources become more efficient, both of these types of renewable energy sources will become better monetary investments as well as improving their eco-friendliness.

Plastic disposable water bottles were also investigated. The decrease in weight of single-use water bottles since 2002 has reduced their embodied energy significantly (by up to 67%). Tensile testing of a variety of commercial bottles showed that the mechanical properties of light-weight bottles are significantly different from those of earlier generations, with higher tensile strength but lower strain to failure and lower toughness (by up to 40%). These results show that the bottled water industry has been able to decrease the embodied energy of the bottles, while maintaining adequate mechanical properties, proving that good engineering practices can help reduce energy usage while maintaining a product’s function.

Project Mentor: Professor Mark DeGuire, Department of Materials Science and Engineering

Determining the effect of alcohol consumption and cigarette smoking on the onset of Alzheimer’s disease

Alexander Song, Department of Biology

Dementia refers to a clinical syndrome that results in a loss of brain function and may result from a wide variety of disorders, including degenerative (e.g. Alzheimer’s disease), vascular (e.g. multi-infarct dementia), and traumatic (e.g. head injury). Alzheimer’s disease (AD) is characterized by a progressive dementia that gradually worsens over time. Typically, this disease appears in middle or later life around the ages of 50 to 60. Certain factors, however, such as alcohol and cigarette smoking, may cause Alzheimer’s to appear sooner than expected. There have been many cross-sectional, longitudinal, and case-control studies that investigate the relationship between these substances and the Alzheimer’s disease. It was determined that long-term heavy abuse of alcohol increased the risk of Alzheimer’s disease along with other cognitive disorders, but moderate consumption of alcohol (one to three drinks per day) was associated with a significantly lower risk of Alzheimer’s disease than no alcohol consumption at all. The type of alcohol did not change the results nor were there differences between men and women. Smoking also was found to double the risk of dementia and Alzheimer’s disease, especially for individuals without the apolipoprotein E (APOE) genotype. In contrast, smoking had no effect for individuals with the APOE allele. Additionally, smokers above the age 75 were found to have increased cognitive and memory impairment than their cohorts who did not smoke. The substances that humans consume may indisputably affect how our brains function and may even result in Alzheimer’s disease and lead to death.

Project Mentor: Dr. Richard Drushel, Department of Biology

Why Wind: A Comparison of Germany, the U.S., and China

Emily Sparks, History and Music performance

This paper examines the differences in the approaches of Germany, the U.S., and China in promoting wind power. Germany, motivated by a strong environmental ethic and desire to mitigate climate change, has implemented a consistent, mandatory feed-in tariff since 1990. United States policy has been inconsistent, changing to reflect the priorities of the party in power. Both parties present renewable energy as a step toward economically necessary
energy security or energy independence. Some states within the U.S. have implemented more stringent policies, separate from the whims of federal politics. In China, wind power is part of a broader effort to electrify rural areas and increase total power supply. As such, policy up to 2005 focused on small, domestically manufactured wind systems. Facing increasing international pressure to reduce its greenhouse gas emissions, China took larger-scale action in 2005 with the passage of the Renewable Energy Law.

Despite these significant differences, all three states are global leaders in wind power production. This finding shows that many different motivations and policies can be effective for promoting wind power. States, then, can tailor policies to their individual needs. Additionally, the identification of several reasons for promoting wind power suggests that environmentalists can argue for wind power from a variety of effective standpoints, and that a wide coalition of environmentalists, manufacturers, and local governments can come together to support wind power.

*Project Mentor: Jessica Green, Political Science*

**Band structure of bulk and mono-layered Vanadium Pentoxide (V$_2$O$_5$)**

**Gregory Stewart**, Department of Physics

Vanadium Oxide (V$_2$O$_5$) is a material that can be fabricated as a thin film of only a few atomic layers thick during mechanical exfoliation due to the weak interlayer interactions, much like how graphene is created. During this project we looked at the band structure of both the bulk and mono-layered V$_2$O$_5$. We used computer software called ABINIT, which is installed on the high performance computer cluster (HPCC), to do all of our calculations. We used the projector augmented wave (PAW) method in our band structure calculations. The construction of the PAW potentials for Vanadium was studied during our project and we found that the 3s and 3p bands of Vanadium needed to be treated as valence bands in order to avoid "ghost bands" from appearing in our calculations. We tested the convergence of the plane wave energy cut-off parameter and its accuracy first with metallic body centered cubic (BCC) Vanadium and then with rock salt structured Vanadium Monoxide (VO). The band structure of V$_2$O$_5$ can be characterized as Oxygen 2s and 2p like bands separated by a gap from the Vanadium 3d like conduction bands. The band gap between them is indirect. There are two narrow bands that fall just below the conduction band called intermediate bands. Many interesting properties can arise from these intermediate bands such as transport phenomena or mediating optical transitions from the valence bands to higher conduction bands.

*Project Mentor: Professor Walter Lambrecht, Department of Physics*

**Exploring Interference Effects in the Optical Absorption of Semiconductors**

**Jason Tabachnik**, Department of Physics; Professor Harsh Mathur, Department of Physics

In a recent research article published in Science, a group of physicists at Yale University announced the discovery of a dramatic new optical device: the anti-laser. Rather than producing bright beams like its well-known counterpart, the laser, the anti-laser completely extinguishes specific wavelengths of light. It consists of a rectangular slab of absorbing material, the thickness of which can be adjusted so that it causes perfect absorption of light. Disappointingly, the current model only supports the perfect absorption of a single frequency and requires fairly difficult conditions to meet this end. To remedy these limitations, this research examines novel geometries of lasing and anti-lasing slabs in order to improve absorption properties. Specifically, we have investigated multiple slab systems, structures with negative refractive indices, and absorbers with a special symmetry called “PT invariance.” The results have been fruitful; we have discovered asymmetrical reflection lineshapes in PT-invariant structures and further flexibility in controlling the energy of incident radiation. With a firm grasp on these important preliminaries, our future work will now explore coherent absorption in the two-slab system before embarking on the
general study of periodic lasing structures. Developing geometries with desirable absorption properties has potential applications for solid-state and optical semiconductor technologies, among the most notable of which is the solar cell. Increasing solar absorption efficiency could provide a dramatic stimulus to the feasibility of generating environmentally-conscious, renewable energy from the sun.

Project Mentor: Professor Harsh Mathur, Department of Physics

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NOD2 and Complement pathway: cross-talk sensitizes raw cells to C5a-induced chemokine production

Dora Tang, Department of Biochemistry; Laura E. Nagy, Cleveland Clinic Department of Pathobiology, Hui Tang, Cleveland Clinic Department of Pathobiology, Umme Amara, Cleveland Clinic Department of Pathobiology

Nucleotide binding oligomerization domain 2 (NOD2) is an intracellular pattern recognition receptor that initiates immune response through recognition of pathogens. Mutations of NOD2 have been specifically implicated in Crohn’s disease, an inflammatory bowel disease. In healthy macrophages, recognition of muramyl dipeptide (MDP) by NOD2 induces several inflammation related genes, an occurrence that is absent in patients with Crohn’s disease. A key part of the innate immune system is the complement system, which functions through opsonization of pathogens and induction of inflammatory responses through a series of signaling cascades. C5a is a protein fragment of complement component 5 and is a known anaphylotoxin that induces various biological responses mainly through its two receptors C5aR and C5L2. Here, we report a novel cross-talk between the NOD2 signaling and complement pathways through C5a induced chemokine production. Gene expression of various cytokines and chemokines is used to assess that NOD2 activation by MDP serves as a positive regulator of cell sensitivity to C5a, possibly through the suppression of C5L2 expression. The role C5L2 in exaggerated inflammatory response presents a notable potential therapeutic target for patients with Crohn’s disease.

Project Mentor: Laura E. Nagy, Department of Pathobiology, Cleveland Clinic
Faculty Sponsor: David Samols, Department of Biochemistry

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Investigation of the synergistic phosphorylation of STAT3 through activation of EGFR and Par-1 in cancer cells

Tom Tee, Department of Cell Biology; Matt Waitkus, Department of Cell Biology; and Paul DiCorleto, Department of Cell Biology

Signaling crosstalk has been shown to occur between the epidermal growth factor receptor (EGFR) and protease-activated receptor-1 (Par-1) in human umbilical vein endothelial cells (HUVEC). When these receptors are both activated, the phosphorylation of Signal transducer and activator of transcription 3 (STAT3), a transcription factor, occurs. Phosphorylated STAT3 (pSTAT3) leads to the growth and proliferation of HUVEC. The identification of this pathway in other cell types may identify a subset of cancer cells that are susceptible to STAT3 inhibition. We investigated the possible presence of this pathway in human embryonic kidney (HEK) cells and HeLa cells. These cell lines were treated with the EGFR and Par-1 agonists, EGF and Thrombin receptor agonist peptide (TRAP) and subsequently analyzed for pSTAT3 levels. We found that EGF and TRAP treatment of HeLa cells induced greater phosphorylation of STAT3 than in HeLa cells treated with EGF or TRAP alone. This result suggests an intracellular signaling crosstalk between EGFR and Par-1 mediates a synergistic activation of pSTAT3 in HeLa cells.

Project Mentor: Professor Paul DiCorleto, Department of Cell Biology
Polycystic Ovarian Syndrome
Development and Pathogenesis

Meera Thakkar, Department of Biology

Polycystic Ovarian Syndrome (PCOS) is one of the most common female reproductive disorders in the United States. It affects almost 5-10% of women at any time, and is one of the leading causes of female infertility. This project focuses on the development of PCOS, as well as looking into the mechanisms and pathogenesis of the condition’s symptoms. In addition to severely affecting the quality of life of those afflicted, PCOS is known to affect many organ systems. An excess of male androgens is produced, which leads to the development of masculine characteristics, such as male-pattern baldness and excess facial hair growth. There is an increased risk for diabetes and obesity, as PCOS also causes hyperinsulemia, insulin resistance, and weight gain. The reproductive risks are greater if the condition is not diagnosed early, including a higher predisposition to infertility and endometriosis. Medications exist to control any systems, such as Metformin, Spironolactone, and birth-control pills.

Advisor: Richard Drushel, Department of Biology

The Social Brain:
An ALE Based Meta-Analysis of Social Cognition in the Brain

Scott Tillem, Department of Cognitive Science; Dr. Anthony Jack, Department of Cognitive Science

There is a great deal of literature on social cognition in the brain, but there is no true consensus as to its functional organization in the brain. This meta-analysis took data from 347 previously published studies on various social/emotional processes (i.e. theory of mind, emotionality judgments, introspection, social judgments, emotional experience, emotion regulation, deception, and autobiographical memory) as well as some other related processes (e.g. action observation, action execution, episodic memory) generated various Activation Likelihood Estimation metrics (ALE). Using these ALEs, this analysis has revealed various regions of potential functional specialization, for various social processes. These regions are present bilaterally in the medial prefrontal cortex, the precuneus, the temporal-parietal junctions, and the temporal lobes.

Project Mentor: Dr. Anthony Jack, Department of Cognitive Science

Identification of a novel determinant of antifolate resistance in Mycobacterium smegmatis

Joseph L. Timpona, Department of Biology; Hoa T. Nguyen, Department of Molecular Biology and Microbiology; Liem Nguyen, Department of Molecular Biology and Microbiology

Given the increasing incidence and widespread dissemination of multidrug-resistant and extensively drug-resistant Mycobacterium tuberculosis strains, new methods of treatment are needed to combat this tuberculosis-causing pathogen. Aside from discovering new drugs or creating semi-synthetic analogs of existing drugs, an emerging strategy that aims to disrupt resistance mechanisms has been placed under scrutiny. This resistance-targeting approach, known as potentiation, has the ability to sensitize or resensitize bacteria to available approved drugs. A potential target for this approach is the folate metabolism, as drugs that target this pathway have been recently called for widespread use against drug-resistant infections including tuberculosis. In a screen for mycobacterial antifolate resistance determinants, we identified a M. smegmatis transposon mutant that became more susceptible to sulfonamides and trimethoprim, antifolates that inhibit de novo folate synthesis. Genetic mapping identified transposon insertion into msmeg_5796, a gene whose amino acid sequence is homologous to the YgfZ protein in Escherichia coli. YgfZ was shown to bind tetrahydrofolate and is required for E. coli resistance to plumbagin, a reox cycling toxin with antimicrobial activity. However, our results showed that Msmeg_5796 is not involved in plumbagin resistance in M. smegmatis. In contrast, an E. coli ygfZ mutant exhibited antifolate resistance levels comparable to wild type parental strain. Our results indicate that Msmeg_5796 is
required for antifolate resistance in *M. smegmatis*, and that its function is not analogous to YgfZ of *E. coli*. Chemical inhibition of YgfZ could potentiate antimycobacterial activity of classical antifolates, thus allowing their use in chemotherapeutic treatment of mycobacterial infections including tuberculosis.

*Project Mentor: Liem Nguyen, Department of Molecular Biology and Microbiology*
*Faculty Sponsor: Charles Rozek, Department of Biology*

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**Synthesis of a clickable probe for electrophiles formed in sterol biosynthesis**

**Wayne Tse**, Department of Chemistry; Ned Porter, Department of Chemistry, Vanderbilt University

We report advances in the synthesis of a clickable probe to further the understanding of the pathogenesis of Smith-Lemli-Opitz Syndrome (SLOS). SLOS is a genetic disorder that is caused by a deficiency in functional 3β-hydroxysterol-Δ7 reductase (DHCR7), an enzyme that converts 7-dehydrocholesterol (7DHC) to cholesterol in cholesterol biosynthesis. This causes the buildup of 7DHC, a compound that is prone to form toxic oxysterols upon reaction with oxygen. Nucleophilic amino acid residues of proteins are likely to react with these 7DHC oxysterols by Michael addition, resulting in covalent protein modifications. The probe will contain an alkyne on the terminal carbons of 7DHC ligand chain. Probe-protein adducts can be captured on streptavidin after click derivatization of alkylnyl adducts with a photocleavable azido-biotin tag. This synthesis would develop an effective probe to isolate and identify the affected proteins of improper cholesterol metabolism.

*Project Mentor: Dr. Ned Porter, Vanderbilt University, Department of Chemistry*
*Faculty Sponsor: Dr. Michael Kenney, Department of Chemistry*

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**Exploring the Function of the Inferior Pre-Central Gyrus**

**Meral Tubi**, Department of Cognitive Science, Department of Psychology

Individuals with alexithymia, autism, and schizophrenia all have deficits in the processing of emotion, language, and bodily awareness. Although countless neuroimaging studies have been completed, providing key insight into the neurological deficits of the disorders, more specific analysis across these abnormal populations in a region-of-interest study has not been conducted. As a result, the research concerns the analysis of the inferior pre-central gyrus. The region has elicited activation during language, attention, reward, and pain tasks. Additionally, the mirror neuron system, which is responsible for imitation, has been activated in this region. By mapping the peak activations from functional Magnetic Resonance Imaging (fMRI) tasks, accumulated from a literature search, a more thorough analysis on the underlying deficits of the disorders and region can be determined. Ultimately, the exploration of the activations that are elicited during both social and non-social reasoning tasks in the inferior pre-central gyrus provide insight into both the region and the disorders.

*Project Mentor: Professor Anthony Jack, Department of Cognitive Science*

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**Effect of In-utero Exposure to Malaria on Child T-cell responses**

**Connie Tzou**, Department of Biology; Dr. Indu Malhotra, Center for Global Health and Diseases; and Dr. Christopher King, Center for Global Health and Diseases

In malaria-holo-endemic areas, pregnant women and infants are particularly susceptible to infection. The presence of the malaria parasites during pregnancy allows soluble parasite antigens, human antibodies, or infected erythrocytes, which have the ability to cross through the vasculature of the placenta,
to have an effect on the fetus during development. In a prospective cohort study including 488 pregnant mothers and newborns in Msambweni, Kenya (on the coast of Kenya), the fetal blood, infant follow-up blood, and supernatant samples challenged with malaria antigens were tested via ELISA with 4 different cytokines (IFN-γ, IL-13, IL-10, IL-5) to answer the ultimate question of whether in-utero exposure to the malaria parasite and its proteins would lead to a more robust or in a more tolerant child immune response. The study showed that IFN-γ and IL-10 were more involved in positive responses overall. However, upon age stratification, IL-5 is just as active as or sometimes more than IFN-γ. The antigen Merozoite Surface Protein 1 (MSP1)-42 (3D7 allele) seems to have differing cytokine responses than its related antigen M42, the recombinant peptide of the protein. Conversely, other antigens, such as MSP1-42 (FVO allele), have a correlating response to K30 and K49, the recombinant peptides of the protein across all 4 cytokines with varying results due to age. While additional experiments and analyses are underway, this analysis will allow researchers to understand any associations with increased susceptibility to childhood malaria infection and can carry implications for future pediatric malaria vaccines.

*Investigating Thrombogenicity of Cardiovascular Polymeric Biomaterials*

**Kristina Vaci**, Department of Biomedical Engineering

For blood-contacting devices in cardiovascular applications, clotting and loss of device function is a major issue. For example, in polymer-coated drug eluting stents (DES) the polymer coating material itself does not have inherent resistance to blood proteins (e.g. fibrinogen) adsorption and subsequent platelet adhesion, activation and aggregation. Hence after the drug reservoir is exhausted from the DES, the device is often prone to thrombosis and occlusion. Similar clotting-related issues affect the performance of vascular grafts, patches, dialysis membranes et c.

To this end, we are investigating thrombo-resistant modification strategies for relevant polymer coatings to determine optimal material surface conditions for blood-compatibility. We have exposed various vascular device-associated polymers to blood or blood-relevant protein solutions, and have characterized protein adsorption and subsequent platelet adhesion on them. We have also explored whether physically or chemically creating a hydrophilic interface between blood and the polymer reduces protein adsorption and platelet adhesion. Our research methods include measurement of the dynamic contact angles on the surfaces before and after blood (or protein) exposure, and also microscope-assisted analysis of platelet adhesion on the surfaces under dynamic shear flow of blood. Our results have provided critical insight into the thrombogenic nature of current cardiovascular biomaterials and this insight may become helpful in refining blood-contacting vascular biomaterials design of the future.

*Improved Robotic Modeling of Barrier Navigation and Shelter Location in Blaberus discoidalis.*

**Daniel Vasil**, Department of Mechanical and Aerospace Engineering; Andrew Smith, Department of Mechanical and Aerospace Engineering; Henry Snow, Department of Electrical Engineering and Computer Science

In previous research, a cockroach robot was developed that attempted to mimic the observed behavior of *Blaberus discoidalis* and better understand the interaction between visual and tactile signals in cockroaches. This robot served as the testing platform for a cockroach-mimicking algorithm developed separately. This year’s robot fixes several issues associated with the old robot by completely redesigning several of the components and adding new features. The new robot chassis is a single part that is more compact and lightweight than the previous design. The antennae from the old robot are redesigned and, while the same rotary potentiometer concept is used, they resolve the issue of the robot becoming stuck in various locations. The new robot implements wheel-legs (Wheels™) which allow it to maneuver on rough terrain and climb obstacles in a fashion similar to cockroaches. The robot also implements two optical sensors that allow for position tracking for improved cockroach behavior coding. This year’s robot utilizes a new optical lens which
allows for a closer biological likeness by improving the field of vision of the robot by 33%. The cockroach modeling software is updated to allow for easy implementation of further future updates. This robot will be used in a scaled arena matching that shown in our course’s companion poster by Sterenstein et al.

Project Mentors: Professor Roger Quinn, Department of Mechanical and Aerospace Engineering; Professor Roy Ritzmann, Department of Biology

* A comparison of novel techniques and conventional methods in the use of AAC devices with individuals with Cerebral Palsy

Rebecca Vaughan, Department of Communication Sciences and Department of Psychological Sciences

Advances in technology allow users the ability to obtain information, provide quicker solutions and ultimately maximize the productivity of any endeavor. The rapid advancements in technology have impacted every area of society including the development and implementation of new and more efficient treatment models as well as providing new ways of communication in Speech Language Pathology. Many disorders prevent or hinder individuals from speaking and expressing themselves, which can cause frustration and a feeling of being overwhelmed in situations. Augmentative and alternative communication (AAC) devices allow an individual the ability to interact and communicate with others by expressing thoughts, wants, needs and ideas. AAC are communication methods used to enhance or replace speech or writing for those who have disabilities in production or comprehension of spoken or written language. This method may use unaided communication, which requires no equipment, or may use aided communication, which uses speech generating devices, or may use a combination of the two. Aided communication devices can then further be divided into low-technology systems or high-technology systems. These systems may include communication boards with visual-graphic symbols or a computer-based device. More recently, applications have been integrated into therapy or to be used as an AAC device. This project looks to provide information about AAC devices especially in the form of applications. This project also looks to compare applications to other types of aided communication AAC devices in order to determine which will be better suited for individuals with Cerebral Palsy.

Project Mentor: Dr. Barbara Lewis, Department of Psychological Sciences

* An ex-vivo system to produce pure and functional HIV-1 pol intersubtype recombinants

José F. Vega1 (Spanish), Bernard S. Bagaya1 (Molecular Biology, Microbiology) and Yong Gao1 (Department of Medicine, Division of Infectious Diseases and HIV Medicine)

The HIV-1 pol gene encodes viral enzymes: protease, reverse transcriptase, RNase H and integrase. Inhibitors to these enzymes are used as antiretroviral therapy but drug resistance is rendering them ineffective. HIV-1 recombination is implicated in development of drug resistance. However, obtaining HIV-1 pol gene recombinants for further study is difficult, often requiring sampling thousands of HIV-1 patients. Generating recombinants in vitro through dual infection of cultures is cumbersome, and an alternative system has been long overdue. We have developed a system to force two HIV-1 subtypes to randomly recombine within the pol gene. The system consists of two plasmids: pREC5’LTR-HIV-gag.pol, containing HIV-1 5’LTR, gag and pol genes but with accessory genes, env and 3’LTR deleted, and pREC3’LTR-HIV-Δgag plasmid containing a near full length HIV-1 genome except 5’LTR and truncated gag sequence. Co-transfection into 293T cells of these plasmids with a helper plasmid pR89.1-gag.pol that expresses gag and pol proteins produces viruses. The 293T supernatant can then be transferred to infect U87.CD4.CCR5 (or CXCR4) cells, and the heterodiploid viruses containing defective HIV-1 genomes from each of pREC5’LTR-HIV-gag.pol and pREC3’LTR-HIV-Δp24 plasmids can complement each other to complete reverse transcription and result in a productive infection. Homodiploid virions on the other hand cannot complete reverse transcription and can be screened out. Therefore, this system is able to produce pure functional pol genes for further study.

Project and faculty mentor: Dr. Yong Gao, Department of Medicine
Compensatory Strategies and Cognitive Impairment in Patients with Heart Failure

Tony Vehovec; Nursing Major, Mary Dolansky; FPB School of Nursing, Joel Hughes, Denise Lin, Richard Josephson, John Gunstad

Approximately 25-40% of heart failure patients have unrecognized cognitive impairment that affects their ability to self-manage their complex treatment regimen. Compensatory strategies include use of pillboxes, assistance from family members, and incorporating reminders. The Situation-specific Theory of Heart Failure Self-care was used to guide this descriptive study to determine the frequency of compensatory strategies used and the relationships with age, race, gender, cognitive function, and adherence to medications. A convenience sample of heart failure patients (N=90) were recruited from outpatient clinics. Baseline demographic and cognitive function data were collected in participants’ homes and adherence to medications was collected over a three week period using an electronic pill box. Participants were scored adherent if they took 80% of one of their medications. Cognitive impairment was measured in 3 domains: 1) Global using the Mini-mental State Examination (MMSE) and the modified MMSE (3MS), Memory using the Rey Auditory Verbal Learning Test, and 3) Executive Function/Attention using the Frontal Assessment Battery, Trail Making A and B. The sample mean age was 67.83 (9.33), 32.2% were women, 25.6% African American, and 86.7% had 1 or more cognitive impairments. Compensatory strategies used included family assistance (13.3%), incorporating into daily routine (13.3%) reminders (17.7%), and pill box (53.3%). There were no demographic differences in use of compensatory strategies used except that African Americans used less strategies than Caucasians (Chi-Square 5.25, p=.02). There was no relationship among use of compensatory strategies and cognitive function or adherence to medications. Better understanding of the factors related to successful use of compensatory strategies and tailoring to the type of cognitive impairments are needed to improve adherence to the complex demands of living with heart failure.

Mentor: Mary Dolansky; FPB School of Nursing

* Gait Analysis of Captive Bears- Differences between pacing and normal locomoting

Heather Voss-Hoynes - Biology and Spanish

Stereotypic behaviors, or repetitive and apparently functionless behaviors, are prevalent in captive animal populations worldwide. Pacing is one common example of stereotypic behavior and is present in the sloth and polar bear populations at the Cleveland Metroparks Zoo. Because pacing is a departure from wild behavior, much research has focused upon extinguishing pacing but has ignored the fundamental characteristics of the behavior which can provide insights into the purposes and causes of the stereotypy. One of the most basic aspects of this behavior is the gait pattern of the bear which includes speed of motion, duration of time each foot spends on the ground, and movement of other body parts such as the head. This project uses high-speed video analysis to fully characterize and compare gait during normal locomotion and pacing. Preliminary data indicates that during pacing the bear uses a shorter swing phase (346.2 ±64.1 ms) than during normal locomotion (478.7 ±180.9 ms), and variance in gait patterns decreases significantly (p=0.025). Comparison of the differences in gaits during pacing and normal locomoting will not only increase overall knowledge about stereotypic behavior but also provide directions for future research. By increasing fundamental understanding of pacing, this project serves as a precursor for determining the neural underpinnings of stereotypic locomotory behaviors.

Project Mentor: Dr. Roy E. Ritzmann, Department of Biology
Simulation of Droplet Breakup by Dissipative Particle Dynamics (DPD)

Jacob Wagner, Departments of Physics, Chemistry, and Polymer Science & Engineering; Rongzhi Huang, Department of Macromolecular Science & Engineering; Mikio Yaminoi, Department of Macromolecular Science & Engineering; and João Maia, Department of Macromolecular Science & Engineering

Coarse grained (CG) simulation methods, such as CG molecular dynamics and Stokesian dynamics, are used to gain a better understanding of mesoscopic phenomena. Hoogerbrugge and Koelman proposed a simulation method called Dissipative Particle Dynamics (DPD) in 1992, which can be applied to systems including Newtonian fluids, colloidal suspensions, emulsions, polymer solutions, polymer melts, polymer blends, and polymer nano-composites. Specifically, DPD is well suited to address the problem of droplet breakup, which is important for mixing operations such as in the production of cosmetics, pharmaceuticals, and food as well as oil recovery and cleanup operations. Droplet breakup was experimentally quantified by Grace in the 1980’s, but the behavior has not been fully reproduced using simulation. This project applies a new DPD simulation method developed by the Maia group with tunable coarse-grained level to capture the physics of droplet breakup in micro- and nano-emulsions. The droplet breakup phenomenon is described based on the viscosity ratio of the phases and the capillary number, a ratio of shear stresses to pressure. Viscosity was modified by taking advantage of the Fluctuation-Dissipation theorem. We have found that DPD can qualitatively reproduce the Grace plot for Newtonian fluids under shear.

Project Mentor: Professor João Maia, Department of Macromolecular Science & Engineering

Synthesis and Analysis of Magnetic Nanoparticles for Sustainability and Biomedical Uses

Kara Wahlgren, Department of Chemistry

Magnetic nanoparticles have been heavily researched due to their vast variety of uses across fields of chemistry and medicine including: ferrofluids, recording data, magnetic resonance imaging, and mediators for cancer magnetic hyperthermia. For my research I assisted in the synthesis and analysis of magnetic nanowires and nanorods. By tuning the ligand to solvent ratio and the reaction time we are able to control the shape and aspect ratio of the resulting magnetic nanowires. Their magnetic properties are morphology dependent which is why nanorods and nanowires are desirable. Also, their shape anisotropy dominates this magnetic property. Because of these factors, magnetic nanowires/rods are promising alternative permanent magnets. For this reason we have focused our research on creating iron platinum nanorods as a source of alternative energy. My second project involved creating polyethylene-nanoparticle mixtures that potentially will have biomedical uses. Since the 1980’s, many joint replacements are made from ultra-high molecular weight polyethylene, due to polyethylene’s low friction on metal bearings. However, this minute amount of friction causes tiny wear particles (around 1x10-6m in size) to release into the surrounding joint cavity. This can cause a wide variety of issues, including inflammation and osteolysis. However, there is no current way to study the loss of these in vivo but creating a polyethylene-nanomagnet mixture that can be used in joints could potentially be used to measure the particles lost.

Project Mentor: Dr. Anna C. Samia, Department of Chemistry

Simulating Interactions between Confined Spins and Ferromagnetic Vortices

Bryan T. Weinstein, Engineering Physics (Department of Physics)

The ability to control quantum dots (QDs) at room temperature may lead to the development of room temperature quantum computers, allowing previously computationally impractical problems to be solved. We believe that the strong localized field created by ferromagnetic vortices can be used to control the spin of electrons in semiconductor nanocrystal QDs at room temperature. The localized field produced by the vortices is much larger in magnitude than conventional methods utilizing a standard coil or stripline, allowing
for improved control of the spins. To gain a better physical understanding of the interactions between the spins of QDs and ferromagnetic vortices, we will use the “Object Oriented Micro-Magnetic Framework” (OOMMF) to computationally simulate how the vortex’s magnetic field affects the electron spins, how the spins affect the magnetization of the ferromagnetic vortex, and how multiple spins interact mediated by the ferromagnetic vortex. The vortex-QD system will elucidate new methods to manipulate the spin of QDs and the interactions discovered could easily be extended to low temperature QDs.

*Project Mentor: Dr. Jesse Berezovsky, Department of Physics*

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**The role of material strain in triboelectric charging and charge transfer**

**Ross Widenor**, Department of Chemical Engineering; Mamadou Sow, Department of Chemical Engineering; Dr. Ajay Kumar, Department of Chemical Engineering; Seung Whan Lee, Department of Chemical Engineering

It is well known that materials can build up static charge when they are rubbed together, referred to as triboelectric charging. Classically, one thinks of rubbing an inflated balloon on hair or socks on a carpet. This phenomenon also manifests itself in a number of real-world circumstances, such as dust storms, where large electric potentials are created by particle collisions and lead to lightning. Despite the existence of these common occurrences, the fundamental mechanism behind triboelectric charging remains poorly understood. This summer, I studied the affect of material strain on triboelectric charging. In my experiments, I found that a relaxed piece of latex that is contacted with a piece of Teflon causes the Teflon surface to accumulate net positive charge, while latex that is inflated like a balloon and presumably strained, causes the Teflon surface to accumulate net negative charge. This behavior was reproduced successfully for 55 out of 56 trials with deflated latex and in 56 out of 56 trials with inflated latex. Overall, this study represents the first clear evidence of material strain causing a reversal of charge transfer in triboelectric charging.

*Project Mentors: Professor R. Mohan Sankaran, Department of Chemical Engineering and Professor Daniel Lacks, Department of Chemical Engineering*


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**Gender Differences in the Narratives of Preschool Children**

**John Wigal**, Department of Psychological Sciences

Storytelling is a useful tool for examining aspects of a child’s development, as it gives insight into a child’s thoughts, values, and experiences. Gender has been found to influence the content of narratives. In past research, boys and girls often differed in the types of emotion used in stories. In general, boys tend to express aggressive and assertive themes, while girls use more nurturing and caring language. In this study, the narrative content of preschool children (ages four and five) was examined. Twenty-nine children (eighteen boys and eleven girls) received a play task and thirty children (nineteen boys and eleven girls) received a storytelling task. Both tasks were scored for feeling words and themes. It was hypothesized that preschool boys would use more negative feeling words and fewer positive feeling words than girls in the play task. In the storytelling task, it was hypothesized that boys would mention characters that were mad, while girls would mention sadness. Overall, it was expected that boys would use more emotion words in the storytelling task.

*Project Mentor: Professor Sandra Russ, Department of Psychological Sciences*
In neighborhoods across North America, small shopping plazas once anchoring local retail activity have become today’s suburban frustration. Initially, envisioned as hubs of consumption and services, many of these places are abandoned and dilapidated. Spaces once fluid with pedestrian and automotive traffic are now stagnant, stale and profitless. Such is the case with a section tangent to Cleveland’s own Shaker Square. In its original conception in the late 1920s, Shaker Square planned to appeal to the upper-class clientele of Shaker Heights, housing realtors, restaurants, specialty clothing stores and professional offices. Today, this vision has survived a nearly ten decade test; however, the rear wing of the square bordering Van Aken Boulevard has outlived its intended use.

In my research, I have investigated the following questions:

What potential might there be for mixed-use renovation, community farming, or social spaces?

How might the small-scale strip mall be reinvented and redeveloped to local advantage?

How can this space be adapted or repurposed to meet the changing needs of this suburban neighborhood?

What innovative new uses, forms, and spaces might result?

As a result of my investigations, I have developed a transformative solution that opens the space and creates an aesthetic of regeneration, evolution and welcome. [Project name] retains the original commercial activity essential to this vibrant neighborhood, while providing a new personality and confidence essential for this space to stand on its own. Through the adoption of green roofs, interactive landscaping, fitness facilities this project becomes a new gateway to Shaker Square.

Project Mentor: Sally Levine, Department of Studio Arts

Charge Readout in Liquid Xenon for the LUX Dark Matter Experiment

Matthew Winkelman, Department of Physics; Dan Akerib, Department of Physics; Thomas Shutt, Department of Physics

As part of its search for dark matter the Large Underground Xenon (LUX) detector must work to reduce the background signal present in its detector. There are sections of the xenon that are outside of the current detector region that can be used to detect background signals for discrimination. This project seeks to explore the electric fields present in this region and then to create a system for reading the charge signal from a scattering event. This system will be tested in a prototype xenon detector under conditions that replicate the conditions present in the LUX detector for xenon outside of the detector region.

Faculty Mentors: Professor Dan Akerib, Department of Physics; Professor Thomas Shutt, Department of Physics

Charge transfer reactions at the plasma-liquid interface

Megan Witzke, Department of Chemical Engineering; Carolyn Richmonds, Department of Chemical Engineering, Dr. Brandon Bartling, Department of Chemical Engineering, Seung Whan Lee, Department of Chemical Engineering, Prof. Jesse Wainwright, Department of Chemical Engineering, and Prof. Chung-Chiun Liu, Department of Chemical Engineering

Electrochemical reactions are normally studied at the interface of a solid metal electrode and an aqueous ionic electrolyte. A smaller number of experiments exist, dating back to more than 100 years ago, of plasmas formed at the surface or inside of liquids to initiate electrochemical reactions at the interface of a plasma electrode and a liquid electrolyte. Despite this long history, reactions at the plasma-liquid interface remain poorly understood. Plasmas that are formed at low pressures require liquids with extremely low vapor pressure, limiting previous studies to ionic liquids (i.e. molten salts). In addition, plasmas are characterized by a complex environment (e.g. ions, electrons, UV, etc.) which has
made it difficult to differentiate charge-transfer reactions from other non-faradaic reactions such as radical generation and chemical dissociation.

We have recently developed a novel microplasma source that allows a non-thermal, atmospheric-pressure plasma to be stably formed at the surface of aqueous ionic electrolytes, facilitating fundamental study of charge-transfer reactions at the plasma-liquid interface. Electron transfer reactions between the plasma and the liquid are studied by using the well-known ferricyanide-ferrocyanide redox couple. The electrochemical reduction of ferricyanide is monitored by UV-vis absorbance spectroscopy and cyclic voltammetry. We find that ferricyanide is indeed reduced by the plasma, confirming that charge transfer reactions can occur at the plasma-liquid interface. The rate of ferricyanide reduction is found to depend on the discharge current, which controls the electron flux delivered to the surface of the solution. By comparing the (discharge) current to the amount of ferricyanide reduced, we obtain a reduction efficiency of ~1%. To address the relatively low efficiency, we have measured the potential at the plasma-liquid interface to determine whether the potential is high enough for water electrolysis and measured hydrogen generation by mass spectrometry.

Project Mentor: Professor R. Mohan Sankaran, Department of Chemical Engineering

Exploring genetic variation of *Schistosoma mansoni* among microareas of varying prevalence in Salvador, Brazil

**Matthew D. Wright**, Department of Biology; Dr. Ronald E. Blanton, Center for Global Health and Diseases; Walter A. Blank, Center for Global Health and Disease; Lucio Barbosa, Center for Global Health and Disease; Thassila Pitanga, Center for Global Health and Disease; Peace Aminu, Department of Chemistry.

*Schistosoma mansoni* is a helminth that causes intestinal schistosomiasis. Schistosomiasis is a chronic parasitic disease affecting over 200 million people worldwide. Despite various efforts to combat this disease, schistosomiasis remains a serious threat in tropical regions. This research aims to explore the genetic differentiation among parasitic schistosome worm populations in microareas of the Sao Bartolomeu neighborhood of Salvador, Bahia, Brazil. In order to learn about possible factors that may influence genetic variation between microareas, DNA extracted from schistosome eggs from fecal samples were purified, genotyped, and analyzed. The use of 15 reliable microsatellite markers on the schistosome genome as well as laboratory tools and protocols such as CTAB purification, qPCR, microsatellite genotyping, as well as population genetic analysis are vital components of our research. This study utilized population genetics analyses to understand implications of the allele frequencies for each *S. mansoni* sample. Many studies have revealed that data collected from infrapopulations can be incorporated in order to gain a holistic view of the component population. By analyzing the data collected with various genetic differentiation indices, we hope to understand possible factors that may influence the genetic differentiation among schistosomes in nearby microareas with varying prevalence of infection. It is likely that migration, socioeconomic status, amount of water contact, and environmental conditions are closely linked to prevalence of infections. By determining, possible factors that may influence the genetic differentiation among schistosomes in nearby microareas, this project intends to foster a better understanding of the epidemiology and prevention of schistosomiasis in this Brazilian neighborhood and elsewhere.

Project Mentor: Dr. Ronald E. Blanton, Center for Global Health and Diseases
Faculty Sponsor: Dr. Emmitt R. Jolly, Department of Biology, Center for Global Health and Diseases

An Alternative Method for Synthesizing Synthetic Platelets

**Larry S. Wu**, Department of Biomedical Engineering; Andrew J Shoffstall, Department of Biomedical Engineering; Donald R. Campbell, Department of Biomedical Engineering

Poly-L-Lysine conjugated poly(lactic-co-glycolic acid) (PLGA-PLL) nanoparticles can be functionalized and used for a variety of applications. One such application is the synthetic platelet, a PLGA-PLL particle
functionalized with an arginine-glycine-aspartic acid (RGD) moiety conjugated to poly(ethylene glycol) (PEG). This particle binds activated platelets reducing bleeding time. Traditionally, the synthetic platelets have been synthesized by using a single emulsion technique. However, using a nanoprecipitation technique, several sizes of particles with a comparable size were synthesized. Nanoprecipitation allows for faster synthesis and a smaller possibility of melting the particles than the single emulsion technique, which requires sonication. These methods of synthesis can be used to further optimize the synthetic platelets for clinical use.

*Project Mentor: Dr. Erin Lavik, Department of Biomedical Engineering*

**Government Relations Internship**

**Irina Yakubenko,** Department of Political Science

Advocacy is something very important to a hospital—something I learned first-hand interning at the Government Relations Department at University Hospitals. Throughout my internship, I was involved in many projects that taught me valuable skills. One of the things I did was contact government officials and set up dates for tours of the hospital. This led to the officials reporting back to congress or the state about the good things UH was doing and how their programs should be supported. This is how the Children’s Hospital’s Graduate Medical Education (CHGME) bill was supported and brought up in congress by Congressman Bob Latta. This bill provides funding for children’s hospitals to train specialty physicians and was zeroed out of the president’s budget, cutting millions of dollars from children’s hospitals. Advocacy from UH led to people talking about CHGME in D.C. and trying to save the program. I was also in charge of putting together an application to get the Otis Moss Health Clinic and Tapper Dental Clinic designated as a Health Professional Shortage Area. This means that they do not have enough physicians to work in their clinics and should be designated as a shortage area, which then gets them money to run better. I researched, contacted people, and attended meetings to help the community and the hospital run better.

*Faculty Sponsor: Professor Kelly McMann, Department of Political Science
Project Mentor: Nikki Scarpitti, Public Policy Specialist, Government Relations*

*Modifying Qβ with C₆₀ for Use in Photodynamic Therapy**

**Alice Yang,** Department of Biomedical Engineering; **Amy Wen,** Department of Biomedical Engineering; **Mary Ryan,** Department of Biomedical Engineering; and **Dr. Nicole Steinmetz,** Department of Biomedical Engineering, Radiology, Materials Science and Engineering

Photodynamic therapy has great potential to revolutionize modern cancer therapies. Using external stimuli, photodynamic drugs will not be activated until they are at the target tumor site, thereby avoiding damage to regular, healthy tissue. One such cancer drug is C₆₀, a spherical fullerene commonly known as the “buckyball.” When light is absorbed by C₆₀, electrons are excited to higher energy states and trigger the production of reactive oxygen species, which can cause cell death. As it is, C₆₀ is highly insoluble in water, leading to difficulties in delivery. Attaching it to a nanoparticle such as Qβ can increase the solubility. Qβ is an RNA bacteriophage that naturally infects *Escherichia coli*. By attaching cell-targeting ligands and a cancer drug to Qβ, it can be modified to act as a vehicle for drug delivery purposes. This project looked at the covalent attachment of C₆₀ to the Qβ nanoparticle by bioorthogonal chemistry and its effects on *in vitro* cell proliferation. It was determined that Qβ improved the cellular internalization of C₆₀ and resulted in enhanced efficacy of the photodynamic therapy. Further development of this drug delivery method with targeting ligands would offer tumor-specific therapy and circumvent the unfavorable injury to healthy tissue that is present with cancer treatments today.

*Project Mentor: Dr. Nicole Steinmetz, Department of Biomedical Engineering, Radiology, Materials Science and Engineering*

# present address: Department of Chemical Engineering, University of Dayton
Development of a library to screen for transcriptional activators in a parasitic worm

Jinny Ye, Department of Biology; Kenji Ishida, Department of Biology; Ifeyinwa Nwankwo, Department of Biology; Dr. Emmitt Jolly, Department of Biology, Center for Global Health and Disease

The parasitic disease ranked second only to malaria in its health burden in tropical and subtropical areas is schistosomiasis. Schistosomiasis affects over 200 million people worldwide despite the effectiveness of the drug praziquantel. Praziquantel is the only known chemotherapeutic agent, leading to its widespread use for the past several decades. The concern of drug resistance bring to light the importance of understanding the basic molecular biology of this parasite of the genus *Schistosoma* in identifying potential drug targets. Drug targets may be found in proteins involved in gene regulation. The methods presented in this paper are the first demonstration of a cDNA library to identify transcriptional activators in a multicellular organism. We systematically tested 266,912 yeast proteins for transcriptional activity using a modified yeast one-hybrid system. Fusion proteins were constructed with the Gal4 DNA-binding domain (DBD) and gene insert cloned from the developmental stage preceding the pathogenically important adult stage. These fusion proteins were used to drive expression of four reporter genes under the control of the Gal4 DBD. Of the initial screening of these fusion proteins, 532 exhibited transcriptional activity, of which 33 sequences have thus far been identified. One identified sequence is myeloid leukemia factor 1 (MLF1) that has never before been characterized in the schistosome species *S. mansoni*. As we continue to systematically identify unique transcriptional activators in the schistosome genome, we strive to contribute to the basic understanding of this important parasitic worm crucial to drug development.

*Project Mentor: Dr. Emmitt Jolly, Department of Biology, Center for Global Health and Disease*

This is a Michelson-Morley Research Competition Presentation

Quantifying Cardio-Respiratory Coupling with an Empirical Oscillator Model

Yenan Zhu, Department of Biology, Systems Biology; Yee-Hsee Hsieh, Department of Medicine, Pulmonary, Critical Care and Sleep Medicine; Thomas E. Dick, Department of Medicine, Pulmonary, Critical Care and Sleep Medicine; Frank Jacono, Department of Medicine, Pulmonary, Critical Care and Sleep Medicine; Roberto F. Galán, Department of Neurosciences, School of Medicine

Cardio-respiratory coupling (CRC) is a physiological phenomenon corresponding to the mutual relationship between respiration and heartbeat. In this study, CRC and its mediation through the vagus nerve were examined using methods principled on a model of generic coupled phase oscillators. Our collaborators from the Department of Medicine provide us with paired respiratory EMG (electromiogram, which measures diaphragm contraction) and EKG (electrocardiogram) recordings from anesthetized rats, before and after severing the vagus nerve (vagotomy). Specifically, we aim to quantify the magnitude of CRC as well as its directionality. To this end, we improve upon previous methods used to study coupling of generic phase oscillators and apply them to study CRC. In theory, we fit the recordings from our experiments to a model of generic coupled phase oscillators, and through the fitting, we obtain a pair of coupling functions that captures the degree of interaction between the two oscillatory systems. Importantly, these measures of coupling are directional, which allow us to determine which oscillator is driving the other. Thus far, we have used our methods to characterize the baseline (CRC in anesthetized rats). We observe unidirectional coupling, where respiration drives heartbeat but not vice versa. And after vagotomy, we find that there is no presence of coupling in either direction. In the future, we aim to extend our analysis to study CRC under different physiological conditions, e.g. sepsis, forced ventilation, and different anesthetics such as urethane. Ultimately, we aim to apply this technique to quantify CRC in human patients to aid the diagnosis of cardio-respiratory pathologies in a non-invasive and efficient manner.

*Project Mentor: Roberto Fernández Galán, PhD., Department of Neurosciences, School of Medicine.*

This is also a Michelson-Morley Research Competition Presentation
In many electrochemical applications, including proton-exchange membrane fuel cells, platinum is used as the electrocatalyst. Since platinum is expensive, it is necessary to find ways to maximize the electrochemical activity of platinum – the ability of platinum molecules to interact with other molecules to catalyze the reaction – while minimizing the mass of platinum needed in each electrode.

This research is concerned with developing high surface area platinum nanoparticles supported by graphene in attempt to create electrocatalysts with high electrochemically active surface area and high stability, but with minimal amounts of platinum. Graphene is expected to impart favorable contributions to the electrocatalytic activity of platinum and is also expected to stabilize the size of the platinum nanoparticles. Graphene-supported platinum will also serve as a model for understanding support stability, especially at elevated temperatures and high potentials. This research addresses how platinum particles adhere to graphene support structures. Functionalization techniques have been explored in order to improve the overall durability of platinum nanoparticle electrocatalyst as applied to the oxygen reduction reaction (ORR) in fuel cells, while exploring conditions under which platinum nanoparticles distribute and adhere most effectively to graphene. Furthermore, the resulting electrocatalyst have been characterized using various analytical methods. Utilizing various characterization techniques, this project aims to determine the parameters under which platinum deposits and adheres to graphene in a reproducibly and stable fashion.

*Project Mentor: Professor Robert Savinell, Department of Chemical Engineering*
CELEBRATION OF STUDENT WRITING
APRIL 20, 2012

The Celebration of Student Writing showcases undergraduate student writing projects from across the University. The celebration encourages students to re-present and display their research and writing in formats other than conventional word-processed letters and lines on the printed page. Some students create video projects; others produce poster presentations or read aloud portions of their writing; still others design models or digital illustrations that present their writing projects in new media.

The Center for the Study of Writing, established in 2008 to facilitate research and scholarship on writing at the University and in the world, serves three distinct but interrelated roles at the University: to support writing and research by resident and visiting students and scholars; to facilitate exciting new courses and curricula on writing; and to provide an array of practical writing and publishing support services to the University and University Circle communities. For more information, see http://www.case.edu/writing/csw.

Since 2009, the Center for the Study of Writing has been sustained by generous gifts from Marilyn McCulloch (FSM ’50); from Edward S. Sadar, M.D. (ADL ’64, SOM ’68) and Melinda Melton Sadar (FSM ’66); from Sharon Schnall (MBA ‘87) and Dr. R. Drew Sellers (EMBA ‘08); from Eric Winter, M.D. (CWR ‘98, GRS ‘91, MD ‘98); from Jackson McHenry (ADL ‘52); and from an anonymous donor. The Celebration of Student Writing is also supported by SAGES and the Department of English.
**CENTER FOR THE STUDY OF WRITING – LEMMERMAN PRIZE FOR FIRST-YEAR ESSAYISTS**

**Representative:** Kimberly Emmons

The Center for the Study of Writing is pleased to recognize the Fall 2011 winners of the Karl Lemmerman Prize for First-Year Essayists. At our table, we will have copies of the winning essays available for your review.

**First Prize:** “Technological Triumph: The Future of Music” by Alberto Rodriguez
*Written for FSSO 114, “Music in Our Lives,” Prof. Matthew Garrett and Dr. Damjana Mraovic-O’Hare*

**Second Prize:** Does an Audience Understand Nothing” by Charles Burke
*Written for FSSY 112, “Shakespeare – Still a Hit,” Prof. Marshall Leitman and Dr. Carolyn Leitman*

“Usage and Interpretation of Song in the Odyssey and Its Modern Counterpart in Film” by Aaron Chiu
*Written for FFSY 110, “The Greek Hero Since Antiquity,” Prof. Timothy Wutrick and Dr. Tasia Hane-Devore*

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**WRITING RESOURCE CENTER**

**Representatives:** Megan Swihart Jewell, Robert McAlear, Michael Parker

The Writing Resource Center offers one-on-one writing assistance to students from all disciplines in the university. Stop by our table to meet our consultants, learn about our own research and how it informs our tutoring, and participate in fun writing contests and games.
ENGL 217B: WRITING FOR THE HEALTH PROFESSIONS

Course Instructor: Marcus Mitchell

Students: Alexander Bergsneider, Yuh Jung Han, Erica Iafelice, Margaret Landefeld, Allen Mallory, Dhruv Seshadri, Kendra Simmons, John Todia, Caroline Wang, Kellie Willis, Tianna Xia

English 217B offers practice and training in writing for the health professions. Recognizing the importance of analyzing audience and understanding rhetorical situations, this course places emphasis on the entire writing process: from planning and drafting through revising and editing. Students will complete assignments that offer guided practice in genres common to the health professions. These assignments will be written for multiple audiences, including other healthcare professionals, patients, the general public, and admissions committees. The course also emphasizes the importance of writing for an audience of “yourself,” and thus includes reflective writing as a semester-long habit. Students will identify individual areas of research, explore those areas through annotated bibliographies and literature reviews, and adapt this research to the genre of informative patient literature and public health literature suitable for a general audience. Students will also craft resumes and personal statements tailored to their individual professional and academic goals.

Using health related topics researched throughout the semester (and drawing upon readings on public health campaigns), students will present public health brochures, fliers, or pamphlets they have crafted. The goals of the students' public health literature are to educate specific audiences about a specific health issue and promote some form of behavior modification in order to encourage better health practices.

ENGL 309: MULTIMEDIA STORYTELLING

Course Instructor: James Sheeler

Students: Alan Dreher, Kirsten Eichelman, Sheehan Hannan, Kayla Gray, Tyler Hoffman, Siqi Li, Hannah Lipshultz, Jenna Millemaci, Alexis Parisi, Paul Ryland, Shannon Snyder, Margo Uhrman, Claire Vidalon, Katy Witkowski

Inside Eliza Bryant Village in Hough, there is a story behind every door. Students from the class spent much of the semester here at the oldest continually operating African-American nursing home in the country, immersed in the stories and lives of residents and staff. Using the latest digital technology as well as traditional pens and spiral notebooks, they ventured behind the scenes to see the inner workings – both physical and emotional – of the place that, for many residents, will be their last address. There, the residents opened their doors, and shared their stories.
FSTS 100: WHAT IS A MUSEUM?

Course Instructor: Susan Dominguez

Students: Emily Buckner, Gretta Cawley, Jasmine Core, Evan Cunningham, Jared Freidman, Andrew Gronski, Will Hayes, Katerina Jurkoshek, Brent O’Reilly, Sara O’Reilly, Priya Sharma, Anna Ushakova, Xiaoyue Wang

This SAGES class introduces Case transfer students to University Circle Institution experiences to stimulate critical thinking and intellectual conversations. Final projects represent the design of a museum exhibit, either multi-dimensional, digital, virtual, mixed-media, accompanied by a written narrative using foundational What is a Museum readings. Students may improve upon an existing exhibit or design something entirely new.

USNA 204: EVOLUTION OF SCIENTIFIC IDEAS

Course Instructor: Barbara Burgess-Van Aken

Students: Ben Biefeld, Andrew Brandt, Cal Dhubaib, Jonathan Harper, Nate Lombard-Poirot, Tyler McConnell, Kyle Mikson, Jim Roberts, Evan VanderHoff

Very few beliefs about the natural world have remained intact over the centuries. In this course we have developed an understanding of how scientific ideas change by exploring questions such as: What is science? How do disciplinary scientific communities form and identify themselves? How does the community of scientists within a discipline come to a consensus about the framework in which they will operate? What induces scientists to decide to search for a new paradigm? What scientific, social, political, and cultural factors come into play during these periods of transition? Today, the class is pleased to present student presentations on semester-long research projects.

USNA 237: LANDSCAPE HISTORY & CONSERVATION

Course Instructors: Erika Olbricht & Matthew Trammell

What value does a historic landscape hold for us today? Can its natural or ecological value compromise its historical or national value (or vice-versa)? Student course projects explore these ideas and others as they advocate for contemporary landscape conservation.
**USNA 260: LIFE IN THE PAST**

**Course Instructor:** Brad Ricca

**Students:** Alison Brooks, Hallie Dolin, Calvin Gao, Patricia Jakandoni, Andrew Maroncelli, Derek Muff, Jarred Napier, Paul Sheppard, John Simon, Arianna Wage, Colin Williams, Christina Xia, Stacy Yeh, Liang Zhang, Yaoyu Zhang

Our course focuses on how we learn, discover, and make conclusions about life in the deep past. What types of life were present? And how can we understand their extinction? We have been looking at recent discoveries regarding extinctions and even stranger theories about bringing prehistoric life back. We also have looked at the cultural ways in which we view these “dinosaurs” (movies, books, museum exhibits) and see if it helps or hurts our scientific and historical understandings of them. At heart, our main question is: can you really understand a time, space and creature that has been extinct for millions of years? How? Why? And why do these “monsters” hold such fascination for us?

**USSY 275: AMERICAN COMICS**

**Course Instructor:** Brad Ricca

**Students:** Haewon Chee, Brian Cirbus, Dale English, Luke Johnson, Mason Li, Emeline Liu, Yue Lu, Bronte Miller, Michael Perisa, Yaeri Kim, Tai Yang

The study of the superhero comic book is a vital site for important questions about the intersections of art and popular culture in America. It is also a place to look at what we consider many different variations of the adjectives “good” and “bad.” From Popeye to Superman, Wonder Woman to the X-men, comics have given us larger-than-life characters who are often caricatures of dominant (and sometimes subversive) American ideologies. We will share some of our discoveries in this unique genre and show what it means to truly read comics – artistically, politically, culturally, and symbolically. What can comics tell us? And how can we write about them in intelligent, critical ways?
USSY 286S: SHAKESPLOITATION

Course Instructor: Barbara Burgess-Van Aken

Students: Sydney Covelli, Jeremy Frank, Elizabeth Fury
Abby Hafer, Renee Hartney, Cora Jackson, Nick Moritt, Davina Oke, Dawn Ramsey, Aruna Singh, Adriana Thompson, Morgan Thompson

Ever since Shakespeare's plays were revived in the Restoration, his works have been reinterpreted, adapted, and appropriated—often radically. Today he remains a cultural icon, thanks in part to the efforts of impresarios, editors, publishers, filmmakers, and marketers. Along with reading five Shakespeare plays through a New Historicist lens this semester, our class has created some Shakesploitations of our own. Today we present a Shakespeare newspaper, a Shakespeare game, a count-down of the top 20 Shakespeare-related songs, and a show entitled “Desperate Shakespeare Wives.”

USSY 287T: KING ARTHUR'S DAYS & KNIGHTS

Course Instructor: Rachel Kapelle

Students: Arianna Constantakes, Hannah Jenkins, Roman Kowalsko, Kathy Lee, Kerry Martenis, Matthew McGoogan, Nicholas Novak, Jeffrey Oleski, Kaylee Sarna, Lara Schoeffler

Few legends have remained popular and vital as long as the story of King Arthur has. Beginning with brief references in sixth-century histories, Arthur has risen again and again in medieval adventure stories, Victorian lyrics, and contemporary cinema. Over thirty-five films, in fact, have depicted the adventures of the Round Table. How can we explain this phenomenon? To investigate this question, our seminar traces the development of the legend from its oldest remaining written manifestations to the present day. At the Celebration of Student Writing, we will showcase what we have learned about the legends and the writing projects that we are completing.
ENGL 395: SENIOR CAPSTONE

Course Instructor: T. Kenny Fountain

Students: Reem Azem, Dena Balk, Katharine Bussert, Daniel Dieter, Molly Drake, Jaq Evans, Elizabeth Greco, Chris McEntee-McDonald, Zack Miller, Aaron Perine, Abigail Pink, Bethany Schmitkons, Gina Yull

This course examines research methods, scholarly resources and analytical skills for prevailing modes of enquiry in English studies. It is intended to be a component of the SAGES program for students interested in conducting a senior capstone project in an area related to English studies. As such, it also fulfills an English major requirement. To fulfill the major writing requirement for the course, students develop a cumulative research endeavor, their capstone project, which may be either a scholarly or creative work. Through the work on this project, students familiarize themselves with local and web-based research tools such as libraries, electronic databases and print indexes, various archives, and InterLibrary Loan. The capstone project culminates in a public presentation of the work during Writing Week and at the Celebration of Student Writing.

PRESENTATION ABSTRACTS: WRITING WEEK READINGS
WEDNESDAY, APRIL 18, 2012 – CLARK 209


The Film industry has consistently contained very few black women professionals; this is especially true for directors and producers. In this project I will examine the reasons behind this unfortunate reality by answering the question: Why are there so few black women directors and producers in Hollywood? I will focus on the careers and lives of film director Euzhan Palcy and film producer Debra Martin Chase, both of whom are noteworthy professionals in Hollywood, in order to answer this question. Through studying their experiences, I hope to show that race and gender still have a significant effect on how successful a person can be in Hollywood. I will also discuss factors that contribute to this problem such as the supremacy of male directors in the film industry by using the specific examples of Spike Lee and Steven Spielberg. I will also discuss how audiences have contributed to this phenomenon. I will use reviews and interpretations to see how people reacted to the films of Palcy and Chase in order to have a better idea of how people feel about films created by black female professionals. This will hopefully give others a better understanding of what hinders black women professionals from thriving in Hollywood.

1:50  Zack Miller, “Fraternities, Sororities, and the Language Acquisition Process”

International students studying in American colleges must adjust to a myriad of issues that native English speaking students do not. In addition to typical college studies, this particular group of students must overcome a language barrier while adjusting to life in a new country and a new culture. These extra concerns that non-native English speakers and international students face often result in additional stress and struggles to adapt to the college environment. There are many different strategies that students who speak English as a subsequent language can employ to
overcome these obstacles. Prior research indicates that building a large network of friends, especially native English speaking friends, is one such strategy. In this paper, I analyze the benefits and detriments to the language acquisition process of one specific type of social network: the American Greek life system. My research begins with a look at the theoretical materials available for my topic. I explore existing language acquisition theories in order to create a background for my project. I then conduct interviews with international students from CWRU in order to gain a greater understanding of their perspective about adjusting to collegiate life while overcoming a language barrier.

2:10  Reem Azem. “Stage Direction in Shakespeare”

Preparations for Shakespeare performances today include radically different methods than those of original Elizabethan theatre. In Shakespeare’s time, the structure that we see in contemporary productions did not exist. Because of the wide discrepancy between preparing to perform Shakespeare on stage or in film then and now, many questions may be asked in regards to Shakespeare’s original objective in writing his plays. How have modernized stage directions preserved the original story and intention(s) of his plays? Is the true essence of a given play lost when performance techniques change so often? How has the background of stage direction in Shakespeare’s time has influenced directions of today (or not influenced them) and just how much have the directions changed?

I will attempt to answer these questions in light of Shakespeare’s texts, original Elizabethan stage practices, distinctions between rescripting and rewriting, roles of the actors then and now, the “tension between scholarship and theatre,” and more. The adaptations that I examine are more recent production and films, particularly those of Kenneth Branagh and other directors/actors who have distinct methods in adapting Shakespeare. Shakespeare is still extremely relevant today, even to those who may not be very familiar his works. In Shakespeare’s plays, he not only has preserved timeless stories but also a language and a philosophy on theatrics that has affected our society. His plays are like history in themselves; classic stories that will continue to appear in popular culture.

2:30  Dena Balk, “If I Could Bleed”: Disconnect in the Poetry of Sylvia Plath.”

My project seeks to explore two areas of Sylvia Plath poetry: comparing the competing scholarly arguments of Dualism and the Divided Self, and introducing the linking idea of Disconnect present in Plath poetics. Some scholars have viewed the Plath poetry cannon through the notion of a Divided Plath, her poetry frequently presenting the reader with multiple selves to display profound alienation and abstraction. Other literary theorists have sought to inform Plath’s poetry through the invocation of the philosophical ideal of Dualism, the concept of distinctive separation between the mind and the body, with her poems often portraying competing aspects of the physical self alongside the spiritual self. In my paper, I hope to draw on these ideas of Division and Dualism to define an overlapping trope within Plath poetry—an astounding sense of Disconnect.

After tracing this thread of Disconnect throughout poems spanning her entire poetic career, I have classified three distinct subtypes that appear within her work: Personal Disconnect, Social Disconnect, and Humanistic Disconnect. Not only does Plath’s poetic voice display an alarming sense of disassociation from herself as a poet and a woman, but it also exhibits the same disassociation from the societal norms and connectedness of her time, as well as from the fundamentally human condition of feeling alive. Viewing her poems through this displayed
disconnect not only sheds light onto Plath’s own role within her poetry, but also enlightens some theories already in place about Dualism and Division within her work. By analyzing the poems through this lens, I hope to lend new insight into various works, contributing to the ever-expanding tapestry of poetic theory that surrounds and enlightens the body of Sylvia Plath’s work.

2:50  Aaron Perine, “Shadows of a Home that Never Was: Kara Walker and Aaron Douglas’ Use of Silhouette”

My project focuses on the works of visual artists Kara Walker and Aaron Douglas. Aaron Douglas is a muralist that worked during the Harlem Renaissance whose works involve silhouettes of dark figures against Art Deco influenced backgrounds. Kara Walker is a controversial contemporary visual artist who also works with challenging images of monochrome figures against contrasting backgrounds. I will use these sources along with critical sources about how African American art expresses ideas of identity. I will compare the two artists’ works, to help readers see the artists’ statements about the origins of African-Americans in this country and the current condition of African-Americans at their respective time periods.

Douglas’ work invokes an Egyptian aesthetic using figures that hearken back to Africa. Douglas attempts to bridge the gap between African-American people in the 1920s while looking back at the mysterious land from which they came. The presence of African imagery and natural imagery in concert with modern buildings suggests an attempt to question the place of these elements in the modern life of African-Americans. Walker’s work takes place in an imagined southern United States using stereotypical imagery concerning black life during slavery. The presence of the South in her work shifts the focus of the lost origins of black identity away from Africa and brings the South into focus as a new center of origin. Walker is trying to bridge the gap from where African-American people were in slavery and where they are now in a different way. Walker addresses how we can deal with these elements from the past by confronting these images in her work. Walker asks if we can move past these stereotypes as a society.

PRESENTATION ABSTRACTS: CELEBRATION OF STUDENT WRITING READINGS
COACHES’ AREA, ADELBERT GYM

12:00  Daniel Dieter, “Poetics in Programming”

My paper will begin by giving basic background information on the world of object oriented programming Java, and will illuminate the different inherent qualities of the language. Elaborating on current programming language theory in relation to natural language, I will explain my reasoning for choosing English poetry as a reference point through which to further examine snippets of code. I will use articles and interviews, along with historical data, to select certain examples of both code and poetry for cross-examination and close reading. The paper will prove the inextricability of poetic language from "beautiful" code. After enumerating and detailing all the parallel functionalities and relevant connections between the two modes of communication, the paper will close with a set of possible applications of a "poetic" coding style, providing strong indication of the significance of the research.
12:20 **Abigail Pink. “Reclaiming Silent Bodies: The Sound and the Fury, The Waves, and Essentialist Feminism”**

My capstone project will be a literary analysis of William Faulkner’s *The Sound and the Fury* (1929) and Virginia Woolf’s *The Waves* (1931). The aim of this analysis will be a feminist reading of the texts’ treatment of the silenced, gendered, and absent bodies of Caddy Compton and Percival, respectively. Both Caddy and Percival are central characters who do not narrate sections in their novels (which are marked by shifting first person narration), and instead are the focus of other characters’ narration. My project will be framed from the essentialist feminist theory about the relationship of women’s bodies to silence, as epitomized by Helene Cixous’s essay “The Laugh of the Medusa.” Following my comparative analysis of the two novels, the paper will examine how critical responses to the novels work as a reclamation of silenced bodies to investigate how essential feminist readings manage the absent, female body of Caddy as opposed to the absent, male body of Percival. I will argue that the model of feminist reclamation shaped by the essentialist feminist movement necessitates the critical readings of Caddy’s absent body as textually and vocally present and of Percival’s absent body as unequivocally silent.

12:40 **Molly Drake, “A Written Junket.”**

My project is a memoir that reflects my personal history with Art. Art History is a way for us to learn about cultures and people of a different time. Memoirs are written not only for autobiographical purposes but also to develop the personality of the writer. I will combine these elements of Art, history, and myself as the subject in order to uncover, slightly hidden, aspects of my disposition. I will write a collection of stories that are independent of one another but are all pieces of a whole. This whole idea celebrates my fascination with and passion for Art that come from the beginning of my life and span through to the present.

1:00 **Katharine Bussert, “From Glass Slippers to Clipped Wings: Poems of Fairy Tales, Myths, and a New Identity for the Growing Youth.”**

This work will explore the poem as a “rite of passage,” a bridge between childhood and adult concerns. “Growing up” is a constant in the lives of every person; it is a shared experience. Given that they represent a shared literary experience, I will be using the stories and characters of fairy tales and Greek and Roman mythology as the basis for these poems. Both fairy tales and myths have a collective presence in popular literary history and, because most people are familiar with these fables, at least to some degree, they would have an easier time entering the world of the story. The point of reimagining both the fairy tales and the myths is to look at them through a different lens and use what is traditionally known about them to explore their implications. The narrative voice in this work tends to be ironic, snarky, and sarcastic in order to emphasize the rebellion that occurs during this period. It also serves to relay a sense of separation from and rejection of the cookie-cutter fable with its basic moral lesson. This approach should create a closeness with the reader and their complex issues. Ultimately, the aim of these poems is to relate to a period where one is struggling to create his/her identity.

1:20 **Chris McEntee-McDonald, “Literary Reflections of the Cellular Phone.”**
Are cell phones killing literature? In an article written for the New York Times, Matt Richtel asked the same question. He asserted that the mobile phone is responsible for undoing many classic plot elements, specifically those which create tension or suspense in narrative. Because of the device’s ability to connect users across vast distances, missed connections, or the inability to reach another character, seem implausible in the cell phone era.

While Richtel’s ideas are thought-provoking and often humorous, they tell us very little about what the cell phone is actually doing in literature currently. Rather than asserting that the plot devices of this or that canonical text would fail in the mobile era, the goal of my project is to explore the function of the cell phone in contemporary fiction. My project focuses on the work of writers like John Grisham, whose characters use cell phones in an everyday manner. I examine these texts through the lens of current sociological theories regarding cell phone use and social change. The work of James Katz, Richard Ling, and Sherry Turkle focuses on how the cell phone is altering modes of self-presentation, the coordination of daily activities, interpersonal relations, and our orientation towards physical space. These theories provide insight into how the mobile phone enables new and unique narrative tropes, even as it “undoes” many classic ones.

1:40 Elizabeth Greco, “Listening Intently: The Movement of Narrative Medicine”

As the world of biomedicine continues to expand, a trend has surfaced in which the purely scientific aspects of health take precedence over the patient as an individual being. The biological and chemical properties of diseases are thoroughly studied and tended to, while non-physiological components of the patient and of his or her life are ignored or overlooked. Our world of health has become centered around the act of treating existing ailments. However, as the world eradicates infectious diseases and attempts to conquer the challenge of chronic diseases, prevention has become the main topic of interest as the face of health changes in such a manner. Prevention of such diseases must not only consider and take into account biomedical factors but social, economical, and political factors impacting various communities and individuals as well. The movement of narrative medicine is one attempt that allows physicians to better understand, diagnose, and treat patients by way of greater levels of communication. By listening to patients’ stories, these physicians can create a larger picture of patients’ lives and all the factors, non-biomedical included, which affect the patients’ health. Through the lens of narrative medicine, I will study how the face of medicine changes from a treatment-based to prevention-based style. I will argue for the importance of narrative in medicine and how it promotes strong physician/patient relationships and aids in the prevention of disease, which thus leads to better medical care.

2:00 Bethany Schmitkons, “Whining Trees and Nauseous Fish: Children’s Bible Stories from Unconventional Perspectives.”

My project is to rewrite common children’s bible stories, and perhaps a few uncommon ones, from the first person perspective of a character in the story who is usually overlooked. The goal in doing this is to imagine the stories as though they are real but in a way that has not been written before. The first person characterization will allow readers to place themselves into the story and watch it unfold, except that they will also possess the knowledge of the time of that biblical character. This serves two functions. The first is to give old stories a new framework, without completely changing the stories, so the readers can look on the stories with fresh eyes, and the second is to help readers connect with stories that they have heard before, but are traditionally written in an impersonal and archaic way. If these two goals are accomplished, then they in turn
should help the reader to reexamine something that already is familiar and to question the value of these stories. Although these are children’s stories, or classically have been in the past, I do not want to write them to be didactic. I want any inherent value in the stories to speak for itself so that the readers can realize it and use it to answer the question of whether or not these stories are significant and worth retelling to the next generation.

2:20  Jaq Evans, “Hatchetmen”

This work of fiction follows a handful of survivors of a secret series of illegal psychiatric experiments performed between 1984 and 1994, and their attempts to both survive and ultimately take on the organization known as Project Adelaide. Project Adelaide functions as an underground operation that seeks out adolescent girls with signs of potential psychic ability – one of the foremost signifiers being night terrors – in order to kidnap and experiment on them, hoping to develop their powers as weapons. Alice Winters was one such girl, though she never developed any sort of superhuman ability. Liv, an orphan of origins unknown, is different. Liv has the ability to read thoughts and memories with a touch; she and Alice were the first girls to escape the program in 1986. Fifteen years later, in fall of 2001, they – along with computer scientist Holden Teague – run a private detective agency in Chicago. Meanwhile, journalist Sara King is searching for the truth behind her brother David’s unexplained disappearance six months prior. Her questions lead her to Winters&Co… and soon enough, the connections between Sara, David, and the trauma Alice and Liv escaped over a decade ago begin to come to light.

_Hatchetmen_ continues the slowly growing trend of literature including queer characters without their sexuality acting as a primary plot point: even now there is not a large selection of literature with prominently featured queer characters in genres other than pulp or romance. Two of the main characters of _Hatchetmen_ (Liv and Sara) are queer, and the fluidity and complicated nature of sexuality is woven into the plot itself as merely a part of life rather than as an aspect in need of emphasis. My aim is for _Hatchetmen_ to help make LGBT identities simply a part of life.
Senior Capstone Presentations

April 20, 2012

SOURCE congratulates the following students who are presenting their senior capstone projects today:

Stacey Adjei                      Joseph Lesnefsky
Jeffrey Atkinson                  Sarah Lukowski
Faisal Bahrani                    Jodi Lyons
David Bertsch                     Elizabeth McNany
Natalia Cabrera                   Erik Milzeik
Carlson                           Matthew Moss
Stephanie Chen                    Lauren Nicholson
Jui-Chun Cheng                    Eric Nied
Patrick Chirdon                   Anirudh Patel
Daniel Chopyk                     Alex Popko
Matthew Cichocki                  Abirami Ramalingam
Brian Cox                         Allie Rini
Vikas Dalwadi                     Adam Rych
David Dang                        Kristen Saad
Dylan Davis                       Ankita Satpute
Roseanne Ebel                     Matthew Sheffield
Jacob Emmert-Aronson              Andrea Sterenstein
Gina Ferris                       Dora Tang
Natasha Gandarilla                Tom Tee
Rebecca Gilson                    Scott Tillem
Andrew Hale                       Joseph Timpona
Eric Hamilton                     Connie Tzou
Alex Han                          Rebecca Vaughan
Disha Haque                       Jose Vega
Jessica Hatch                     Kenneth Walther
Jessica Hwang                     Bryan Weinstein
Brian Hysell                      John Wigal
Cameron Keller                    Matthew Wright
Justine Ko                        Jinny Ye
Steven LaDelfa
The SOURCE Summer Program provides financial support for Case Western Reserve University students from all academic majors to take part in research and creative endeavor projects. The program is very generously supported by the Case Alumni Association, the Dominion Foundation, SAGES, WISER and the University.

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### 2011 SOURCE Summer SURES Program

**Summer Undergraduate Research in Energy and Sustainability**

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<th>Student</th>
<th>Project Title</th>
<th>Mentor</th>
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<td>Kevin Chiou</td>
<td>Development of Advanced Polybenzoxazine technology for Energy Saving, Thermal Management Systems</td>
<td>Hatsuo Ishida, Macromolecular Science and Engineering</td>
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<td>Steven LaDelfa</td>
<td>Solar Thermal (ST) Water Heating for CWRU Facilities</td>
<td>Philip Taylor, Physics &amp; Gene Matthews, Facilities</td>
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<td>Heather Lemire</td>
<td>Optimizing Transparent Conducting Oxide Deposition for Application in Organic Thin Film Solar Cells</td>
<td>Kenneth Singer, Physics</td>
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<tr>
<td>Name</td>
<td>Title</td>
<td>Advisor</td>
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<tr>
<td>Matthew Moss</td>
<td>Feasibility of Solar Thermal Water Heaters on Campus</td>
<td>Philip Taylor, Physics &amp; Gene Matthews, Facilities</td>
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<td>Sangeetha Natarajan</td>
<td>Materials Studies of Bulk Heterojunctions for Organic Photovoltaic Applications</td>
<td>Kenneth Singer, Physics</td>
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<td>William Smythe</td>
<td>Sustainability Issues in Engineering Materials</td>
<td>Mark DeGuire, Materials Science and Engineering</td>
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<td>Emily Sparks</td>
<td>Climate Change and Renewable Energy: Parallel Policies?</td>
<td>Jessica Green, Political Science</td>
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<td>Jason Tabachnik</td>
<td>Interference Effects in the Optical Absorption of Semiconductors</td>
<td>Harsh Mathur, Physics</td>
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<td>Kara Wahlgren</td>
<td>Effect of Different Nanoalloy Coatings on the Photocatalytic Hydrogen Production of TiO₂</td>
<td>Anna Samia, Chemistry</td>
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**The Case School of Engineering – Alcoa Campus Partnership Program**

**Academic Year Undergraduate Research Internship**

**Spring 2012 Participants**

Nadia Ayat, Modifying Potato Virus X by Genetic Engineering Techniques, *Nicole Steinmetz, Biomedical Engineering*

Aaron Keith, Ultrasonically assisted crystalization processes, *Donald Feke, Chemical Engineering*

Lauren Randolph, Targeting cancer cells in vitro using engineered tobacco mosaic virus nanoparticles, *Nicole Steinmetz, Biomedical Engineering*

Alice Yang, Modifying QB with C60 for Use in Photodynamic Therapy, *Nicole Steinmetz, Biomedical Engineering*
CWRU has a number of formal programs across campus. Information about these and other programs can be linked from the SOURCE website:
http://www.case.edu/provost/source/opp/funding.htm

Academic Careers in Engineering & Science (ACES+)
Biomedical Engineering National Science Foundation REU Program (BME-REU)
Case’s Rising Engineers and Technological Entrepreneurs (CREATE)
Center for AIDS Research Minority HIV Research Training Program (MHRTP)
Center for Layered Polymeric Systems (CLiPS)
Center for Proteomics and Bioinformatics
Center for Stem Cell and Regenerative Medicine Undergraduate Student Summer Program (ENGAGE)
Experiential Learning Fellowships – College of Arts and Sciences
Heart, Lung & Blood Minority Research Training Program
Hematology Training Program
Physics (NSF-REU)
Physiology and Biophysics NSF-REU in Protein Dynamics
Rainbow Babies and Children’s Hospital
SOURCE Summer Research Program
Summer on the Cuyahoga
Summer Undergraduate Research in Energy and Sustainability (SUREs)
Summer Undergraduate Research in Pharmacology (SURP)
Summer Undergraduate Research in Physiology (SURP)
The Wellman Hill Political Science Internship
ACKNOWLEDGEMENTS

There are many to thank for making this day happen. Obviously, the student presenters and their faculty mentors for making the day possible and allowing all of us to see some of the great work being done by our undergraduates with our faculty. I also appreciate our many judges who are noted elsewhere in this program. Students request to be judged and we cannot provide this educational experience without the assistance of many from all over the University.

There are many others who have contributed, some more visibly than others, but all in needed ways. I apologize ahead of time for leaving anyone out. I wish to thank: Kimberly Emmons and the Center for Student Writing for allowing Intersections to serve as the host for The Celebration of Student Writing, Vice Provost Don Feke, Henry Hill and Rico Mixon - our wonderful campus movers, Ryan Keytack and the Admissions staff, Charles Rozek with the Michelson-Morley competition, and James Salerno. I also want to thank Carol Stark who is working our judges’ table again this year. I hope you will be back with us again next year.

This semester SOURCE has had five student workers who have contributed much to our office. Remy Hidaka, Di (Eric) Huang, Zoha Imam, Danielle Kory, and Kevin Shui: we have enjoyed working with each of you and appreciate very much the different talents and skills you have provided.

Bethany Pope contributes to Intersections (and SOURCE in general) in so many ways that I won’t begin to detail here, but I will say thank you very much.
SOURCE
SUPPORT OF UNDERGRADUATE RESEARCH AND CREATIVE ENDEAVORS

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