



**Fourth Annual  
Science Undergraduate  
Research Symposium**

**Thursday, November 29, 2007**

**KEYNOTE ADDRESS**

**“Putting Nanoparticles to Work”**

**Dr. Richard Haglund, Jr.**

**Department of Physics & Astronomy**

**Vanderbilt University**

**4:00 PM**

**RECEPTION & STUDENT POSTER SESSION**

**5:00 – 6:00 PM**

**STUDENT ORAL PRESENTATIONS**

**(Simultaneous sessions)**

**6:00 – 8:00 PM**

# POSTER SESSION

Beaman Lobby

5:00-6:00 PM

## Biology

### **“The Relative Amount of Inbreeding in the Eastern Subterranean *Reticulitermes flavipes*”**

Ivey L Beck

Faculty Advisor: Steven Murphree, Ph.D.

Major: Biology

Colonies of eastern subterranean termites, *Reticulitermes flavipes*, have been shown to possess a relatively high degree of inbreeding. In this study, we attempt to follow up on a previously published study that reported an unusually high degree of inbreeding at Montgomery Bell State Park in Burns, Tennessee. By using PCR and microsatellite techniques, we analyzed specimens collected from ten colonies. By comparing different loci within each colony, our preliminary data have revealed different conclusions than those previously reported. It is possible that there was a defect in the allozyme markers used in the previous investigation, or that there were newly founded colonies under genetic drift at the time of the previous research. The complete results of this study will be provided at the poster presentation.

### **“Studying DNA Polymerase Complex of Smallpox Virus”**

Sarah Brandt

Faculty Advisors: Debasish Chattopadhyay (UAB) and Nick Ragsdale, Ph.D. (Belmont University)

Major: Biology

Smallpox still poses a deadly threat to people throughout the world. There is no effective treatment for smallpox. Viral replication is an obvious target for therapeutic intervention. Poxviruses replicate in the host cytoplasm using a processive polymerase complex composed of several viral proteins. In order to further the progress towards finding a cure for smallpox virus, we have expressed and purified A20, an essential protein found in the processivity factor of smallpox virus and examined its interaction with Uracil-DNA glycolylase (UDG), another essential protein found in the processivity factor. Knowledge of this complex can potentially lead to the development of tools to disrupt the polymerase complex and thereby inhibit viral replication.

### **“A Comparison Of Visual Versus Olfactory Cues For Mate Selection In Zebrafish, *Danio rerio*.”**

Zachary W. Caro

Faculty Advisor: Lori L. McGrew, Ph.D.

Major: Biology

The aim of this study is to gain a more detailed understanding of mating cues observed in *Danio rerio*, zebrafish, specifically visual and olfactory cues. Previous studies have shown that courtship behaviors may be induced by different cues including chemosensory, olfactory, and visual cues. However, few studies have been done on the different roles of these cues and the effects they have on males. Other studies also show that pheromones are responsible for kin recognition among zebrafish. This study examines the role of these cues in mate selection among zebrafish by using three different phenotypes (striped, leopard and pearl) to determine whether there is a preference based on the phenotype of the fish exhibiting the cue. This study may demonstrate the importance of visual and olfactory cues in both initiating a mating response (recorded by male courtship behavior) as well as the final outcome of mating (measured by egg production).

### **“T-Cell Cytokines Associated with Inflammatory Bowel Disease in *mdr1a*<sup>-/-</sup> Models”**

Dale S. Carter

Faculty Advisor: Jennifer T. Thomas, Ph.D.

Major: Biochemistry and Molecular Biology

Chemotherapy resistance has become one of the most serious difficulties associated with cancer treatment. The MDR (multidrug resistant) gene, which encodes for p-glycoprotein, has been shown to cause this chemotherapy resistance. This transmembrane, ATP dependent pump prevents a lethal dose of chemotherapeutic agents from building up in the cancer cells. In order to determine the biological function of p-glycoprotein, a knockout mouse was created. The loss of p-glycoprotein resulted in serious Inflammatory Bowel Disease (IBD), thought to be due to a dysregulated immune response to the toxins produced by the microbiota of the GI tract. In order to study p-glycoprotein's function on different cell types

(bone marrow derived or intestinal epithelial), bone marrow chimeras were produced. Past studies have ruled out CD8<sup>+</sup> T-Cells as the cause of IBD; it is theorized that CD4<sup>+</sup> T-Cells are responsible for this disease. In order to determine what T-Cell types are causing this colitis, I extracted RNA from colon samples of wild type, *mdr1a*<sup>-/-</sup>, and the two bone marrow chimeras. This was transcribed into cDNA and then put through Real-Time reverse transcriptase PCR to detect the specific cytokines of the different T-Cell types. The cytokines of Th1, Treg, and Th17 cells were detected. Th2 cells showed the lowest level of expression. In all the diseased animal models, the Th17 cytokines were detected in vastly higher amounts, indicating that the Th17 cell may play a more important role in causing IBD.

(This work was performed in the laboratory of R.G. Lorenz, University of Alabama Birmingham)

### **"The Efficacy of Selected Botanically Derived Biorepellents Against *Aedes aegypti* in Human Volunteer Laboratory Assays"**

Melissa Draper

Faculty Advisor: Steven Murphree, Ph.D.

Major: Biology

Commercially available insect repellents can be divided into two categories: synthetic chemicals and plant-derived essential oils. Previous research indicates that the most effective natural plant-based repellents involve a mixture of essential oils, such as oil of lemon eucalyptus, citronella oil, geranium oil, soybean oil, coconut oil, neem oil, and a combination of catnip and Osage orange, combined in an oil base. Efficacies of the commercially available repellents Buzz Away<sup>®</sup>, Bite Blocker<sup>®</sup>, Burt's Bees Insect Repellent<sup>®</sup> and Bug Band<sup>®</sup> were evaluated in this study. Duration of protection by each product was tested with arm-in-cage studies, in which volunteers inserted their repellent-treated arms into a cage with a fixed number of unfed female *Aedes aegypti* mosquitoes, and the elapsed time to first landing/probing was recorded. Time of landing varied among the volunteers depending on their individual attractivity to the mosquitoes in addition to the effectiveness of the repellent. The results of this study will be provided at the poster presentation.

### **"The Effects Of Caffeine On Learning In Zebrafish, *Danio rerio*."**

Adam Gilliland

Faculty Advisor: Lori L. McGrew, Ph.D.

Major: Biology

Zebrafish (*Danio rerio*) have long been used as a model organism in cellular and developmental biology. Recently, researchers have begun to study zebrafish behaviors. A number of experiments have characterized the effects that certain drugs have on zebrafish embryos. Caffeine, however, has not been studied in zebrafish. Considering the prevalence of caffeine in America, and its potential to increase attention and focus in humans, it is a logical step to determine whether caffeine can facilitate learning in zebrafish. Fifteen wild-type zebrafish were given varying doses of caffeine, ranging from 0 mg/L to 10 mg/L. The fish were then tested using a rapid conditioning paradigm, to see whether the caffeine affected their learning ability in regards to avoiding a negative reinforcement. The results suggest that caffeine did not affect the learning ability of the zebrafish. The doses of caffeine may have been too high based on physiological changes in the fish.

### **"*Caenorhabditis elegans* Immune Pathways in Defense Against *Streptococcus pneumoniae* "**

Stephen May

Faculty Advisor: Nick Ragsdale, Ph.D.

Major: Biology

*Streptococcus pneumoniae* is the leading pathogen among bacteria that have a vaccine for treatment. The virulence factors for *Streptococcus pneumoniae* allow for it to infect humans. Several organisms respond to these virulence factors by inducing programmed cell death (PCD). A *C. elegans* model explored PCD as a possible defense mechanism. Additionally, this model was utilized to investigate the possible connection between the p-38 MAPK signaling pathway and PCD. PCD provided protection against *S. pneumoniae* infection and evidence suggested a link between the signaling and cell death pathways.

### **"Effects of Two Different Types of Cellular Phone Conversations on Gait Characteristics While Walking"**

Tara L. McDonough

Faculty Advisors: C. Steven Murphree, Ph.D. (Belmont University) and

Nancy S. Darr, PT, DPTSc (Belmont University)

Major: Biology

Cellular phones are an important part of today's society. While there are many advantages to this wireless communication device, researchers have found one disadvantage to be its distracting nature which can compromise safety. The purpose of this study was to examine the effects of two different types of cellular phone conversations on gait characteristics and gait safety of healthy young adults while walking. Gait characteristics of subjects such as velocity, cadence, and step length were recorded using a GaitRite® mat. Subjects walked across the mat under three conditions: 1. without a cellular phone, 2. engaged in a social conversation on a cellular phone, and 3. engaged in a conversation which involved solving arithmetic equations over a cellular phone. Subjects then filled out a questionnaire to evaluate their everyday use of cellular phones and the extent that this use affects social and physical aspects of their lives. Preliminary data demonstrated that gait speed was reduced and gait variability was increased during the dual tasks of walking and talking on a cellular phone. This supports the conclusion that talking on a cellular phone while walking reduces gait safety.

### **“Differential Localization of MMP-2 Isoforms in Autoimmune Thyroid Tissue”**

Naveen Mohyuddin

Faculty Advisor: M.W. Thompson, Ph.D. (MTSU)

Major: Biology

Recent evidence suggests that a catalytic domain fragment of MMP-2 (42 kDa), but not the full-length form (62 kDa), is inhibited by lactoferrin. It is also known that the hemopexin domain (20 kDa), from the 62 kDa domain, disrupts integrin signaling. Little is known regarding the extent of breakdown of active 62 kDa MMP-2 in normal or diseased tissue. Normal and autoimmune thyroid tissues were examined by immunohistochemical localization to examine the degree of MMP-2 autocatalytic processing. Antibodies corresponding to both the catalytic domain and the hemopexin domain were utilized and tissues were observed under both ultraviolet and visible light microscopy. Images were merged to determine the extent of overlapping staining. While results regarding the proteolytic processing of MMP-2 were inconclusive, it was observed that MMP-2 is expressed at extremely high levels in autoimmune thyroid tissue, indicating that MMP-2 may be responsible for much of the tissue damage and rearrangement observed in these tissues.

### **“Occurrence of Methicillin-Resistant *Staphylococcus aureus* in Belmont University Athletics Facilities”**

Brittany Myers

Faculty Advisor: Jennifer T. Thomas, Ph.D.

Major: Biology

*Staphylococcus aureus* is a gram positive, cocci-shaped bacterium that appears as “grape-like” clusters under the microscope. It can be carried on the skin or in the nose of healthy people and does not cause much harm until a scrape or cut is suffered to the skin giving the bacteria an opportunity to enter the skin leading to serious skin infections. In recent years, some types of this organism have gained resistance to antibiotics such as methicillin, creating methicillin-resistant *Staphylococcus aureus* (MRSA). This resistance occurs when the bacterium acquires the *mecA* gene, which produces a penicillin-binding protein, PBP2a, that allows the bacteria to produce a cell wall even in the presence of methicillin. This “superbug” has recently found a home in schools around the country (including middle Tennessee), especially around athletics facilities and equipment. Transmission of the bacterium can occur through direct contact, including physical contact during sports, or athletes sharing towels or equipment. Given this increasing concern for MRSA, I chose to examine the athletic facilities at Belmont University to determine the occurrence of *Staphylococcus aureus* isolates and to determine how many of the isolates are MRSA. 8 locations were chosen with three swabs obtained for each location. Preliminary data indicate that *Staphylococcus aureus* is extremely common accounting for greater than 50% of the bacterial isolates in two of the locations; all locations indicate *Staphylococcus aureus* contamination. Studies to identify the presence of the *mecA* gene by PCR analysis are in progress to determine the incidence of MRSA.

### **“Diversity of Soil Bacteria Around Native and Exotic Plants”**

Amy Nause

Faculty Advisor: A. Darlene Panvini, Ph.D.

Major: Biology

The introduction of exotic plant species into an area can significantly alter the diversity and composition of the soil bacteria community. Three sites at Warner Parks, Nashville, TN were identified as having areas significantly covered by exotic *Lonicera maackii* as well as areas containing only native species. Six soil samples were taken from each site, three under the *Lonicera* and three under native species. The soil samples were diluted and plated on nutrient agar to grow bacteria. Each bacterium was isolated and re-plated to grow pure colonies. Colony color, shape, and margin description were used along with Gram staining and bacteria shape to identify the different types of bacteria present in the soil samples. Preliminary results suggest that more bacteria types were present in the soil samples underneath *Lonicera*. The ecological significance of changes in bacterial communities in relation to the presence/absence of exotic plant species will be considered.

### **“Examining the Impact of Human Activity on Swan Lake”**

Jill A. Neblett

Faculty Advisor: A. Darlene Panvini, Ph.D.

Major: Biology

Swan Lake is a human-created lake located in Dunbar Cave State Natural Area in Clarksville, TN. The lake is surrounded by various human-influenced habitats, such as a golf course and a road, and one side is bordered by the entrance to a cave. This study evaluated the overall quality of water in the lake to determine if nearby human activities negatively impact the lake. Over the period of one month, eleven variables of water quality were measured each week on four sides of the lake. The results indicate that the overall water quality is good and that none of the human-influenced habitats appears to negatively affect overall quality. However, some of the individual variables (e.g. water temperature, pH, and turbidity) did appear to be influenced by the surrounding habitat. Information from this study can be used by the natural area staff in setting guidelines for managing the lake and surrounding property.

### **“Insect Herbivory on Exotic Vinca and Native Goldenseal”**

Annie Lou M. O’Steen

Faculty Advisor: A. Darlene Panvini, Ph.D.

Major: Biology

Preliminary studies in Warner Parks, Nashville, TN during 2006 suggested that levels of herbivory on exotic species were less than those on native species. The current study examined levels of insect herbivory on exotic vinca and native goldenseal plants by counting the number of leaves with herbivory and assessing the percent leaf area chewed by insects. Leaves of both species were collected, scanned, and digitized so that leaf surface areas of the digital images could be measured using ImageJ. Insects were collected using pit-traps and sweep nets in the areas underneath and around the plants to determine potential insect herbivores. Goldenseal had significantly more leaves and greater surface area affected by herbivory. Diversity of insects found around the plants varied slightly. The impact of exotic plant species on insect diversity and overall ecological processes will be considered.

### **“The Efficacy Of Selected Over-The-Counter Chemical Repellents Against *Aedes aegypti* In Human Volunteer Laboratory Assays”**

Cori Pedigo

Faculty Advisor: Steven Murphree, Ph.D.

Major: Biology

Commercially available insect repellents can be divided into two categories: synthetic chemicals and plant-derived essential oils. The most effective synthetic chemical repellents include DEET, IR3535 and Picaridin. Efficacies of the commercially available repellents Repel<sup>®</sup> Sportsmen Formula<sup>®</sup> Insect Repellent, Repel<sup>®</sup> Insect Repellent, Skin so Soft<sup>®</sup> Bug Guard plus IR3535 and Skin so Soft<sup>®</sup> Bug Guard plus Picaridin were evaluated. Duration of protection by each product was tested with arm-in-cage studies, in which volunteers inserted their repellent-treated arms into a cage with a fixed number of unfed female *Aedes aegypti* mosquitoes, and the elapsed time to first landing/probing was recorded. The results of this study will be provided at the poster presentation.

### **“Nicotine Facilitates Learning In Zebrafish, *Danio rerio*.”**

Rebecca L. Repasky

Faculty Advisor: Lori L. McGrew, Ph.D.

Major: Biology

Losses in memory have been a devastating reality for millions of Americans, especially with modern increases in age and the onset of neurodegenerative diseases such as Alzheimer's disease. Studies have shown that in many model systems, nicotine increases memory. A recent addition to the group of standard models is the zebrafish *Danio rerio*, a small fish used traditionally in the studies of developmental biology and genetics. In our study, the fish were tested using a rapid-conditioning test to observe learning of side-preference in a tank. Previous studies used the salt nicotine ditartrate in their tests; however, in order to standardize results, this study used pure nicotine. Results revealed a dose-dependent curve, with optimum concentrations providing higher learning than control fish showed. We also determined that long-term exposure to nicotine produced results no different from fish not exposed to nicotine, suggesting the development of tolerance to the chronic presence of nicotine.

### **“Effect of 6-Hydroxydopamine Treatment on DJ-1 and Parkin Protein Levels in *Caenorhabditis elegans*”**

Jennifer Rix

Faculty Advisor: Nick Ragsdale, Ph.D.

Major: Biology

Previous studies have shown that there are increases in the protein levels of both DJ-1 and parkin proteins levels in patients with neurodegenerative diseases such as Parkinson's Disease. These proteins are often found in clumps of proteins referred to as Lewey Bodies. Additionally, over-expression of these and other proteins results in motor deficits in *C. elegans*. This study investigates the impact of the neurotoxin 6 hydroxydopamine on the expression of DJ-1 and parkin proteins. It is expected that these proteins will increase. These results will give insight into the potential role of environmental toxins in causing neurodegenerative diseases

### **“Role Of Serotonin In Caffeine-induced Locomotory Changes In *Caenorhabditis elegans*.”**

Jelena Stupar

Faculty Advisor: Lori L. McGrew, Ph.D.

Major: Biology

Caffeine is one of the most commonly used addictive substances among humans. However, there are relatively few studies demonstrating how caffeine affects humans. Consumption of caffeine, results in desensitization to endogenous neurotransmitters, creating dependence. Caffeine affects a number of neural pathways in humans, and this complexity makes it difficult to determine the exact mechanism of action. *C. elegans* are a simple model system that makes examining neurological pathways easier and demonstrates similarity to the neurological pathways in humans and other animals. Previous studies have demonstrated that caffeine works as an adenosine receptor antagonist and inhibits its ability to bind to adenosine, thereby affecting adenosine-modulated serotonin release. Based upon this and the role of adenosine in *C. elegans*, we predicted that caffeine would affect locomotion and chemotaxis in the nematodes. We used image capture and analysis software to characterize movement in worms treated with caffeine and compared them to untreated controls.

### **“Commonality of Methicillin-Resistant *Staphylococcus aureus* in Hospitals and Restaurants”**

Kelienne M. Verdier

Faculty Advisor: Jennifer T. Thomas, Ph.D.

Major: Biology

*Staphylococcus aureus* is a gram-positive bacterium commonly found on the skin and in the nose of people and animals. It and its toxins are associated with many diseases including skin infections, pneumonia, toxic-shock syndrome, and food poisoning. Of recent concern is the increase in the incidence of methicillin-resistant *Staphylococcus aureus*, MRSA, which is a type of *Staphylococcus aureus* that is resistant to the antibiotic, methicillin, which is in the same family of antibiotics as penicillin and amoxicillin. MRSA has traditionally been one of the leading causes of nosocomial (hospital-acquired) infections, but has most recently been associated with infections in other settings. These “community-associated” infections usually appear as skin infections, but are extremely difficult to treat and may lead to more serious complications. Because of the increase of MRSA in community settings, I chose to examine the commonality of MRSA in restaurants compared to hospitals. *Staphylococcus aureus* isolates were collected from five hospital and five restaurant lobbies in the Nashville area. Preliminary evidence indicates that *Staphylococcus aureus* isolates are much more common in restaurants than hospitals. Ongoing work is examining the presence of the MecA gene, the gene responsible for methicillin resistance, in the isolates. We can then determine the percentage of *Staphylococcus aureus* isolates from a given location that are MRSA.

### **“Confirming Characteristics of 6-OHDA Treatment in *Caenorhabditis elegans*”**

Chelsea Wilson

Faculty Advisor: Nick Ragsdale, Ph.D.

Major: Biology

Parkinson's disease is a neurodegenerative disease characterized by the death of dopamine neurons in the substantia nigra pars compacta of the brain. While environmental toxin exposure, increased generation of reactive oxygen species, and inhibition of mitochondrial electron transport is the current hypothesis, the mechanisms of dopamine neuron degeneration and increase in the production of reactive oxygen species in Parkinson's disease is unknown. *Caenorhabditis elegans* serves as a good model system for the degeneration of dopaminergic neurons because of high conservation between nematodes and vertebrates. The effects of 6-hydroxydopamine on treated and control *C. elegans* have been characterized

regarding egg laying, mean velocity, and centroid velocity. This current work research is interested in examining the effects of 6-OHDA in the F<sub>2</sub> generation.

### **“Characterization Of “Shrinker” Mutants In *Caenorhabditis Elegans.*”**

Bethany N. Woodard

Faculty Advisor: Lori L. McGrew, Ph.D.

Major: Biology

This study utilized the nematode, *Caenorhabditis elegans*, a widely used model organism in neuroscience. A wild-type strain, N2, and two mutant strains, *unc-46* and *unc-25* were characterized. The mutant strains have a shrinker phenotype which is caused by a mutation in GABA receptors. Shrinker worms are shorter than wildtype worms and cannot move effectively; they lack sinusoidal movement. In collaboration with the computer science department, we have used image capture and analysis to evaluate movement deficits in these mutants. Following characterization of the animals, we treated the nematodes with muscimol (a GABA receptor agonist) and  $\beta$ -alanine (a GABA transporter blocker) and evaluated the efficacy of these agents to restore wildtype function. The untreated *unc-46* mutant worms showed statistically significant differences in length when compared to N2 worms. Following treatment with muscimol, the *unc-46* mutants showed a significant increase in length.  $\beta$ -alanine however, had no significant effect on the mutant worms.

### **“The Effects of Pigment Patterns on Socialization in Zebrafish, *Danio rerio.*”**

Michelle Howell Young, Rosemary C. Harris

Faculty Advisor: Lori L. McGrew, Ph.D. (Biology) & Lonnie Yandell, Ph.D. (Psychology)

Major: Biology

Zebrafish, *Danio rerio*, are a well established model organism for molecular and developmental biological research; yet are still a relatively new model organism in the study of behavior. Zebrafish exhibit a variety of social behaviors, many of which appear to be consistent within the species, including shoaling and mating. However, within a shoal, individual differentiation can be observed, including individual tendencies towards aggression, submission, hyper-activity, or hypo-activity. There may also be phenotype specific behavioral divergence found among the various mutant lines of zebrafish. Ideally, with a better understanding of the differences in behavior, correlations with molecular or developmental changes may enable us to identify the genes responsible for these differences. Because of the availability of mutants and elucidated gene-linkage, zebrafish offer opportunities to study the biological determinants of behavior. To this end, we are characterizing behavior in different phenotypes of *Danio rerio* in a laboratory setting. The phenotypes studied were represented by variant mutational pigment patterning including the iridescent pearl *Danio*, the spotted leopard *Danio*, and striped wild-type *Danio*. Individual social discrimination tests were conducted between native and alternate phenotypes in order to characterize individual social preferences based on the role of visual cues for shoal interactions.

## **Chemistry**

### **“Spectroelectrochemical Sensor: The Effect of Ionic Strength on Sensor Response”**

Christopher R. Bowman

Faculty Advisor: Kimberlee D Boggs, Ph.D.

Major: Biochemistry & Molecular Biology

Chemical sensors are an important tool in testing for the presence of chemical species with applications in the environment, medicine, and the chemical industry. The spectroelectrochemical sensor includes three modes of selectivity based on electrochemistry, spectroscopy, and selective partitioning. The present work focuses on selective partitioning which is achieved by using an ion-exchange film. Possible interference in sensor signal comes from ions in the supporting electrolyte solution competing with the analyte for ion exchange sites in the film. The effect of ionic strength of supporting electrolyte solutions on sensor response was evaluated.

### **“Synthesis of a Lanthanide Chelate Imaging Agent for CEST Effect and Multimodality”**

Jordan M. Fritz

Faculty Advisor: Kimberlee Boggs, Ph.D.

Major: Chemistry for the Health Sciences

Imaging agents are useful tools in the hands of clinicians. The use of imaging agents allows internal tissue and bone to be observed unobtrusively, yet effectively, and can help lead to the early diagnosis and treatment of numerous medical conditions. Many different imaging techniques are currently used, including optical, magnetic resonance (MR), positron

emission tomography (PET), and single photon emission computed tomography (SPECT). As the medical field continues to move forward in its diagnoses of illnesses, new and more effective agents must be developed to help improve the quality and accuracy of the clinician's diagnosis. Multimodal agents are a desired, practical, and synthetically attainable type of imaging agent that allows a number of different imaging techniques to be employed using the same imaging agent. Therefore, the multimodal imaging agent appears to offer a distinct advantage over traditional imaging agents which focus simply on single imaging techniques. It is proposed that a novel multimodal lanthanide chelate imaging agent be synthesized, and characterized for Chemical Exchange Saturation Transfer (CEST) effect and multimodality. Synthesis and purification of the desired product will utilize a variety of techniques and instrumentation.

### **“Alteration of Amino Acid Residues in the Conserved Motif of Archaeal Thioredoxin”**

Elizabeth Smothers

Faculty Advisor: Alison Moore, Ph.D.

Major: Chemistry

Thioredoxin (Trx) belongs to a superfamily of proteins containing a redox-active disulfide bond, which functions in maintaining the reducing atmosphere of the cell. Trx's exhibit a strictly conserved motif of a -CXXC- amino acid sequence. Alteration of the variable amino acid residues in the conserved motif may alter the redox properties of Trx. The goal of this project was to generate a series of Trx variants containing one of either the acidic amino acids, glutamic acid and aspartic acid, or the basic amino acids, lysine and arginine, at the first variable amino acid residue in the conserved motif by site-directed mutagenesis. A control variant with amino acid residues similar in the conserved motif to the prototypical *Escherichia coli* Trx was also generated, using a recombinant archaeal Trx as a template. Extended study will involve the over-expression and purification of the variants and the effects of variation on the redox potential of the protein.

## **Mathematics**

### **“Pascal's Triangle”**

Josh Adams and Zane Colgin

Faculty Advisor: Sarah Ann Stewart, Ph.D.

Major: Computer Science (Josh) and Math/Computer Science (Zane)

Pascal's formula is named after Blaise Pascal, a French mathematician, physicist, and philosopher, and is one of the most famous in combinatorics. It says:

$$\binom{n+1}{r} = \binom{n}{r-1} + \binom{n}{r}$$

The geometric form of this formula makes the more readily known Pascal's triangle, despite being known by early Chinese, Pascal discovered it centuries later on his own. This formula makes it easy to compute higher combinations in terms of lower ones. Pascal's formula can be used to derive other formulas very useful for combinatoric problems.

### **“Pigeonhole Principle”**

Stephen Allen and Andrew Kaley

Faculty Advisor: Sarah Ann Stewart, Ph.D.

Major: Audio Engineering Technology and Mathematics

The pigeonhole principle is the theorem that given two finite sets, with values  $n$  and  $m$  (in the integers) where  $n > m$ , they cannot be one-to-one. Another way of stating it is that if  $n$  items are placed in  $m$  holes, there is at least one hole that will have more than one item. It is also known as the Dirichlet's Box (or drawer) principle. The principle is believed to have been created by Johann Peter Gustav Lejeune Dirichlet in 1834. Suppose you are trying to box up some snakes to ship to local pet stores. You have ten boxes and thirteen snakes. But if two snakes are in the same box, they will fight and one will die. The pigeonhole principle lets us know that we cannot ship these snakes with just the boxes we have. There would be three boxes that have two snakes in them, resulting in the death of three snakes.

### **“Paths and Circuits: The Seven Bridges of Konigsberg”**

Chelsea Jo Brown, Esther C. Moon, and Ali B. Thomas

Faculty Advisor: Sarah Ann Stewart, Ph.D.

Majors: Mathematics, Biology, Mathematics

“Is it possible for a person to take a walk around town, starting and ending at the same location and crossing each of the seven bridges exactly once?” The Seven Bridges of Konigsberg is a famous math problem generated by a real life situation. To solve this problem, one must use the application of graph theory created by Leonhard Euler. Euler proved that a path around the Seven Bridges of Konigsberg does not exist, using vertices and edges to create a continuous graph. The land masses become the vertices of the graph, and the bridges become the lines that connect the vertices in the graph. This application can be used for transportation networks, such as roads and sky networks. Any transportation problem can be solved by determining the number of paths between the vertices and comparing them.

### **“The Traveling Salesman—Hamiltonian Circuits and Their Uses”**

Ross Buffington, Hank Carter, Heather Ellis

Faculty Advisor: Sarah Ann Stewart, Ph.D.

Major: Computer Science

A Hamiltonian circuit is a simple circuit in a graph that includes every vertex of the graph exactly once, with the exception of the first and last vertices, which are the same. The famous Irish mathematician Sir William Rowan Hamilton developed the problem in 1859 with his regular dodecahedron puzzle. Hamiltonian Circuits, although commonly compared to Eulerian trails, are significantly different in implementation, and have no concrete algorithm for finding them. Of particular interest to graph theory is the subset of Hamiltonian Circuits classified as Traveling Salesman problems. These problems seek to find the fastest or cheapest Hamiltonian circuit in a given set of vertices. The only known method for finding the cheapest Hamiltonian circuit is a brute-force algorithm that examines all possible circuits and chooses the cheapest. Unfortunately, for a graph with only 30 vertices, this method must examine approximately  $8.84 \times 10^{30}$  different circuits. An improvement on this algorithm uses economy trees to find a lower bound for all possible Hamiltonian Circuits in a graph, such that when the Hamiltonian Circuit of this minimum cost is found, the Traveling Salesman problem has been solved. The applications of this problem are commonly seen in online directional software such as Mapquest and Google Maps. These programs use a form of the Traveling Salesman problem to plot routes, although the route is not always the cheapest available, thus demonstrating the flaws that still exist in our understanding of the problem.

### **“Proving a Quadrilateral”**

Zane Colgin

Faculty Advisor: Sharon L. Crumpton, Ph.D.

Major: Math/Computer Science

Many geometry texts go over in detail the properties of parallelograms. They give the conditions necessary to prove a parallelogram similar or congruent. However the more general quadrilateral is given only a definition and a few properties. There is criteria that must be met to prove a quadrilateral congruent or similar. Knowing these criteria may be helpful in the formulation of other geometric proofs.

### **“Calendar Controversy”**

Megan Hamilton

Faculty Adviser Dr. Sharon Crumpton, Ph.D.

Major: Mathematics and Elementary Education

From the beginning of time, the calendar has been of great importance to every society and civilization. However, it has often been argued about the accurateness of such a historic document. From the mistakes of Dennis the Little to the common Gregorian calendar, mathematicians, including Viète and Nicholas Cusa, have found discrepancies within the calendars. In the early 1500's, it came to Pope Gregory's attention that an error of ten days had developed during the creation of the spring and fall equinox, so he enacted the Gregorian Adjustments in which he omitted ten days over the following two weeks. Another controversy that has occurred was the idea of negative years and the year 0. Gregorian followers believed in B.C. being the counterpart of a negative year. They also believed that the years went from -1 to 0 to 1 A.D. However, the Julian followers believed that the year 0 and the negative years did not exist, but that the years were 1 B.C. to 1 A.D. Due to their extreme conflicting beliefs including the number of days in a month, equations exist in order to configure one or the other. Possible problems that created conflicting calendars was the questionable date of the real Easter and Christmas. By calculating the mistakes in the calendar that we use everyday, mathematicians could correctly document history and the dates it occurred.

### **“Lots-o-Knots”**

Tom Kimsey and Catherine Simpson  
Faculty Advisor: Sarah Ann Stewart, Ph.D.  
Major: Computer Science and Mathematics

This poster will explore the branch of mathematics known as knot theory. Knot theory deals with the manipulation of mathematical knots which are simple closed curves in 3-dimensional space. Knot theory involves many areas of mathematics, and is used in several areas of scientific research. Currently, knot theory is being used by genetic researchers to better understand the behavior of DNA as it is replicated. This poster will be concerned with defining knot theory and with describing its use in genetic research.

### **“What You Didn’t Know About Basic Arithmetic”**

Caleb Kinch, Joel Boyter, and Nikki Finuf  
Faculty Advisor: Sarah Ann Stewart, Ph.D.  
Majors: Audio Engineering Technology, Audio Engineering Technology, and Mathematics

There are countless peculiar properties and apparent coincidences that are encountered when dealing with simple arithmetic. One need not venture any further than the deceptively safe realm of addition, subtraction, multiplication and division to stumble upon the bizarre characteristics of mathematics. Shakuntala Devi’s book, Figuring: The Joy of Numbers, discusses these oddities and how they can give us a better understanding of numbers. Consider the digit 1. It has the ability to produce digit palindromes.  $1 \times 1 = 1$   $11 \times 11 = 121$   $111 \times 111 = 12321$   $1111 \times 1111 = 1234321$  and so forth until two numbers with 9 digit ones are reached. Here the property ends. It is interesting to examine why this property and others like it are true and discover how they are relevant to understanding and appreciating numbers.

### **“Graph Theory at Its Best”**

Chris Kirk  
Faculty Advisor: Sarah Ann Stewart, Ph.D.  
Major: Mathematics

In my SURS project, I want to illustrate my elementary understanding of graph theory by examining different ways a graph can be used to solve problems. In particular, I want to look at directed graphs and show my understanding of these by looking at specific examples. One example I want to look at in particular is the cannibal/vegetarian problem where you try to get all on one side of the bank without allowing more cannibals than vegetarians on any one side of the bank.

### **“Triangular Numbers Found in Certain Series”**

Neil Kowalewski  
Faculty Advisor: Sarah Ann Stewart, Ph.D.  
Major: Mathematics

The process of finding every possible integer by using the sequence of two numbers is obtainable. There was a problem in finding the smallest possible positive integer at which every positive integer afterwards could be obtained using the result of two consecutive integers that are greater than 1 and less than 10. For example using 7, 8 in a series a series that adds the total such that it returns a certain integer.  $\{7, 7\}$  would return 21. This is due to the fact that the series is the first 7 plus the sum of the second and first in the series, 14.  $\{7, 8, 7\}$  would return 55 because the total is equal to 7 plus the sum of the next integer 8 plus the sum of the next integer, 7, added in, 22; therefore, the total is 7 plus 15 plus 22 which bears 55 as the answer. The pattern of single integer series has the pattern of the total being obtained by multiplying the integer in the series and the triangular numbers,  $\{0, 1, 3, 6, 10, 15 \dots\}$ . The project is finding two consecutive integers involved in a series that adds the inner sums to the total sum of the series when the smallest possible positive integer is found at which every positive integer that follows is obtainable using the series of those two consecutive integers.

### **“Catalan Numbers and Their Applications”**

Evan M. Leslie  
Faculty Advisor: Sarah Ann Stewart, Ph.D.  
Major: Computer Science

The Catalan numbers are sequences of natural numbers that appear in many counting problems. First discovered by Leonhard Euler who was considering a solution to the problem of how many ways a polygon of  $N$  sides can be divided into triangles by non-intersecting diagonals. Later, Eugène Charles Catalan would solve a problem involving how many ways one can parenthesize a chain of  $N+1$  letters using  $N$  pairs of parentheses such that there are either two letters, a

parenthesized expression and a letter, or two parenthesized expressions within each pair of parentheses. The answer to these counting problems and many other interesting challenges like it is, of course, the  $n^{\text{th}}$  Catalan number.

### **“Markov Chains”**

Scott O’Brien

Faculty Advisor: Sarah Ann Stewart, Ph.D.

Major: Applied Discrete Mathematics

A Markov Chain is a system that is used to find the probability of moving from one state to another state. Markov Chains have the Markov property, which says that the probability of moving to the next state in the system is based solely on the state that the system is currently in and not based on how the system got to its current state. The changes of states are called transitions. Markov Chains are part of Discrete Mathematics because the parameters for the states are discrete; thus, there are only finitely many states. Andrey Andreyevich Markov invented Markov Chains during the early twentieth century. Board games, weather models, marketing models, page-ranking on search engines, and music software are all applications of Markov Chains.

### **“Creating Efficient Travel Routes with Minimum Spanning Trees”**

Matthew Perry and Lacey Bowles

Faculty Advisor: Sarah Ann Stewart, Ph.D.

Major: Mathematics

Graphs are used to solve problems and can make given situations optimal or more efficient. A graph consists of a finite set of vertices and a finite set of edges, where the edges connect the vertices. A graph is connected if every vertex in the graph is joined by an edge. If it is possible to begin at a given vertex and traverse the graph, never repeating an edge, then the graph is said to contain a circuit. A tree is a graph that is circuit-free and connected. Given a connected graph, if the graph contains a circuit, a spanning tree can be created by removing an edge from the circuit. Creating a spanning tree from a graph can be useful in such fields as the travel industry. If a connected graph represents the cities to which an airline company plans on traveling, a minimum spanning tree can be constructed from the graph to represent the most efficient route system. A weighted graph is a graph in which each edge has an associated value. A minimum spanning tree for a weighted graph is a spanning tree with the least possible total weight. Finding a minimum spanning tree can be solved by using Kruskal’s Algorithm, which systematically examines each edge of the graph in order of increasing weight. Each edge is added to the minimum spanning tree, as long as a circuit is not created. When the algorithm is completed, a minimum spanning tree has been constructed.

## **Psychology**

### **“Size and Complexity in Stereogram Images: The Effect on Stereoscopic Perception”**

Erin M. Carson, Matthew R. Kraatz, and Nicole R. Lyke

Faculty Advisor: Lonnie Yandell, Ph.D.

Major: Journalism, Music Business, Mathematics & English

The ability for depth perception in humans is in part produced by binocular disparity. Because each eye holds the world in a slightly different perspective, two slightly different images are taken into the brain. These two images are combined to form one cyclopean form based on stereoscopic perception. In this study, participants were asked to decipher the specific cyclopean image, which was varied in size and complexity and was hidden in numerous stereogram images. Seventeen undergraduate students were tested, each viewing twelve different stereogram images. The results in this study did not support the hypothesis that images with a larger size and simpler in complexity would be more accurately perceived. There was no evidence that variations in size and complexity of the cyclopean image had any effect on stereoscopic perception.

### **“The Effects of Speed and Positioning of Moving Dots in Biological Motion”**

Katherine L. Cauthen, Kristina J. Graham, William R. Parish

Faculty Advisor: Lonnie R. Yandell, Ph.D.

Major: Mathematics, Design Communications, English

Biological motion is a term used to define the study of the movement patterns of living things. It has been shown that the movement of a human can be recognized even when presented merely as points of strategically placed lights, thus this depiction has been termed a point-light display. This study aims to determine if features such as gender, weight, emotion and state of anxiety can be accurately detected in point-light displays. Sixteen students from Belmont University were tested on their perception of sixteen biological motion point-light displays that varied in their depiction of gender, weight,

emotion and state of anxiety. It is expected that the participants will be able to accurately rate gender, eight, emotion and state of anxiety from the point-light displays.

### **“Picture Priming in Semantic Satiation”**

Eric Deems, Jordan Ferguson, and Hannah King

Faculty Advisor: Lonnie Yandell, Ph.D.

Major: Business Administration, Studio Art, Theatre & Drama

Previous research has indicated that word priming can cause any related set of words to become more quickly satiated in test subjects than using only the set of words alone. This experiment will test whether using a related picture to prime the subjects will cause the subjects to become satiated quicker than using only words to prime the participants. In this study, eighteen Belmont students will be primed with a related picture, an unrelated picture, and no picture and then presented a word. The participants will record when the meaning of the word begins to change. The expected outcome of this study is that the subjects will become satiated more quickly when primed with a related picture than when primed with an unrelated picture or no picture at all.

### **“Subconscious Recognition of Objects in a Change Blindness Paradigm”**

Kristin Ferrari, Katie Overton, Robert Woolsey

Faculty Advisor: Lonnie Yandell, Ph.D.

Major: Music Business, Psychology, Economics

Change blindness is the visual phenomenon that occurs when an individual fails to notice a large change in their visual field. Previous research has attempted to understand how and why this phenomenon occurs. This study focuses on the capability of subconsciously detecting an object that is changed during a visual presentation but is not consciously reported. Seventeen Belmont University students were divided into two groups. The “change” group was shown a series of photographs that used a flicker task to induce a change and studied for ten (10) seconds. The “no change” group was shown an identical set of flickering photographs; however, these photographs contained no changes. It was predicted that participants in the change group will detect changes more than the no change group. It was also predicted that the no change group was more likely to detect the changed object than the change group because the no change group saw the object twice as long. Of the people who were change blind, it was predicted that a portion of them who didn’t notice the change in the scene would still be able to identify the changed object. After viewing the photographs, participants were asked to answer a series of questions concerning each picture.

### **“The Effects of Shading and Background Size on Illusory Contour Visibility”**

Amanda Hill, Sarah Mertan, Sally Nixon

Faculty Advisor: Lonnie Yandell, Ph.D.

Major: Psychology

Visual illusions have long been able to mystify viewers, causing them to see things that are not actually present. Illusory contours, one such example, seem to imply three-dimensional figures in a two-dimensional plane, requiring a perception of the depth supposedly present. However, what is most notable about the contour is its ability to be visible when there is very little behind it to give the illusion of depth. The purpose of this study is to discover if contours with backgrounds that are more heavily shaded appear more pronounced to subjects than are contours with backgrounds that are less heavily shaded. Eighteen Belmont undergraduate students were asked to compare four different sets of illusory contours and decide which of the two contours was visible to them; in each set was a contour considered “less shaded” and a contour considered “more shaded.” It was expected that the subjects would define the more shaded images as having more pronounced contours.

### **“The Effect of Speed on Motion Induced Blindness”**

Jake Kerry, Kathleen Bond, Hannah Shipp

Faculty Advisor: Lonnie Yandell, Ph.D.

Major: Audio Engineering Technology, Marketing, Piano Pedagogy

Motion-induced blindness is a phenomenon in which a series of solid targets, or dots, are suspended against a moving background pattern. When observers stare at a center point of the pattern, with targets around it, the targets disappear and reappear within the observer’s consciousness. The question that this study addresses is the following: does the speed at which the background pattern moves affect how long it takes for targets to disappear from an observer’s consciousness? Sixteen Belmont University students will be asked to focus on a central point on a computer screen. This central point will be surrounded by three separate points, all of which will be imposed on a rotating background. There will be three stations

in which the background speed will be manipulated. The first of these stations will have a slow background speed, the second a medium background speed, and the third a fast background speed. Each station will also contain a stopwatch which will be started when the participant first focuses upon the central point and stopped when they first notice a disappearance in the surrounding points. This will allow for an accurate measurement between the time when subjects begin to look at the image and when they first experience Motion Induced Blindness. It is hypothesized that all three speeds will produce the same effect, however, when the background speed is faster it will take less time to notice a disappearance in the surrounding points than when the background speed is slower.

### **“Does Deconstruction of the McGurk Effect Alter Perception?”**

Brandon Ladage, Allora McCullough, and Rebecca Stone

Faculty Advisor: Lonnie Yandell, Ph.D.

Major: Pharmaceutical Studies, Entrepreneurship, Music Business

The McGurk Effect is a phenomenon in which people perceive inconsistent audio-visual information incorrectly and believe they heard an audio combination never actually presented. This study looked at how deconstructing the differing audio and visual stimuli would affect participants' susceptibility to the McGurk Effect. Seventeen Belmont University undergraduate students observed four modules containing audio, visual stimuli or both. The first presentation had audio and video information, the second had video information only, the third had audio information only and the fourth again had audio and video information. Participants recorded their perceptions, as well as their confidence in their answers. This study expects to find that awareness of the illusion will change participants' perceptions of the McGurk Effect.

### **“Four Behavioral Models for Zebrafish (*Danio rerio*)”**

Sarah L. Lashley and Luke Lancaster

Faculty Advisor: Lonnie Yandell, Ph.D.

Major: Psychology

Blaser and Gerlai (2006) stated that zebrafish (*Danio rerio*) make an excellent model organism because their basic brain structure is very similar to ours-which allows them to have sophisticated behavior. This study tests novel open tank task, group preference, the aggression/mirror, and predator approach that were previously designed for a small undergraduate laboratory based on the study by Blaser and Gerlai (2006). The purpose is to establish reliability of the testing procedures and we are expected to show consistent behavior between the three trial times.

### **“The Effects of Intrinsic and Extrinsic Religion on Self Esteem of College Students”**

Irena Tepavcevic

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

Self-esteem, or lack of it, affects the attitudes and actions of most people; it is an important aspect of life and is directly linked to what people believe in, including religious views, and what they do in the course of their life. Because of this central role in understanding people, knowing the causes of self-esteem can be an important finding. This study further investigates a known relationship between religiosity and self esteem by testing whether high self-esteem is a result of religious belief. A sample of college students from the Introduction to Psychology course participated. Self esteem was measured by using the State Self Esteem Scale (Heatherton & Polivy, 1991) Religion was measured by using the Religious Orientation Scale (Batson, 1986). Self-esteem was measured before and after individuals prepared an oral presentation about religious beliefs or about the value of education. To the extent that self-esteem scores differed after these various presentations it can be concluded that religious beliefs can directly affect one's self-esteem.

## **ORAL PRESENTATIONS**

### **Beaman A**

**6:00 – 8:00**

**Dr. Pete Giordano, Moderator**

**6:00 – 6:15**

### **“Names and Facial Association”**

Hannah Benneyworth

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

**6:15 – 6:30**

**“Religiosity and Age of Marriage”**

Rosemary Harris

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

**6:30 – 6:45**

**“The Effects of Perceived Stress and Coping Style on Health Habits”**

Rachael Haney

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

**6:45 – 7:00**

**“Effect of Stereotype Threat on Test Performance”**

T. Sharde Carney

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

**7:00 – 7:15**

**“The Effect of Extrinsic Motivation on Creativity”**

John DePriest

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

**7:15 – 7:30**

**“Dream Content and Field of Study”**

Luke Lancaster

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

**7:30 – 7:45**

**“Motivation, Memorization, and Self-efficacy”**

Kevin Stone

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

**7:45 – 8:00**

**“Advertising and Men’s Acceptance of Alcohol Use”**

Anthony Yater

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

## **Beaman B**

**6:00 – 8:00**

**Dr. Robert Magruder, Moderator**

**6:00 – 6:15**

**“Six Behavioral Models for Zebrafish (*Danio rerio*)”**

Sarah L Lashley

Faculty Advisor: Lonnie Yandell, Ph.D.

Major: Psychology

Zebrafish (*Danio rerio*) are relatively new model organisms to behavioral science and neuroscience. The main goal of this study, in addition to establishing a small undergraduate laboratory, is to establish procedures for testing typical behavior in

zebrafish (*Danio rerio*) and creating methodology to compare the way individuality; genetic mutations; drugs; and many other aspects can affect behavior. The six behavioral paradigms are novel open tank, group preference, mirror/aggression, predator approach, classical conditioning, and operant conditioning. Four of these six tasks are fashioned from a previous study (Blaser and Gerlai, 2006).

**6:15 – 6:30**

**“Experiment vs. computation: What does nature think of human-designed proteins?”**

Elizabeth A. Repasky

Faculty Advisor: Rachel Rigsby, Ph.D.

Major: Chemistry

A statistical term that accounts for surface-residue solvation of de novo designed proteins has been created in a protein design program, Rosetta. This is done by differentiating between polar surface amino acids and hydrophobic core amino acids. The new alteration in Rosetta Design is tested by creating a de novo four-fold symmetrical TIM barrel design, an alpha-beta barrel fold common in nature. Three rounds of design have led to an improvement of this algorithm through experimental expression and characterization of the designed proteins. A fourth round of design is currently being created to combine the best attributes of each of the previous results.

**6:30 – 6:45**

**“The Transcendence of Pi”**

Amy L. Valentine

Faculty Advisor: Sharon L. Crumpton, Ph.D.

Major: Mathematics

The number pi has a long history. Both the early Egyptians and Babylonians knew about pi and had an estimation of it before 1500 BC. Since then to the present, hundreds of mathematicians have studied this unique number. Many changes and discoveries have been made to help describe and define it. Now there are some known properties of pi such as its irrationality and the apparent randomness of its digits. Another of these properties is the transcendence of pi, or in other words, pi is a transcendental number. A transcendental number is a number that is not a root of any algebraic equation having integers as coefficients. [Ferdinand von Lindemann](#) proved that  $\pi$  is transcendental in 1882. The proof and results of this fact have helped to develop many more mathematical ideas as well as leave some unanswered questions.

**6:45 – 7:00**

**“The Real John Nash”**

Joshua S. Moffitt

Faculty Advisor: Dr. Sharon L. Crumpton, Ph.D.

Major: Mathematics

John Nash is one of the most preeminent mathematicians in modern history. His work on game theory, including his famous Nash Equilibrium for strategic, non-cooperative games, has applications in political conflicts, labor negotiations, business competition, international relations, and economics- for which he won the 1994 Nobel Prize. Tragically, for most of his life, Nash suffered from Paranoid Schizophrenia. This serious disease crippled Nash's beautiful mind from the late 1950's until the early 1990s. However, due to the very popular film *A Beautiful Mind* produced in 2001, there are many misconceptions about his work and life due to inconsistencies about him presented in the film. By reading Sylvia Nasar's biography *A Beautiful Mind* and other articles on Nash, I discovered the problematic, difficult, brilliant man that was the real John Nash. My goal is to present the side of Nash that Hollywood did not portray by presenting information about his life and works that influence modern American society.

**7:00 – 7:15**

**“Magic Squared: A Brief History of Magic Squares”**

Nathan E. Davis

Faculty Advisor: Sharon L. Crumpton, Ph.D.

Major: Computer Science/Mathematics

For over four millennia, mankind has been fascinated with the so-called “magic” square. The concept is deceptively simple; all one is asked to do is to place numbers into an  $n \times n$  grid so that all the rows, columns, and the two primary diagonals have the same sum. Yet, the magic square has attracted the attention of such great intellectuals as Leonhard Euler, Benjamin Franklin, and Albrecht Dürer. Why would they put so much effort into a seemingly straightforward puzzle? This project provides answers to this question by examining the history of the magic square, beginning with the

lo-shu square and showing the magic square's impact up to the present day. Additionally, some of the basic mathematical theory behind the magic square, including how to construct certain types of magic squares, will be discussed.

**7:15 – 7:30**

**“Acoustic Modes of Nonrectangular Rooms”**

Clark Johnson

Faculty Advisor: Scott Hawley, Ph.D.

Major: Audio Engineering Technology

The goal of my research is to calculate acoustical modes for nonrectangular rooms. Room modes are multidimensional standing waves which are determined by the room geometry. The interest for this problem comes from a background of audio engineering and an introduction to acoustical physics in PHY2010.

The solution to the problem was approached several different ways. We first investigated a closed-form analytical approach, but this idea was dismissed because analytical solutions exist only for rectangular rooms. The next method of action was to look at different computational methods. After some research, we narrowed down the field to two: the finite element method and the finite difference method. The method we have chosen is the finite difference method, because of the availability of an existing computer code and previous work with it by Dr. Hawley.

**7:30 – 7:45**

**“Body Esteem and Peer Relations Among College Students”**

Mary Motsinger

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

**7:45 – 8:00**

**“Vocalized Music vs. Instrumental Music on Memory Recall”**

Monal Patel

Faculty Advisor: Michael P. Sullivan, Ph.D.

Major: Psychology

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