We experiment.

2017

SVSU SCIENCE & ENGINEERING SYMPOSIUM

FRIDAY, APRIL 21 2017
PIONEER HALL 8:30 AM-4:30 PM

SV SU SAGINAW VALLEY STATE UNIVERSITY

SVSU Science and Engineering Symposium

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SVSU Science and Engineering Symposium

Program

8:00 a.m.	**Registration**	Pioneer First Floor
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9:05 a.m.	**Keynote Lecture** Dr. Giselle Tamayo-Castillo President, Costa Rica National Council for Science and Technology Professor of Chemistry, University of Costa Rica	Science East-204
10:00 a.m.	**Poster Session**	Pioneer First Floor
	Biology Posters Chemistry Posters Computer Information Systems Poster Electrical Engineering Posters Mechanical Engineering Posters Physics Poster SBESI Poster	
12:00 p.m.	**Lunch**	Pioneer First Floor
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1:00 p.m.	A. Biology	Pioneer-242
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Keynote Lecture

Metabolomic Studies:
the use of analytical tools to answer biological questions

Speaker: Dr. Giselle Tamayo-Castillo
President, Costa Rica National Council for Science and Technology
Member of Costa Rica National Academy of Sciences
Professor of Chemistry, University of Costa Rica

Dr. Tamayo-Castillo received her doctorate in natural sciences from the Technical University of Berlin in Germany and has held numerous leadership positions in national and international academies of sciences. She is a globally recognized expert in rainforest ecosystem with more than 50 articles on biodiversity published in peer-reviewed journals. Her research expertise includes genotyping of rainforest organisms and discovering potential new pharmaceuticals using these plants.

Biology Posters

B01. Towards Making Extrudable, Water-Soluble Plastic from the Shells of Gulf Shrimp
Grace Macomber (Advisor: Dr. Sylvia Fromherz)

As the human population increases at a rate of 3.1 percent, trash and pollution is creating a major problem on a global level. This pollution is causing an increase in greenhouse gas emissions, in the amount of space landfills use to store all of this trash, and in the amount of plastic in oceans. Non-recycled trash gets into the water system, which eventually empties into the ocean. Trash in the ocean is collecting at an alarming rate; 14 billion tons are dumped in the major oceans every year. This is a serious problem, and scientists are working on solutions. Gulf shrimp have been eaten for as long as humans have been aware of them; their shells, for the most part, have been a waste product. These shells, composed of mostly chitin, have also been called "natural plastic" because of their flexibility, durability, and plastic-like texture and appearance. When manipulated, this material can be transformed into a biodegradable polymer. The chemical manipulation of the chitin in shrimp shells involves the synthesis of chitosan, which can be altered to form a natural plastic. When this is made, it can be strengthened with lignin, an organic polymer found in plants. When the chitosan is strengthened with lignin, it gives the polymer rigidity while still allowing it to be biodegradable. The reinforced chitosan can be transformed into practically anything. This research project may contribute to the current literature on the creation and uses of chitosan and assist in efforts to address global pollution levels.

B02. How Does Overconsumption of Vitamin B6 Cause Permanent Neurological Damage?
Caylee Lawnichak
(Advisor: Dr. Sylvia Fromherz, Co-advisor: Dr. Andy Sharp, Southern Illinois University)

Pyridoxine, also known as vitamin B_6, is common in supplements such as compound daily vitamins and as an isolated vitamin. Unfortunately, overconsumption of pyridoxine can cause permanent neurological damage. In chicken embryos, it has been found that treatment with high doses of pyridoxine results in selective loss of the sensory neurons that contribute to spatial sense and balance (the proprioceptive neurons). The way in which pyridoxine does this is not fully understood. It is hypothesized that the pyridoxine may disrupt a cell-signaling pathway involving the muscle-produced growth factor, neurotrophin-3 (NT-3) and its proprioceptive neuron receptor, tyrosine receptor kinase C (TrkC). My project is to test this hypothesis by Western blot monitoring of the levels TrkC in control and pyridoxine-treated chicken embryos. Thus far, I have rehearsed the western blot method and have learned about the highly sensitive detection approaches necessary for my project. I have helped to identify possible anti-TrkC antibodies through a bioinformatics approach because there is no antibody made directly against chicken TrkC. I have also carried out an observational study of early to mid-chick embryonic development and have observed isolated dorsal root ganglia from the spinal cord of embryonic day nine chicks. Finally, I have quantified the amount of protein present in the ganglia and in a control thigh muscle sample.

B03. Exploring the evolution of methylbutenol synthase through reduction of the *Picea sitchensis* linalool synthase active site
Martin J. Weaver (Advisor: Dr. Dennis Gray)

Methylbutenol (MBO) is a 5 carbon, volatile, organic compound (VOC) emitted from many, but not all, pines in Western North America. The compound seems to function as a mediator for heat stress in emitting organisms by stabilizing photosynthetic membranes and machinery during heat flecks. The molecule is synthesized by MBO synthase which is a hemiterpene synthase, part of a larger class of secondary metabolic enzymes in plants. MBO's emission is quite interesting physiologically as it is expensive in terms of photosynthesis and is interesting chemically as it has significant effects on atmospheric chemistry and possible biofuel applications. In this study I seek to test a probable path of evolution for the methylbutenol synthase by performing active site mutagenesis on a possible progenitor enzyme, linalool synthase, to decrease its active site size. The recombinant protein will then be expressed and analyzed by functional assay using gas chromatography. This project is still in progress. The original linalool construct has been cloned into a vector for expression and the site directed mutagenesis generating the recombinant gene has been performed successfully. However, several other constructs derived from these genes are still in the process of being cloned. Once complete, the results of the project will give insight into structure and functional relationships in enzymes and provide a greater insight into our current understanding of terpene evolution.

B04. Expression and characterization of a putative linalool synthase (ISH) sequence from *Pinus sp.*
Samantha Turner (Advisor: Dr. Dennis Gray)

The goal of this faculty-led undergraduate research project is to express and functionally characterize the putative linalool synthase from *Pinus sp.* This experiment will aid in reconstructing the evolutionary history of hemiterpene emission within the conifers, and provide information on the structure and function relationships of the terpene synthases. The method employed includes expression of the target protein in *E. coli* followed by extraction and purification of the protein. Analyses of basic enzyme characterization are then performed on the purified protein to confirm the function of the newly ascertained terpene synthase gene. The results of this project will end in the classification of the catalytic activity of the putative linalool synthase.

B05. Investigating microRNAs in the development of cardiovascular disease
Phillip Markey (Advisor: Dr. Jay Scott)

Cardiovascular Disease (CVD) is the leading cause of death in the United States and the incidence is expected to increase. The mechanisms of how CVD develops are beginning to be well-understood; however, there remains a need to identify effective biomarkers in blood to identify risk of developing CVD. Small endogenous biomolecules known as microRNAs (miRNA) can provide an earlier diagnostic tool and potentially be used in treatment. To identify miRNAs expressed in CVD, mice will be exposed to high fat diet, increasing susceptibility to CVD, and levels of miRNA will be measured in relevant tissues and in circulation. It is expected that circulating miRNA will increase as signs of CVD become prevalent, establishing miRNA as a biomarker for CVD. Measuring miRNAs may identify the tissues the miRNAs were produced in which could have implications for future therapies.

B06. Ultrastructural analysis of rainbow trout (Oncorhynchus mykiss) larvae hearts exposed to retene

Jade Foldie (Advisor: Dr. Jay Scott)

Polycyclic aromatic hydrocarbons (PAH) are ubiquitous environmental contaminants known to cause cardiovascular toxicity in the larval stages of rainbow trout development. The earliest of these developmental defects can be seen in the cardiovascular system, especially in the structure and function of the heart. Microarray analysis of larval trout hearts exposed to retene, an alkylated PAH, have identified both up- and down-regulation of specific genes involved in cardiac structure; however, whether this ultimately leads to significant cellular and functional changes remains to be determined. To investigate potential cellular changes in cardiac muscle tissue, cardiomyocytes of retene-exposed hearts were observed for specific ultrastructural alterations known to influence cardiac function, including sarcomere and myofilament arrangement, mitochondrial damage, vacuolization, glycogen stores, and intercalated disc structure. For all cellular structures observed, there were no overt differences between control and retene-exposed hearts; however, it appeared that there may be a change in protein expression around the intercalated discs, as evidenced by the density of staining. Although there was a trend for an increased density around retene-exposed intercalated discs, no statistical significant difference was found. The results suggest that retene is causing cardiotoxicity through the altered function of structurally normal cardiac cells.

B07. Do blood-borne factors contribute to "inflammaging"?

Kristen Loesel (Advisor: Dr. Jay Scott)

The immune response often becomes deregulated with increasing age, and this leads to a long-term low-grade inflammation, termed “inflammaging,” which has been linked to numerous non-communicable diseases such as cardiovascular disease, cancer, and various metabolic diseases. Therefore, it is imperative that we further our understanding of the complex pathways involved in the inflammatory response. To test if the low-grade, systemic inflammation is mediated by factors circulating in blood, blood serum from young and old mice is being used to investigate age-related changes in inflammatory signaling using cultured bone marrow-derived macrophages. Our results to date suggest that there may only be low-level changes in circulating factors inducing inflammatory responses in macrophages. Current experiments are expanding our investigation of blood-borne factors and age-related changes in inflammatory signaling when inflammation is exacerbated by a high fat diet.

Chemistry Research Posters

C01. Synthesis of Dianthin G, a Peptide that Promotes the Formation of Osteoblasts
Kathlyn Underwood (presenter) and Matthew Powers (Advisor: Dr. Jennifer Chaytor)

Osteoporosis is a common disease that occurs in the bones of both men and women. The disease is more prominent in adults over the age of 60 as it affects 1 in 4 men and 1 in 2 women in this age bracket. While many people have osteoporosis, there are still millions of people who are at risk of developing the disease or have low bone mass levels that may lead to an increased susceptibility of fractures, especially in the hip, wrist, and spine areas. Recently, there has been a discovery of a plant known as *Dianthin superbus* that has been tested for osteoblastic proliferative activity. The peptide from *D. superbus* has been shown to activate the production of osteoblasts to increase bone mass. Dianthin G is a cyclic hexapeptide that is extracted from *Dianthin superbus* and was initially taken from a northern province in China, known as Shandong, and is used in traditional Chinese medicine. This study has examined the chemical synthesis of Dianthin G and its structural analogs. The proliferative activity of these compounds on rat osteoblast cells will later be tested to see if they have the ability to prevent the formation and endurance of osteoporosis. The chemical synthesis and purification of these cyclic peptides will be discussed in this presentation.

C02. Effects of Alkyl Chain Variation on Gel Formation and Properties in Carbohydrate-Based, Low Molecular Mass Compounds
Nicholas Toupin (Advisor: Dr. Jennifer Chaytor)

Organogelators are a class of compounds useful for a variety of applications ranging from drug delivery, to scaffolded material synthesis, to environmental remediation. While gels have proven to be extremely useful much is still unknown about the wide variety of factors that cause gel formation and that affect the properties of the gel itself. This project attempts to explore how variations in the structure of the gelator can affect the properties of the gel it may form. Specifically, a range of amphiphilic compounds were synthesized utilizing galactose as its polar region and alkyl chains of varied length for its nonpolar region. This project attempts to draw a correlation between nonpolar chain length of the gelator and the ability of the molecule to form a gel and the viscosity of the gel it forms. Furthermore, two mono-unsaturated alcohols were utilized to form gel precursors in order to observe the effects of unsaturation on gel formation and viscosity. After preliminary data analysis, it appears that there is an optimum alkyl chain length for maximum viscosity in this set of compounds. Gels were not formed in compounds with alkyl chain lengths over nine. Furthermore, viscosity was maximized at an alkyl chain length of nine. Only one of the unsaturated alcohols were able to form a gel and the viscosity of that gel was much less than the viscosity of its fully saturated counterpart, suggesting that unsaturation leads to less viscous gels. The synthesis and testing results will be discussed in this presentation.

C03. Exploration of α-glucosidase Inhibitors via Preparation of β-D-glucose Analogs
Bryant Pero and Jack Razmus (Advisor: Dr. Jennifer Chaytor)

Type 2 diabetes mellitus is a disease that causes elevated glucose levels in the blood, which can lead to various health problems if left untreated. Increasing numbers of people affected by the disease have led to research efforts to find alternative treatments in addition to insulin. Alpha-glucosidase inhibitors have shown to reduce the amount of glucose introduced into the blood from the intestines. In this project a collection of new compounds similar in structure to a known alpha-glucosidase inhibitor were synthesized and characterized. These compounds feature a glucose linked to aryl groups via a short carbon linker. Current efforts are underway to increase the yields of the synthesized products, in addition to improving their purification. This involves an alternative synthesis scheme to remove steps known to have poor yields. A biological assay testing the alpha-glucosidase inhibitory effects will be performed after all compounds have been synthesized, purified and confirmed via characterization. This presentation will discuss the synthesis, purification, and characterization of these compounds and the new synthesis scheme, along with the challenges that were encountered.

C04. Synthesis and characterization of gadolinium-silica precipitation tubes
Christopher J. Sabal (presenter) and Daniel P. Weller (Advisor: Dr. Jason J. Pagano)

During the past decade the study of tubular precipitation structures from a class of chemical reactions known as chemical gardens has created the field of chemobrionics. Chemical gardens are defined as plant-like tubular structures which form when water soluble metal salt crystals make contact with solutions of silicate or other anions. Our research group uses a simple experimental set-up upon replacing the metal salt crystal with a metal salt solution as the reactant. Accordingly, we prepare gadolinium-silica precipitation structures upon the hydrodynamic injection of gadolinium nitrate into a large volume of sodium silicate solution carried out in the upward direction. This experimental methodology is highly reproducible which allows for the formation of single tubes having measurable radii at predetermined flow rates. The data analyzed from our experiments reveal a power law dependence between vertical growth rate and the selected flow rate. The walls of the resulting tubular structures have a typical width of 90 μm and are gradient materials. We examine the structural features and chemical composition of post-synthesized precipitation tubes using SEM-EDS. Lastly, the results from FT-IR and thermal analyses are presented.

C05. Development of synthetic models for metal-containing biomolecules with an emphasis on understanding their redox behavior
Arti Patel and Andrea Nikolai (Advisor: Dr. Adam Warhausen)

The aim of this project is to gain insight in to the interactions of hydroxamic acids with biologically relevant molecules. Hydroxamic acids, which are known donors of the important diatomic molecule nitric oxide, typically interact with metals in a bidentate fashion. In this research, a new 5-coordinate ligand that mimics the natural biomolecular system is being utilized to force monodentate coordination of the hydroxamate to the metal. This is done in order to determine if the mode of coordination has any influence on the hydroxamate's ability to donate NO. Once the new complexes have been synthesized a large emphasis of this work focuses on understanding their redox behavior using electrochemical and spectroelectrochemical methods.

C06. Synthesis, Characterization, Electrochemical, and Spectroelectrochemical Investigation of Iron and Ruthenium Hydroxamate Complexes
Bradley Ross (Advisor: Dr. Adam Warhausen)

Interactions between nitric oxide and biologically available materials have been widely studied in the field of chemistry. Fortunately, there is much more to learn and to study with respect to organic molecules that are capable of producing nitric oxide within living organisms. The nitic oxide donating molecules utilized in this research are hydroxamic acids. This project aims to study the interactions of these hydroxamic acids with iron- containing bimolecular models. Due to stability and similarities this project also aims to utilize ruthenium – containing biomolecular models. The emphasis of this work focuses on understanding their redox behavior using electrochemical and spectroelectrochemical methods.

C07. Spectrophotometric Determination of Iron in Basil from the SVSU Greenhouse Using the Method of Standard Additions
Mario A. Cornejo (Advisor: Dr. Kyle Cissell)

Basil contains essential vitamins and minerals, including iron. Using basil grown in the SVSU greenhouse, we present a method to determine the concentration of iron using standard additions. To isolate the iron in the basil, combustion was performed with a Bunsen burner to remove biomass and water, leaving a white ash. The ash, containing iron, was then dissolved with concentrated hydrochloric acid, followed by reduction of Iron (III) to Iron (II) using hydroquinone. To limit the effects of the complex matrix on the orange color formed by complexation of Iron (II) with 1,10-phenanthroline, the method of standard additions was performed. The intensity of the orange-colored iron (II)-phenanthroline complex was measured with an absorbance spectrophotometer, with the concentration of iron in the basil determined from the x-intercept of the standard addition plot. Here, we present the iron content in basil grown in the SVSU greenhouse using hydroponic solutions as a nutrient source.

C08. GCMS Analysis of Lemongrass and Lavender Essential Oils
Marissa Dobulis (Advisor: Dr. Kyle Cissell)

Essential oils have been used for treatments of many disorders in alternative medicine for thousands of years. It has only been in recent years that the actual biological effects of the oils have been studied, and even less is known of what components of the oils elicit biological effects. Knowledge of these compounds and their concentrations may result in both medicinal and everyday use to prevent or assist in disease prevention or treatment. Through use of gas chromatography-mass spectrometry (GCMS), we have examined lemongrass and lavender oils from different essential oil manufacturers to identify compounds and compare doses of potential active ingredients between the different manufacturers. Using the methods of standard additions and internal standards, we have attempted to determine concentrations of potential key components in the oils. It was found that α-caryophyllene was seen in highest concentration in the Now© brand lavender essential oil, and β-citral was most frequently seen in the Doterra© brand lemongrass essential oil. Future work will include analysis of lavender and lemongrass essential oils as well as potential biochemical assays to identify the biological effects of each component.

C09. Development of 3D-Printed Chromatography Instrumentation

Kristen Bluer (Advisor: Dr. Kyle Cissell)

Liquid chromatography is a staple for any laboratory performing separation of components in a mixture. Due to the high cost of liquid chromatography instrumentation, its use is limited to laboratories with the monetary resources needed to perform separations, thus making its use unreachable for 3rd world countries. To develop an affordable option for liquid chromatography, 3D printers are attractive alternatives to modern instruments. Here, we present 3D-printed versions of a gravity chromatography column, solvent proportioning valves, and a peristaltic pump, which can be driven using simple Arduino microcontrollers.

SVSU Chemistry Club Poster

C10. An Overview of Green Chemistry

Emily Greeson (Advisors: Dr. Jennifer Chaytor and Dr. Adam Warhausen)

Humans have always been striving to improve crop protection, commercial products, and medicines. However, it was not until the 1950s that the long-term negative effects of these advancements started to present themselves and warranted concern and attention. Many governments began to regulate the generation and disposal of industrial wastes and emissions. In 1970, the United States formed the Environmental Protection Agency (EPA), which was meant to protect human and environmental health through setting and enforcing environmental regulations. Green Chemistry takes the EPA's mandate one step further by asking chemists and engineers to design chemicals, chemical processes, and commercial products in a way that avoids the creation of toxins and waste. Through the practice of green chemistry, waste can be reduced, the demand on diminishing resources can be reduced, and processes can be employed that use smaller amounts of energy. In the fall of 2015, the Saginaw Valley State University Chemistry Club started making green chemistry a priority in their demonstrations and activities. It is the goal of the Chemistry Club to educate the community about green chemistry through this poster, and in the future by facilitating even more green chemistry events.

Chemistry Class Project Posters

C11. Analyzing Antibiotic Resistance via DNA Gyrase Activity

Kelly Koon and Ashley Timmreck (Advisor: Dr. Tami Sivy)

In a world where amazing strides are being made in medicine, such as cancer treatments and groundbreaking surgical techniques, we are failing to discover a way to combat what is constantly around us: bacteria. As antibiotics continue to be prescribed for viral illnesses such as the common cold, bacteria are developing resistance to these drugs. The purpose of this study is to determine the effectiveness of antibiotics using agar plates treated with ciprofloxacin, as well as performing a DNA Gyrase assay. This assay allows for visualization of topoisomerase II activity, which is present in all bacteria. Upon addition of ciprofloxacin, if activity of topoisomerase II has decreased, we can assume that the antibiotics are indeed killing the bacteria, or are in the process of doing so. This antibiotic was chosen as it is used for a wide variety of infections, also known as a broad spectrum antibiotic. Future applications include comparisons to specific antibiotics, and modifications to treatment concentrations in the healthcare setting.

C12. Investigation of Quorum Sensing and Bacterial Bioluminescence in *V. fischeri*

Danielle Duranczyk, Matthew Powers, and Brendan Ehrlich (Advisor: Dr. Tami Sivy)

Vibrio fischeri is a gram-negative marine bacterium from the family Vibrionaceae, which contains both cooperative and pathogenic species. *V. fischeri* is most notably recognized for its role as a light organ symbiont with *Euprymna scolopes, also known as the Hawaiian bobtail squid. V. fischeri* bacteria live in specialized sacs in the squid, which controls and uses their bioluminescent activity. This symbiotic relationship is crucial for the survival of the squid and is executed by population density directed gene expression known as quorum sensing.

This research will explore the quorum sensing activity of bacteria by examining bioluminescence in *Vibrio fischeri*. The quorum sensing signaling molecule secreted by *V.fischeri, N*-(3-oxohexanoyl)-$_{L}$-homoserine lactone (OHHL), binds to the LuxR receptor in other *V. fischeri* cells and leads to the expression of the lux operon, which encodes genes for the production of luminescent proteins. Bioluminescence is only triggered at specific population densities due to accumulation of the OHHL signaling molecule. When large amounts of bacteria are present, OHHL is produced and bound beyond basal levels and the colony is collectively triggered through quorum sensing to trigger bioluminescence. We propose to induce quorum sensing in *V. fischeri* by using both its native quorum sensing molecule as well as a synthetic agonist analog. This will be accomplished by varying the concentrations of both the native signal molecule OHHL and the agonist analog and qualitatively investigating the bioluminescence response of the *V. fischeri*. Investigation into the quorum sensing properties of bacteria such as *V. fischeri* could be used in future studies to utilize quorum sensing mechanisms to alter behavioral response through the use of agonist signaling molecules as a new class of treatment against bacterial virulence.

C13. Extraction of BPA for Qualitative Analysis from Household Sources

Chelsea Harmon, Bradley Hunt, and Alexis Maroney (Advisor: Dr. Tami Sivy)

Bisphenol A (BPA) is a chemical found in many everyday household items including aluminum cans, plastic water bottles, children's toys, and thermal printed receipts. This chemical is commonly inadvertently extracted from these sources by the addition of heat or polar solvents like hand sanitizer, and is a known human endocrine disruptor. By mimicking the size and shape of many steroid-based hormones like estrogen and testosterone, BPA is able to enter the cell via passage through the lipid bilayer, where it may cause a host of problems associated with hormonal cell-signaling cascades. These disruptions have been cited to play a role in onset of obesity, diabetes and cardiovascular disease in adults. The first part of this project will include extracting BPA from three main sources that humans are likely to come into contact with, which will include receipts, water bottles, and soda cans. To extract BPA from receipts, they will be warmed in ethanol. The ethanol can then be collected for analysis. In order to extract the BPA from the water bottles and soda cans, they will be boiled in water and the water in them will be collected for analysis. Sample preparation will then be done for analysis in Gas Chromatography - Mass Spectrometry and quantitation will be possible by using a standard calibration curve of BPA. It is expected that there will be enough BPA in each source to pose a potential health risk. A comparison of our values to BPA studies in the literature will allow us to make this conclusion.

C14. Genetic Manipulation of *E. coli* with UV Light

Christopher Hesterly, Heather Marshl, and Andrew Trombley (Advisor: Dr. Tami Sivy)

In 2003 the World Health Organization added overexposure to UV light, both natural and artificial, to a list of known carcinogens. UV light exposure, over time, damages DNA and is capable of causing mutations that could, and often do, lead to uncontrollable cellular growth. To highlight this danger, we exposed liquid cultures of non-pathogenic *E. coli* to varying intervals of UV light. The sample that received the greatest exposure while still being able to produce colonies on plates was used as the experimental variable and then compared to a control produced from the same cell line. DNA from these two samples were extracted and purified. Then using PCR to isolate a section of the *murA* gene, the gene responsible for producing the first enzymatic step in the biosynthetic pathway for peptidoglycan, both samples were sequenced and the percentage of discrepancies were calculated. These discrepancies are a clear example of genetic mutation caused by exposure to UV light.

Computer Information Systems Poster

Martial Arts Studio Management Software System
CIS 424 Senior Capstone Class (Advisors: Dr. Scott James)

This year's CIS capstone project involved the analysis, design and implementation of a software system capable of automating and tracking employee, instructor, student and class information for a martial arts studio. The software utilizes Microsoft SQL Server as a data repository while the software itself was designed utilizing Visual Basic and the .NET framework. Barcoding technology was utilized to simplify student class attendance and progress toward belt achievements. The system also permits developing email templates that can be sent to groups of individuals ranging from a single student to entire sets of classes. Email may be sent on an ad hoc basis, scheduled intervals or based on the occurrence of an event.

Electrical Engineering Posters

E01. The Smart Kennel

Sarah Albanawi, Jonathan Knieper, Victoria Olguin, and Jordan Reed
(Advisor: Dr. Rajani Muraleedharan)

In the United States, there are approximately 2.6 million dogs and cats that are euthanized mainly due to overcrowding in shelters. Also, the main reason why owners relinquish or give away their dogs is place of residence does not allow pets (28%), not enough time (29%) and behavior issues (10%). In this project, a smart pet kennel that specifically favors potty- training a new pet while encouraging first time pet owners to continue their lifestyle is proposed. The Smart Kennel will have a variety of Wi-Fi enabled sensors that monitor the pet, encourage positive behavior, as well as making sure conditions in the kennel are conducive to the pet's well-being. An Android application will be developed to provide the owner reassurance of the pet's well being and allow for remote interaction. With the various options available through the application, the owner will encompass total control over the many Smart Kennel functions while away from the home. The project aims to reduce the number of pets turned away by family (owners) due to the owner's active lifestyle, and potty-training a new pet. The Smart Kennel promises to provide 24/7 pet monitoring and stress-free potty-training for a pet that deserves a home and second chance of new life.

E02. Object Detection and Motion Control via LiDAR

Lekako Johnson, Scott Swiecki, Brendon Phelan, and Alaa Alshokoori
(Advisor: Dr. Rajani Muraleedharan)

The recent developments in LiDAR technology make it more practical to develop a system using this technology than ever before. Tracking the surroundings of a vehicle is necessary to improve safety on the roads and remove human error from the equation. With autonomous vehicles already driving on public roads, the use of LiDAR systems in vehicles will save thousands of lives and allow people with special needs and physical disabilities to regain their mobility.

E03. The Flying Trio

Ali Al Yousif, Matthew Media, and Eric Hasse (Advisor: Dr. Rajani Muraleedharan)

The goal of the project is to build a Quadcopter and evaluate its ability to monitor, record, and respond to search and rescue scenarios at Saginaw Valley State University. This project involved building a customized Quadcopter and using pre-built Quadcopters. The advances in electrical engineering, physics, and the availability of the hardware and software have greatly contributed to the advancement in building and designing the device. The device is equipped with a controller that sends/receives information to control velocity, elevation, stability, and GPS reception. Quadcopters have the ability to mount a freely rotating camera, which adds to its capability and sophistication. The objective was to understand the engineering aspect of Quadcopters, their limitations, and research what improvements are necessary for autonomous flight. Quadcopters give us an advantage in search and rescue operations because they can easily give us an aerial view in remote areas that are hard to get to by land. Its size (small, but capable of covering large area), will depend on the material used and price variations; as the cost varies from cheap to extremely expensive.

E04. Energy Harvesting Solar Tracking System for Mobile Scoreboard Applications
Mandeep Singh, Alexander Strawn, Timothy Dinnan, and Naser Akroof
(Advisor: Dr. Rajani Muraleedharan)

Sustainable lifestyles require the merger of technology and life events. This senior design project will integrate solar energy and a mobile scoreboard for application of keeping score at any outdoor event and harvesting energy when not in use. The proposed eco-friendly solar-powered scoreboard will be capable of tracking the sun for maximum energy efficiency. The energy harvested using this design will power the scoreboard or be stored in a battery bank for other applications such as powering a hybrid car in a parking lot, or charging a cell-phone. The user-friendly scoreboard promises to provide easy interface for the score keeper and updated scores for the spectators in a timely fashion. Although, the benefit of implementing a solar tracking design over a non-tracker is 20%-30% more energy-effective, the tracking system is often not adapted due to expensive technology. In this research project, a cost-effective and energy-efficient solution for harvesting energy using dual axis solar tracker will be implemented.

E05. Automated High-Pressure Aeroponics
Ahmad Alefari, Thomas Glavin, Jonathan Seeley, and Haisu Zhang
(Advisor: Dr. Rajani Muraleedharan)

Aeroponic growing systems are far superior to traditional methods of crop production, including increased yield rate with far less water and fertilizer consumption, with decreased contamination, infection, and disease. The proposed design will feature a system that allows the automated control of water, nutrients, and light cycles. This design will also feature a monitoring system that will incorporate data and visual updates with emergency alerts, which provides the ability for crops to be produced almost remotely. This technology has profound implications to the future of crop production in regards to both an environmental and economic perspective. Funding of this project not only contributes to the progression of automated aeroponics, but also provides an invaluable opportunity for the members of this team to further develop as engineers.

E06. Feasibility of an Ambulance Detection System

Skyler Skrzypczak, Scott Robinson, and Mousa Alshamrani
(Advisor: Dr. Rajani Muraleedharan)

The proposed project is a sensor network that will determine the existence of ambulance sirens and alert drivers to their presence and direction. This information will be sent to an in-car LCD display that will alert the driver to the presence and direction of the siren. The proposed system would give drivers more time to pull over for the ambulance, decreasing transport time and reducing the number of accidents involving emergency vehicles.

E07. Automated Pet Intensive Care Unit

Amen Abbas, Jonathan Claus, Michael Papesh, and Zwe Thiha
(Advisor: Dr. Rajani Muraleedharan)

Great Lakes Pet Emergencies is an emergency veterinary clinic for when the worst happens to a beloved animal companion. The current system in place for a pet in intensive care involves an oxygen tube being sutured into the animal. This process is painful to the animal, and adds complications to the healing process. The project will improve on that existing system by creating a monitored, regulated intensive care cage. This will provide a safe, secure, and comfortable environment for the animal to recover.

Mechanical Engineering Posters

M01. Huhtamaki Plastics Hand-Held Lid Counter

Hussain Alsheyoukh, Taylor Hunter, Ara Szczepaniak, and Chase Szostak
(Advisor: Dr. Brooks Byam)

Huhtamaki Plastics is a global specialist in packaging for food and drinks such as food containers, cups, and coffee lids. With producing billions of products every year, keeping an accurate count of what started at the beginning of the manufacturing process all the way to the end can be difficult. Huhtamaki has run into an issue of maintaining an accurate count on their coffee cup lids. In between the lids being on the conveyor belt and transported to be packaged, some are lost causing a discrepancy in the count. Many times, operators and quality auditors need to quickly count a stack of parts to verify they are correct. This has created a need for a tool which can quickly count a stack of lids before they are packaged.

M02. Nexteer Downforce Durability Test Stand

Kent Schomaker, Gage Kienitz, Zach Davison, and David Kipfmiller
(Advisor: Dr. Brooks Byam)

Nexteer gave us the problem of designing a downforce test stand. The downforce test stand is being designed for understanding the wear relationship of the ball nut to ball screw interface, by simulating in field lifecycle fatigue in an accelerated and controlled laboratory environment. Nexteer Product Engineers hypothesize that repeated impact loading/fatigue on the product will cause undesirable wear and possible premature failure of the product. The test stand will allow product engineers working on the downforce system (and future similar systems) to perform benchmarking and validate their product designs.

The problem described above is defined by a set of measurable objectives pertaining to function, size, cost, features, safety, and performance of the system. The required function of the downforce test stand is to firmly secure the part, while simulating lifetime wear profile on the part. This is to be performed by inducing a cycle of linear loading at the bottom of the part, as well as adjustment of the nut/spring preload by rotation of the screw at predetermined intervals.

Required features of this system will include a method of linear actuation to create simulated loads and rotational input to adjust ball nut position. Fixturing must allow the test part to be secured in a quick and ergonomic manner. Additionally, the system must include a method of monitoring and recording various data parameters such as torque, current, and compression of the spring. The system must include a feature which allows input parameters to be easily adjusted by lab staff.

M03. TDI Bearing Subassembly Fixtures
Aaron O'Neil, Nick Fox, Patrick Stefaniak, and Jacob Heminger
(Advisor: Dr. Robert Tuttle)

The team will be presenting solutions to TDI's most pressing engine assembly problems. New concepts for ball bearing assembly and epoxy degassing/application will be presented.

M04. The Fab Shop Removable Floating Dock
Wade Gelhaus, Andrew Vogel, Nathan Neubecker, and Akram Alsheyoukh
(Advisor: Dr. Brooks Byam)

Our senior design group is creating a removable floating dock for a local client to install and remove as he pleases. The dock will be able to be installed with just one individual.

M05. Duro-Last PVC Rib Welder
Kyle Boensch, Josh Dornseifer, Cory Harris, and Samuel Quinn
(Advisor: Dr. Thomas Mahank)

The objective of the project is to design and build an apparatus that has the ability to accurately and efficiently align and weld a PVC rib to PVC membrane on a pitched roof in a safe manner. The design must meet the measurable objectives to optimize the heat applied and feed rate to produce an adequate weld without cold welding or melting the membrane material. The PVC rib welder is a redesign of the current model, which has been in use for approximately three years. The new model will simplify the overall design by reducing cost, increasing weld speed and quality, and increasing ease of use for the contractors.

M06. Nexteer RCR NASCAR EPS
Alex Fullerton and Ryan Whitman (Advisor: Dr. Brooks Byam)

Modifying and installing a Nexteer Electric Power Steering system into a Richard Childress NASCAR race car. Car will perform a demo by RCR to NASCAR governing body post project to see if NASCAR is willing to change the rules to make teams adopt electric power steering to all NASCAR race cars.

M07. SVSU Golf Tilting Hitting Pad
Trent Goerge, Joey Southgate, and Teng Huang (Advisor: Dr. Brooks Byam)

This project is to create a tilting golf hitting pad for the SVSU golf team. This project will incorporate SVSU's current golf pad and will allow the pad to tilt at least 8 degrees on both the pitch and roll axes. To allow the pad to tilt, electric scissor jacks will be placed near the four corners of the pad. These jacks can be raised and lowered to obtain the desired angle of the pad in both the pitch and roll directions.

M08. Dow Corning Corporation Coupling Fluid Evaluation Apparatus
Carley Leinberger, Jacob Penkala, and Romain Gerard (Advisor: Dr. Brooks Byam)

The Dow Corning Corporation manufactures a coupling fluid found in viscous fan clutches. The Molykote coupling fluid is being used in increasingly harsh environments and not always performing optimally. To solve this problem, Dow Corning needs a way to test their coupling fluids often to determine their validity and for further innovation on new formulations. The current method involves sending coupling fluids away to clutch manufacturers for testing at their facilities and the time involved during this process dampers efficiency. The goal of this project is to provide Dow Corning's Molykote group with a method of testing these coupling fluids. The apparatus that was designed is a multicomponent assembly which simulates the operation of a fan clutch while monitoring the temperature of the fluid and the efficiency of the clutch. By monitoring these parameters, Dow Corning will be able to determine what conditions their fluids are failing at and be able to formulate better fluids based on that data.

M09. Kremin, Inc. Advant-EDGE Offline Wheel Dressing Machine
Scott Bourbina, Abdullah Aldosary, and Jonathan Ihrke (Advisor: Dr. Annamalai Pandian)

This project aims to improve upon an existing prototype, making the machine more efficient and user friendly. Areas of improvement include: method of tool holder clamping, design and tolerances of the spindle housing, and development of an adapter to allow different types of tool holders to be used in the machine.

Physics Poster

Measuring Force using Capacitive Sensors: Research-Oriented and Pedagogical Approaches
Ryan French (Advisors: Dr. Chris Nakamura)

We present a pedagogically useful lab apparatus for capacitors that resulted from a simple interdisciplinary research effort. In Fall of 2016 the authors began design research to develop sensors for measuring forces exerted by Crayfish in agonistic (fighting) behavior. This is a problem of interest to biologists (A. Martin) on which physicists (R. A. French, M. D. Vannette and C. M. Nakamura) can collaborate. These efforts have resulted in the design of capacitive force sensors that can be quickly made with cheap, readily accessible materials and that can measure forces up to 15 N. Elastic deformation of the sensor alters the capacitance reproducibly. We discuss two measurement schemes: direct measurement via LCR meter and measurement via frequency shifts of an LC-Oscillator. The measurement schemes can be viewed in different ways to highlight physics appropriate for different audiences from high school to university.

Saginaw Bay Environmental Science Institute Poster

Urban and rural land use contributions to phosphorus and *E. coli* pollution: A case study on Bad Axe Creek
Emily Greeson (Advisors: Dr. David Karpovich and Dr. Tami Sivy)

Bad Axe Creek is a tributary of the Pinnebog River, which flows into the Saginaw Bay. In a previous study, nutrient and bacteria data were collected in order to see if geography plays a role in the levels. Fecal coliform bacteria are of concern because of the potential human health issues they pose, and elevated phosphorus is of interest because of its role in eutrophication. During the summer and fall of 2016, samples were collected biweekly by the Saginaw Bay Environmental Science Institute at seven sites. *E. coli* was analyzed by Colilert-18 in triplicate to determine overall bacteria loading, while quantitative polymerase chain reaction (qPCR) was utilized on composite samples to identify sources of contamination using *Bacteroides* target sequences. Certain sites tended to have high levels of *E. coli*, independent of temperature or weather conditions. At these sites, *Bacteroides* source tracking indicated rural sites have more bovine contamination, while urban areas have more human contamination. Phosphorus was tested using 4500-P Method E for both soluble reactive phosphorus and total phosphorus. In the future, we will expand our study to include more rain events.

Oral Session A: Biology **Room: Pioneer-242**

Presentations are 15 minutes each, starting at 1:00 p.m.

B01. DNA Fingerprinting of Charity Island Phragmites (*Phragmites australis*)
Melissa Frasca and Courtney Franzel (Advisor: Dr. David Stanton)

Phragmites australis is an invasive reed species that was introduced into the United States over one hundred years ago. Since then it has spread aggressive throughout the Great Lakes region, displacing native species and destroying wildlife habitat. It has taken over the eastern shore of Saginaw Bay and is now taking over the western shore as well. In addition, it has invaded Charity Island in the middle of Saginaw Bay. In partnership with Huron Pines, an eradication program is currently underway. Herbicide spraying on the island began last fall and will likely continue for at least the next two years. In order to assess genetic variation, population substructure and the genetic effects of eradication efforts, a DNA fingerprinting survey was performed. One hundred and thirty samples were taken from Charity Island prior to herbicide treatment. The next summer, one hundred and six samples were taken after the first herbicide treatment. The samples were scored for ten polymorphic DNA fingerprint loci. The data allow for determination of the effect of treatment on genetic diversity, as well as modes of recruitment in post treatment populations. These results have important implications for treatment strategies in this and other localities.

B02. DNA fingerprinting of walleye (*Stizostedion vitreum*) from Saginaw Bay and spawning populations.
Heather Marshall (Advisor: Dr. David Stanton)

There is a large population of walleye in Saginaw Bay that is both economically and ecologically important. The population is heavily managed and has been stocked extensively in recent years. In order to properly manage this population, genetic information is required. We obtained fin clips from walleye captured in Saginaw Bay for two summers by trolling. With the help of the Department of Natural Resources (DNR), we also obtained fin clips from spawning populations using electroshocking on the Tittabawassee, Shiawassee, Kawkawlin and Rifle Rivers. In total, over 450 fin clips were obtained. DNA was extracted, using a DNeasy kit. PCR amplification and capillary electrophoresis were performed in order to determine genotypes for ten polymorphic DNA fingerprint loci. The data were analyzed by calculating the number of alleles per population, observed and expected heterozygosities, genetic distances (D) and population substructure (F_{ST}). Two private alleles were identified that were found in single spawning populations and in the bay population, which is indicative of spawning site fidelity. This information will aid management decisions regarding stocking programs, as well as decisions regarding damming of rivers and the construction of ladders to be used by spawning walleye.

Oral Session B: Electrical Engineering Senior Design II **Room: Pioneer-240**

Presentations are 30 minutes each, starting at 1:00 p.m. (see Pages 14-16 for abstracts)

E01. The Smart Kennel
Sarah Albanawi, Jonathan Knieper, Victoria Olguin, Jordan Reed
(Advisor: Dr. Rajani Muraleedharan)

E02. Object Detection and Motion Control via LiDAR
Lekako Johnson, Scott Swiecki, Brendon Phelan, and Alaa Alshokoori
(Advisor: Dr. Rajani Muraleedharan)

E03. The Flying Trio
Ali Al Yousif, Matthew Media, and Eric Hasse
(Advisor: Dr. Rajani Muraleedharan)

E04. Energy Harvesting Solar Tracking System for Mobile Scoreboard Applications
Mandeep Singh, Alexander Strawn, Timothy Dinnan, and Naser Akroof
(Advisor: Dr.Rajani Muraleedharan)

Oral Session C: Mechanical Engineering Senior Design I **Room: Pioneer-245**

Presentations are 30 minutes each, starting at 1:00 p.m. (see Pages 17-18 for abstracts)

M01. Huhtamaki Plastics Hand-Held Lid Counter
Hussain Alsheyoukh, Taylor Hunter, Ara Szczepaniak, and Chase Szostak
(Advisor: Dr. Brooks Byam)

M02. Nexteer Downforce Durability Test Stand
Kent Schomaker, Gage Kienitz, Zach Davison, and David Kipfmiller
(Advisor: Dr. Brooks Byam)

M03. TDI Bearing Subassembly Fixtures
Aaron O'Neil, Nick Fox, Patrick Stefaniak, and Jacob Heminger
(Advisor: Dr. Robert Tuttle)

M04. The Fab Shop Removable Floating Dock
Wade Gelhaus, Andrew Vogel, Nathan Neubecker, and Akram Alsheyoukh
(Advisor: Dr. Brooks Byam)

M05. Duro-Last PVC Rib Welder
Kyle Boensch, Josh Dornseifer, Cory Harris, Samuel Quinn
(Advisor: Dr. Thomas Mahank)

Oral Session D: Mechanical Engineering Senior Design II **Room: Pioneer-247**

Presentations are 30 minutes each, starting at 1:00 p.m. (see Pages 18-19 for abstracts)

M06. Nexteer RCR NASCAR EPS
Alex Fullerton and Ryan Whitman
(Advisor: Dr. Brooks Byam)

M07. SVSU Golf Tilting Hitting Pad
Trent Goerge, Joey Southgate, and Teng Huang
(Advisor: Dr. Brooks Byam)

M08. Dow Corning Corporation Coupling Fluid Evaluation Apparatus
Carley Leinberger, Jacob Penkala, and Romain Gerard
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M09. Kremin, Inc. Advant-EDGE Offline Wheel Dressing Machine
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