SCIENCE & ENGINEERING SYMPOSIUM

Pioneer Hall

Friday, April 22nd, 2016 • 8:30 a.m. - 4:30 p.m.

SVSU

SVSU 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
9:00 a.m.	**Opening Remarks** Dr. Frank Hall Dean, College of SE&T	Science East-204
9:05 a.m.	**Keynote Lecture** Dr. David Gallo Lamont-Doherty Earth Observatory Columbia University	Science East-204
10:00 a.m.	**Poster Session**	Pioneer First Floor
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12:00 p.m.	**Lunch**	Pioneer First Floor
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	B. Electrical Engineering	Pioneer-240
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Keynote Lecture

TBA

Speaker: Dr. David Gallo
Lamont-Doherty Earth Observatory, Columbia University
Ocean Explorer, Advocate and Educator

Dr. Gallo has been a frequent invitee to give talks at TED (Ideas Worth Spreading: see link below) on new frontiers in Ocean Science, a realm for which we have only explored 3%, and, in fact, his TED talk ranks in the top 20 of viewed TED talks with more than 12,600,000 viewers! He is famous for finding the remains of Air France Flight 447 in the South Atlantic and has been interviewed on several cable news and other networks to talk about how we search for debris in the deep ocean.

TED Talk: https://www.ted.com/talks/david_gallo_shows_underwater_astonishments

Biology Posters

B01. Investigating the ultrastructural cardiotoxic effects of PAHs in the early life stages of rainbow trout (*Oncorhynchus mykiss*)
Kelsey Ferla (Advisor: Dr. Jay Scott)

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants that cause embryo-larval toxicity in fish, known as blue sac disease. The characteristic deformities observed with blue sac disease include pericardial and yolk sac edema, cardiovascular dysfunction, spinal deformities, and fin rot. PAH toxicity appears to be targeted on the cardiovascular system, as various congeners of PAHs are known to produce changes in cardiac morphology and disrupt cardiac function (e.g., produce arrhythmias). The signs of toxicity have been well-described; however, the mechanisms are not well-understood. Thus, we are investigating whether the underlying cause of PAH-induced toxicity may be due to ultrastructural changes in cardiac tissue. Using transmission electron microscopy, cardiac tissue from rainbow trout larvae exposed to retene (7-isopropyl-1-methylphenanthrene), phenanthrene, and pyrene will be examined for signs of ultrastructural toxicity, including: altered sarcomere structure and arrangement, abnormal intercalated discs, vacuolization, concentration of glycogen, and mitochondrial damage. This research is in collaboration with Dr. Eeva-Riikka Vehniäinen at the University of Jyväskylä, Finland.

B02. Investigating the role of serum-derived factors in "inflammaging" using bone marrow-derived macrophages
Kristen Loesel (Advisor: Dr. Jay Scott)

Chronic inflammation, termed "inflammaging," is a long-term low grade inflammation that increases with age and leads to many destructive diseases states, including cardiovascular disease. For this reason, it is imperative that we further our understanding of the complex pathways involved in the inflammatory response. Using the responses in bone marrow-derived macrophages (BMMs), we are first testing the age-related changes in inflammatory signaling caused by factors circulating in the blood, and then we will be working to identify the genes that are closely associated with inflammation. BMMs, which secrete signaling proteins called cytokines (e.g., IL-6, TNFα, CRP), provide a good marker for systemic inflammation and can highlight inflammatory signaling pathways induced by factors circulating in blood. Our preliminary data suggested that the serum from blood of aged mice induces a greater level of inflammatory signaling than that of young mice.

B03. Postglacial dispersal of smallmouth bass into mid-Michigan rivers
Jarrett Page, Katie Priest, and Meagan McNinch-Stapish (Advisor: D. Cal Borden)

Michigan was covered by a glacial ice sheet 15,000 years ago. Fish accessed drainage outlets of glacial lakes created by the melted ice front. During the melting of this ice front, the Saginaw Bay and Grand River were joined, establishing a temporary corridor for smallmouth bass to disperse into Michigan. Smallmouth bass are in all major river systems throughout Michigan and the Great Lakes, but accessed these waters from different glacial refugia. Our hypothesis is that smallmouth bass in Saginaw Bay river systems originated from the Illinois River Basin. To test this geological hypothesis, we used mitochondrial DNA markers to compare Michigan smallmouth bass with smallmouth bass in adjacent waterways to identify their origin.

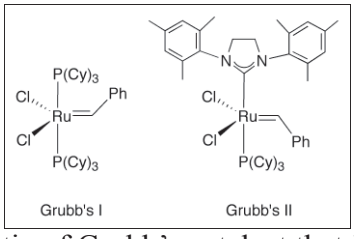
Chemistry Research Posters

C01. Synthesis, characterization, electrtochemisty, and spectroelectrochemistry of iron-salophen-hydroxamate complexes
Brad Ross and Taylor Syring (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 about 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 biomolecular models. The emphasis of this work focuses on understanding their redox behavior using electrochemical and spectroelectrochemical methods.

C02. Electrochemical investigation of Grubb's catalysts and their analogues utilizing cyclic voltammetry
Danielle Duranczyk and Mohammad A. Almughalaq (Advisor: Dr. Adam Warhausen)

The complexes benzylidene-bis(tricyclohexylphosphine)-dichlororuthenium (Grubbs's I) and [1,3-bis-(2,4,6-trimethylphenyl)-2-imidazolidinylidene]dichloro(phenylmethylene)(tricyclohexylphosphine)ruthenium (Grubb's II) are very well known and extensively studied complex. This is due to the wide range of reactions that it can be involved in.



This research focuses on a characteristic of Grubb's catalyst that is lacking from current literature, more specifically, the redox properties of neutral Ru Grubb's catalyst and analogues, the synthesis and isolation of the catioinic Ru complexes, and the reactivity of the cationic Ru complexes which will be isolated from chemical oxidation reactions. All redox properties will be examined using cyclic voltammetry techniques. The reactivity studies could lead to a new class of catalysts.

C03. Electrochemical investigation of tris(triphenylphosphine)rhodium(I) chloride and its analogues utilizing cyclic voltammetry
Becky Calangelo and Jacob Turner (Advisor: Dr. Adam Warhausen)

The complex tris(triphenylphosphine)rhodium(I) chloride is a well-known and extensively studied complex. It is known for the wide range of reactions that it can be involved in; most notably it catalyzes the hydrogenation of dienes to alkanes. An area of interest that lacks in current literature are the redox properties of tris(triphenylphosphine)rhodium(I) chloride and its analogues. Our focus is to expand the knowledge of these complexes, more specifically, with respect to their first oxidation potential. Our group set out to investigate the electrochemical, and spectroelectrochemical properties of this complex as well as its analogues. The redox properties of these complexes have been examined utilizing cyclic voltammetry (CV) techniques. The extensive CV experimentation includes the utilization of screen printed platinum and glassy carbon disk electrodes, as well as varying temperatures.

C04. Synthesis of Dianthin G, a Peptide that Promotes the Formation of Osteoblasts
Kathlyn Underwood and Nick Toupin (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.

C05. Synthesis of Stylissamide X
Kathy Warrick (Advisor: Dr. Jennifer Chaytor)

Many of the conventional cancer treatments used now have serious disadvantages including side effects that result from high toxicity to healthy tissues. Peptides are promising therapeutic agents because of their high specificity with lower toxicity to normal tissues. Currently, there are 60 approved peptide drugs in the market that work by altering angiogenesis, protein-protein interactions, gene expression, or signal transduction pathways. Specifically, cyclic peptides have useful properties including metabolic stability and restricted conformations, making them appealing pharmaceutical agents. The cyclic peptide known as Stylissamide X has the potential for application as a cell migration inhibitor. Stylissamide X was originally isolated from an Indonesian marine sponge and was shown to inhibit the migration of HeLa cells. Our goal was to develop a method of synthesizing Stylissamide X, due to the limited availability of the naturally occurring compound. The compound was synthesized using two methods of solid-phase peptide synthesis that differed with the starting resin used and the order of the linear peptide synthesis. The product will be isolated and the structure will be verified using high-performance liquid chromatography and mass spectrometry. In addition, three analogs will be synthesized by replacing each proline residue with a valine. Due to the rigid structure of proline, it is believed that this will affect the activity of the peptide. Testing of the biological activity of the compounds will be done to confirm that the proposed structure exhibits the same properties as the naturally occurring substance and to determine any changes in activity that the analogs may have.

C06. Synthesis of β-D-Glucose Derivatives as Possible Inhibitors for Intestinal Glucose Absorption
Bryant Pero (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 therapy. 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 evaluated for purity. Once they are fully purified and characterized, these compounds will be evaluated for alpha-glucosidase inhibiting ability. Spectroscopic results

showed that the compounds were synthesized with the expected peaks present, but had a large amount of impurities in the sample. The lack of purification was likely due to poor flash chromatography results. Further attempts led to a single purified product that will be fully characterized. A previously known compound was synthesized as a positive control that displays alpha-glucosidase inhibition. The synthesis, purification, and characterization of these compounds will be discussed in this presentation.

C07. Synthesis and Characterization of Carboxylated CdSe/ZnS and CdTe/ZnS Quantum Dots

Carlye Rehmann (Advisor: Dr. Kyle Cissell)

Quantum dots (QDs) are small, luminescent nanocrystals often employed as labels for biochemical applications. Due to the high cost of commercial QDs, it is necessary to synthesize quantum dots in-house at SVSU. To this end, CdSe/ZnS and CdTe/ZnS core/shell QDs have been synthesized and characterized using UV-Vis absorbance and fluorescence spectroscopy, and further modified with a carboxylic acid moiety. QDs of multiple different colors from a single excitation wavelength have been synthesized, displaying that multiple labels can be employed simultaneously. To synthesize the QDs, CdO and either Se or Te powder were dissolved and mixed in octadecene and oleic acid with tributylphosphine as a capping ligand. Upon synthesis of the core, the ZnS shell was added with hexamethyldisilathiane and diethylzinc precursors to form a stable, CdSe/ZnS or CdTe/ZnS core-shell QD. In order to employ the QDs in biological applications for nucleic acid detection, the QDs were modified with mercaptoacetic acid, resulting in a surface carboxylic acid moiety tethered to the QDs via a disulfide linkage. To achieve this modification, the CdSe/ZnS QDs were mixed at a high pH (>12) with a solution of methanol and mercaptoacetic acid. The synthesis method presented here will be employed to mass produce QDs to be conjugated to nucleic acids for biomarker detection assays.

C08. Optimization of a Cellular Phone-Based Image Acquisition Method for Nitrate/Nitrite Paper-Based Fluidic Devices

Zachary Velasco and Jackie Luthardt (Advisor: Dr. Kyle Cissell)

In order to assess the health of an aquatic ecosystem, nutrient levels such as nitrogen and phosphorus are often measured. Nitrite and nitrate are two of the most common chemical forms measured for nitrogen. To facilitate rapid, simple testing for nitrite and nitrate, paper-based fluidic devices were developed by our research group which form a magenta color in the presence of nitrate or nitrite when mixed with Griess reagents (sulfanilamide and N-(1-naphthylethylenediamine dihydrochloride)) in phosphoric acid. The presented research focuses on two optimization approaches to improve the performance of the device: image acquisition and device optimization. To these ends, we have compared cellular phone cameras to a dedicated imager for image acquisition and have found that cellular phone cameras can be a viable option to expensive laboratory imagers. The most important parameters in optimizing cellular phone image acquisitions for semi-quantitative analysis using ImageJ analysis software were found to be consistent lighting and consistent distance between the camera and device. By placing LED lighting inside a white box with a stage for the cellular phone camera, these parameters were met. In order to optimize the device, we performed a 3^3 factorial design in which the Griess reagents and phosphoric acid concentrations were varied. In addition, device channel length and width were varied, along with different mixing approaches. Data generated from the optimization will be presented along with a second generation prototype of the SVSU nitrite test card that includes a QR code for tracking.

C09. Use of rapid bacteria testing using qPCR for source tracking in the Saginaw Bay Watershed

Emily Greeson (Advisor: Dr. Tami Sivy)

Current testing methods to measure microbial contamination have relied on overnight incubation in order to reach a minimal detection level for potentially harmful bacteria. These fecal indicator bacteria, particularly *E. coli*, have shown a strong correlation with contact-associated illnesses, and this lag-time between sampling and results could result in human contact with contaminated water. During the summer of 2015, our lab continued to explore whether there is any correlation between fecal indicator bacteria levels as measured by the standard Colilert method versus EPA Method C: *Escherichia coli* in Water by TaqMan Quantitative Polymerase Chain Reaction (qPCR). Our testing sites expanded, with seventeen samples collected from Isabella County, seven samples from Iosco County, and three samples from Bay County. The new method has proven to be rapid, with results within 3-4 hours of sampling, thus it eliminates the extended incubation time of standard testing. However, it is complicated and requires specialized equipment and researcher expertise. Our objective has been to use the rapid bacteria method to identify the source of the bacteria and then quantify the contamination. With further refining of the method and expanded testing we are nearing this goal.

SVSU Chemistry Club Poster

C10. An Overview of Green Chemistry

Humans have always been striving to improve crop protection, commercial products, and medicines. However, until the 1950s 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 toxics 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. One example was their chemistry demonstration, during the Midland ACS Fall Scientific Meeting, that used chlorine kits to compare a chlorinated cleaning product to a similar "green" product which uses no chlorine. Another example was their trip to Niagara Falls in April 2016 to look at a "green" form of energy at the hydroelectric power plant in New York. 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. Capsaicin isolation and growth inhibition of *Bacillus subtillus*

Stephen Holihan, Bryant Pero, and Nicholas Toupin (Advisor: Dr. Tami Sivy)

Chili peppers, members of the nightshade family in the genus *Capsicum*, are characterized by the presence of the secondary metabolite capsaicin in their fruit. Capsaicin is a defense compound that simulates a burning sensation in predatory threats to the plant when in contact. The compound has also been studied as a growth inhibitor in some species of bacteria. Species of peppers vary in the amount of capsaicin present, which is represented by assigned values on the Scoville Heat scale. In this experiment, several peppers with varying Scoville heat units underwent Soxhlet extraction to remove the capsaicinoids present in the pepper. The capsaicinoids were purified via flash chromatography to yield pure capsaicin. A proportional amount of the capsaicin yield from each pepper is to be incorporated into their respective growth plates and broth tubes of the bacteria *Bacillus subtillus*. After a period of 24 hours the bacteria will be observed for inhibitory effects via decreased presence of colonies and spectrophotometric analysis. We hypothesize that as the peppers increase in Scoville heat units, the bacterial growth will be further inhibited, due to an increased amount of capsaicin present.

C12. Effect of Circadian Rhythms on Luciferase Concentration in *P. fusiformis*

Tayler Jones and Jacob Wilson (Advisor: Dr. Tami Sivy)

Pyrocystis fusiformis is a marine dinoflagellate that has the ability to bioluminesce. This species can be easily grown and observed in a laboratory setting. This bioluminescence is a result of the enzymatic activity of luciferase on its substrate, luciferin. The normal circadian rhythm of this species is a 12 hour day/night cycle. The hypothesis is that by changing the day/night cycle to 18 hours of day and 6 hours of night, there will be a higher concentration of luciferase. It is rationalized that this would be a result of more photosynthesized energy to produce luciferase. Three cultures were started on a 12 hour day night cycle for a week. Luciferin was extracted from one of the cultures via boiling in a phosphate buffer. Luciferase was extracted, purified, and then quantified with a Bradford Assay, using the second culture. The third culture was switched to a 18 hour day and 6 hour night cycle and allowed to adjust for a week. The extraction, purification and quantification were repeated for this culture as well. These luciferase samples were then reacted with luciferin inside a fluorometer as an additional measure of concentration. It is expected that the results obtained will reflect the hypothesis. If successful, this could reveal optimal growing conditions for maximum production of luciferase from *P. fusiformis*.

C13. Miraculin: Mode of Action

Conrad Carroll and Phillip Markey (Advisor: Dr. Tami Sivy)

Miraculin is a protein found in the miracle berry, a fruit native to Western Africa. This protein has been shown to alter sour tastes to a sweet sensation, however the mechanism is not well understood. We hypothesize that this change in taste is due to the variable binding affinity of miraculin to taste receptors under differing pH conditions. To test this hypothesis, we first isolated Taste 1 Receptor 2, Taste 1 Receptor 3, and Taste 2 Receptor 1 proteins from a beef tongue. The protein was then incubated with miraculin in varying pH conditions of pH 2.7 and pH 7.0. To test the binding of miraculin, the samples were run on an SDS PAGE gel for analysis. We expect to see greater binding of miraculin to taste receptors that are responsible for sour tastes under low pH conditions than neutral pH conditions.

C14. UTIs and antibiotic-resistant bacterial organism
MacKenzie Allen and Chris Sabal (Advisor: Dr. Tami Sivy)

Revertants are bacteria that grow even in the presence of an antibiotic due to a developed resistance. This experiment looked specifically at *E. coli* grown in the presence of a common UTI drug, Norfloxacin. Literature suggested that the developed resistance is a result of point mutations within the *gyrA* and *gyrB* genes. These mutations lower the binding affinity for Norfloxacin on both DNA gyrase subunits, effectively resisting the drug's effects. Bacteria was grown in both liquid and solid agar media with varying concentration of Norfloxacin ranging from 0-1000 ppm. Growth was monitored by absorbance readings for liquid media and sight for solid media. In order to test whether cells were actually resistant, electrophoresis was run on each sample. Once revertants were confirmed, PCR was used to generate templates of the *gyrA* so that DNA sequencing could be performed. The liquid media did not show promising results, with cell concentrations dropping immediately in the samples with no significant rise in absorbance following it. The solid media did give promising results, so further analysis was pursued from those samples. The electrophoresis showed a single solid band for the 1000 ppm sample, with more of a smear appearing for the other samples and the control. The results of the sequencing showed point mutations in the Ser-83 and Asp-87 to Leu and Asn respectively within the DNA gyrase A subunit. The result coincides with what was previously found for Norfloxacin resistant *E. coli,* suggesting that the mechanism of resistance has not changed over time.

C15. Analysis of Proton Pump Inhibition from Over the Counter Heartburn Treatments
Emily Greeson and Jessica Martin (Advisor: Dr. Tami Sivy)

Over the counter heartburn treatments can be organized into three main drug classes based on their mechanism of action. Antacids neutralize stomach acid and are the fastest acting of the heartburn treatments, lasting for 1-2 hours. The second class is H2 antagonists, which reduce or inhibit the secretion of gastric acid by binding competitively with histamine to H2 receptors on cell membranes. They take longer to start working, but last for 6-10 hours. The third group of drugs, proton pump inhibitors (PPIs), irreversibly block the H+/K+ ATPase pump in gastric cells, which ultimately inhibits acid secretion. They reduce acid secretion up to 99% and last for 24 hours. The purpose of this project is to study the effects that the three classes of drugs have on both enzymatic activity and acidity. The following drugs were used to represent each of the classes: calcium carbonate (antacid), famotidine (H2 antagonist), esomeprazole, iansoprazole, and omeprazole (PPIs). A Bradford assay was performed using a 10% gastric mucosal tissue and saline homogenate to determine the degree of ATPase inhibition for each drug. Additionally, pH changes were measured after addition of the drugs to determine the degree of acid neutralization. It is predicted that the pH will maintain constant when the H2 antagonist and PPI drugs are used. However, the pH solution will increase with the addition of the antacid. The proton pump inhibitors will decrease enzymatic activity of the pump, therefore blocking acid production. H2 antagonists and antacids will not affect the enzymatic activity.

C16. Mini Hydrogen Fuel Cell Hot-Rod (Can a hydrogen fuel cell really produce free, clean energy?)
Danielle Dodge (Advisor: Dr. David S. Karpovich)

The hydrogen fuel cell is constantly being promoted as a free energy and zero emission alternative to gasoline for use in passenger vehicles. This laboratory experiment provides students the experience to see how hydrogen fuel cells work, how they may appear to be a source of free or clean energy, and how this myth is disproved. The laboratory procedure was adapted from a hydrogen fuel cell laboratory that was developed at Brown University by faculty and undergraduate students in 2014. In this experiment, a small voltage from a battery charger or solar panel is used to initiate the electrolysis of water into hydrogen and oxygen and then split the hydrogen into protons and electrons via a proton exchange membrane (PEM) fuel cell. The hydrogen ions produced will pass through the membrane to form water. The remaining electrons flow through an external circuit which generates electricity to power the car. A circuit board and mini cell phone vibrator has been adapted to fit the car to enable students to make electrical voltage measurements to determine open circuit potential, maximum work of the fuel cell and current. This laboratory allows students to learn hands-on about the electrochemistry of fuel-cells. Incorporating these concepts into a moving car helps students to better understand electrical concepts and to capture the interest of students who may not already be interested in STEM careers.

C17. Wind/Solar Energy- A Greener SVSU
Jeffrey Mitchell (Advisor: Dr. David S. Karpovich)

SVSU has been given a very valuable asset in promoting science in high school students. The SVSU mobile lab donated by Dow Chemical has been outfitted with an array of scientific materials for students to learn hands on *in situ*. To aid in their discovery we have incorporated some improvements that will reduce greenhouse emissions, provide sustainable energy sources and give increased learning capacity to the students. The addition of a 400 watt wind turbine and dual solar panels have the potential to reduce the need for the gas generator to provide power to the lab equipment. Also, these additions will provide a learning tool for students to experiment with power output, voltage regulation and amperage calculations. These renewable and sustainable energy sources will provide lab lighting as well. Wind and Solar energy have become important sources of green energy that will help to reduce the emission of greenhouse gases as well as harmful particulate matter, making the SVSU mobile lab a Greener way to learn.

C18. How do we harness the full power of the wind?
Sarah Kulhanek (Advisor: Dr. David S. Karpovich)

Wind energy can only be harnessed at its full potential when it is done with the proper techniques and knowledge. This experiment comes in three phases. The first will be to develop the understanding of what design thought goes into making a windmill propeller. In order to do this different blade angles, sizes, and shapes will be tested. The second phase is to develop an understanding of how wind speed plays a role in the energy that can be harnessed. This will be measured using the most efficient set of parameters from phase one and testing them with two different fan speeds. The third and final phase is to develop an understanding of how much energy is actually be generated. This is done by comparing the voltages that have been measured in phases one and two against that needed to power a flashlight bulb.

C19. Microbial Fuel Cells: From Organic Waste to Electricity
Madison Rase (Advisor: Dr. David S. Karpovich)

A microbial fuel cell, or MFC, is a fuel cell that harnesses the naturally occurring electrochemical processes of anaerobic bacteria breaking down organic waste materials as food in order to generate electricity. For this project, sludge was collected from the Kawkawlin River, Saginaw Bay, and a private pond to provide a source of organic waste and bacteria, and the fuel cells were constructed from everyday materials. The electrical output from a fuel cell using each source material will be compared, and their ability to power a small light bulb will be tested. An oxidation reaction takes place in the sludge filled container, where the bacteria consume glucose and water to yield carbon dioxide, hydrogen ions, and electrons. The positive hydrogen ions travel across the salt bridge and the electrons travel through the copper wire, creating a current, to the second container. A reduction reaction occurs in the second container, where the hydrogen ions, electrons, and oxygen combine to form water, completing the redox reaction. The lifetime of the MFC is only limited by the lifetime of the anaerobic bacteria and the supply of organic waste. While still a relatively new technology, further developments could make the microbial fuel cell a viable option for energy generation in waste treatment plants.

Mathematical Sciences Poster

MS01. A Model for Superior Risk-Adjusted Stock Market Returns
Juan Sancen (Advisor: Prof. Curtis Grosse)

The purpose of this project is to research and test growth investment strategies that generate superior risk-adjusted returns. A wide variety of statistical procedures have been applied including sound techniques of selecting and analyzing data. The primary purpose of the research is not to achieve individual wealth but rather to use an application of the model for generating funds for SVSU student scholarships. The overall value changes for the model are mostly independent of the broader stock market movements. Specifically, the stock selection process uses a hedge fund long/short strategy. It is not based on the popular “day-trading” or “buy-and-hold” approaches. The model does not require a prediction of future market performance, since theoretically it should perform better than the S&P 500 benchmark in both a bull and bear market. Its market-neutral approach consists of buying 10 stocks long and shorting 10 other stocks in such a way that portfolio risk is minimized. The research project uses various sources and databases for stock selection. These stocks are evaluated for both fundamental and quantitative factors. The former highlights accounting criteria while the latter captures institutional demand for the stocks. While the results for an individual year may vary, the goal is risk-adjusted returns over time compared to the overall market. We use standard measures of risk to assess the results. The main model has been able to outperform the S&P 500 11.02% to 9.76% annually and has consistently achieved a higher Sharpe ratio of 3.7 to 2.07 over the S&P 500.

Electrical Engineering Posters

E01. Home Energy Distribution System (HEDS)
Faisal Alturaiki, Travis Depcinski, Bozhong Xue, and Lukacs Zimmerman
(Advisor: Dr. Rajani Muraleedharan)

Renewable energy is available in abundance, and this project aims to utilize home power generation/storage units in an automatically controlled manner with minimal human (homeowner) interference. Although, many households have either (a) back-up generation/storage units or alternative energy devices for their house, or (b) access to the grid, an item that appears to be lacking in home energy generation is a universal controller. The controller will be capable of handling any type of backup or alternative sources of power generation and the grid. The proposed Home Energy Distribution System (HEDS) promises to effectively minimize grid consumption at any residence, while ensuring uninterruptable power during grid outage condition. The HEDS power generation sources includes gasoline/diesel generators, wind powered generators, solar photovoltaic cells, battery storage units and any future generation sources available at a residence.

E02. Long Range Load Allocation Planning
Jordan Holbrook and Matthew Koepke (Advisor: Dr. Rajani Muraleedharan)

The goal of this project is to determine the load growth and best economic plan for a low voltage distribution system. Possible upgrades to the circuits will be examined, which will allow the substation to accommodate the increased load predicted over the next ten years. All Consumers Energy distribution circuits are modeled on a program called CYME. CYME is able to simulate projected load growth on a distribution circuit and then display overload. Overloaded devices can include transformers, capacitors, reclosers, isolators, regulators, fuses, and conductors. The first step in this project is to research the substation and surrounding area assigned. Field verifying the distribution system, meeting with the system owner, and making the corrections to the model is pivotal to an accurate study. This project involves estimating increased load on a circuit based on the projected growth of industry, business, and residences in the area. The increased load on the circuit will be simulated using CYME. Based on the simulation, three solutions will be proposed. The final recommendation will be determined based on a cost-benefit analysis.

E03. ECU Test Stand
Weston Appold, Kyle Middaugh, and Clifton Oaks (Advisor: Dr. Rajani Muraleedharan)

The Electronic Control Unit (ECU) is the computer that controls the engine on all modern automobiles. This project will develop a testing solution to comprehensively verify correct operation and be used to tune the ECU to run at optimum efficiency. In place of an actual engine, National Instruments hardware and software will be used to simulate all the parameters that an engine would need to operate. The ECU manufacture's software will be used to monitor the ECU's operation throughout the test. Once verification is achieved the simulated engine will be run at similar to real world conditions to see what areas of the ECU need to be improved. Engine faults will also be simulated to see how the ECU reacts to problems it may face in everyday operation.

E04. SENT Communication Emulator

Timothy Maxwell and Lucas Ritter (Advisor: Dr. Rajani Muraleedharan)

In order to fully test any of the systems at Halla Mechatronics, a large test stand or vehicle are required. Due to this, the need has arisen for an emulator and necessary hardware in order to simulate the environment that is required in order to fully test the steering systems in a more convenient manner. This will increase the speed and accuracy of certain tests, lower the cost of testing, and increase productivity. This device will need to utilize the SENT protocol, a relatively new communications standard, which does not yet have the widely available hardware and software to perform precise simulation. To Emulate the in vehicle torque SENT messages we will be using a FPGA board or Microcontroller to program different messages and possibly even fault injection to fully test our companies EPS hardware and software.

E05. LED Swimming Pace Rope

Jason Ugartechea (Advisor: Dr. Rajani Muraleedharan)

In the world of athletics any type of distance sport requires the ability for the athlete to pace himself in order track their progress based on metabolism. For runners, cyclists, and other distance athletes this is not a problem as they can monitor their progress by a watch. However for the swimmer, this is not feasible as an individual cannot stop to check his or her time in order to see if they are keeping up with a set pace. The solution comes in the form of an LED light rope that will be submerged at the bottom of the pool. This light rope will span the length of the pool and will have a "running" LED light that will be used as an indicator for the swimmer where their position in the lane should be in order to keep a pre-determined pace. The pacing light uses a micro controller that will take the inputs of the user of distance to be swam as well as time in which the swimmer is to finish in order to project the desired pace into a physical representation on the pool floor for an easy to use indicator for the swimmer to follow.

E06. P.A.N.C.A.K.E.

Shane Oberloier (Advisor: Dr.Rajani Muraleedharan)

As the field of Artificial Intelligence grows, it is becoming a necessity for quick and efficient processing capability. One common artificial intelligence method used is the Artificial Neural Network (ANN). ANNs can be very quick, as well as capable of handling a large amount of input data. This process can be expedited by doing calculations via digital logic rather than using a general microprocessor. In this project, the digital logic will be implemented in VLSI, for a heightened speed and energy efficiency. Since the ANN is constructed in hardware, it will also be capable of massive parallel processing, a feature that is lost in software implementation. The system will be designed as a configurable tool fitted for all purposes that will require an artificial intelligence solution. The benchmark problem of weather forecasting will also be tested for proof of concept.

E07. Amigo Mobility Solar-Assisted POV

Jassim Alhelal, Saad Alzoabi, Thomas Miller, and Brandon Peter
(Advisor: Dr. Rajani Muraleedharan)

In today's constantly evolving society, great technological advances allow for energy to be harnessed from a multitude of sources – with solar energy being one of the most abundant. As energy extraction efficiencies keep rising, so does the feasibility of implementing these devices into small-scale applications. The goal of this project is to combine solar technology with an Amigo Mobility power-operated vehicle (POV) to significantly increase the runtime of the vehicle while keeping the profit margins realistic. The developed solar powered kit features two 50W flexible solar panels that charge the systems 12V batteries independently through separate pulse-width modulated (PWM) solar charge controllers, allowing for maximum electrical efficiency. To avoid electrical oscillations between the two chargers, the POV will feature automatic switching between the two charge types. In addition, a versatile USB port capable of charging any type of phone or tablet has been implemented as an added convenience to the rider. In order to be appealing to the customer, the roof-mounted solar panels act as a sun shade to the rider all the while giving adequate room for persons of any height. The mounting system as a whole has been designed for maximum rigidity and durability. It has the ability to be quickly folded and removed, allowing the user to place the system on another cart or into storage in a more compact manner. All in all, the solar powered kit has been implemented in an aesthetically pleasing manner that maintains the stability of the POV for rider safety and meets the project requirements set by Amigo Mobility International.

E08. Practical Fire Equipment Scene Light

Bryce Gainer, Matthew Leser, Samuel Nelson, and Cameron Tompkins
(Advisor: Dr. Rajani Muraleedharan)

Firefighting is a profession that demands high visibility in extreme conditions. Current scene lights on the market can meet the need for high visibility but can often times make the job difficult due to their excessive bulk. The team at Practical Fire Equipment (PFE) L.L.C. have therefor proposed this project to design a new scene light that will provide ample illumination, a long run time and ease of use for these fire fighters. The scene light has the capability to produce a luminous output between 4,000 and 24,000lm with a minimum run time of 20 minutes powered by its 16 rechargeable AA batteries. The detachable 20 ft. long GFI protected extension cord allows for prolonged use on the field while simultaneously charging the unit. With the help of its on board controller, switching from battery to outlet power is as simple as plugging it in. Operation of the light has been made easy through the use of a two button system. The first button turns the light on/off and adjusts brightness, while the second button serves as a battery life indicator. Completion of this project was done using a three phase method including research, design and prototyping. These three phases were used to pick out components and design/test hardware circuits/software programs that would make this light possible. The projected outcome of this project is a high power, LED driven, mobile and versatile scene light that meets the specifications

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Mechanical Engineering Posters

M01. Small Square Bale Loading Attachment for Cook's Choice Produce LLC

Waheed Bahha, Brian Cook, and Caleb Palmer (Advisor: Dr. Brooks Byam)

Cook's Choice Produce LLC (CCP) is a family farm near Midland, MI owned by Leon Cook. The farm's largest operation is that of producing small square bales of hay and straw. CCP has identified a need to move stacks of bales that are dropped from a New Holland Stack wagon in a more efficient manner. In order to address this need a small square bale loading attachment that mounts to a telehandler (similar to front end loader) and moves 30 to 60 bales at a time is being designed. This loading attachment will address CCP's need by interfacing with CCP's current hay handling system while effectively reducing the overall loading and unloading time required to move the small square bales of hay and straw.

M02. Overnight Garage Car Wash

Cedric Daley, Mitch Delemeester, and Thomas Fayfer (Advisor: Dr. Thomas Mahank)

The design team has been tasked by Mr. Terry Duperon with inventing an autonomous, at home, garage car wash. The objective is to build a working prototype which demonstrates the concept and provides a platform for Mr. Duperon to build on in future iterations. Simplicity and safety are paramount, so the system has been chosen to be "no-touch". The car wash will apply multiple foam baths to the car, a post rinse, and a chemical drying agent. The prototype will be designed to clean the equivalent of a 2001 Mazda 626 over the course of 8 hours. Additionally, the prototype must cost no more than $2,000.

Certain parameters have been set by the design team which reflect the at home nature of this project. The system must fit within a typical garage space. Water will be provided by the home-owner at approximately 30 psi and 40°F, and the car wash will consume no more than 30 gallons per use. Soap, water, and drying agents will be applied by nozzles which travel around the car. The system will plug into a 120V standard wall socket and draw no more than 10 amps at any time. It will have over-spray protection and will rely on a garage drain for drainage. Finally, the system will remain quiet at under 60 dB during operation.

M03. The GRIPULL-Duro-Last
Anthony Brown, Lauren Moore, and Jeff Schalk
(Advisor: Dr. Brooks Byam)

Duro-Last Inc. is the world leader in custom prefabrication single ply vinyl roofing material. The GRIPull is an essential installation tool. It has many flaws and reoccurring failures. The objectives of the redesign are to: eliminate mechanical failures, lower manufacturing cost, and decrease installation time.

M04. Kukla Performance Electronically Actuated Motorcycle Kickstand
Derek Keim, Andrew Maschke, Tyler Mausolf, and Josh Wilson
(Advisor: Dr. Brooks Byam)

Kukla Performance of Bay City, Michigan had a need for an electronically-actuated motorcycle kickstand to market for sale. The product was sought to allow motorcycle riders to easily engage and disengage the kickstand regardless of rider ability or motorcycle ergonomics. To solve the problem, three kickstand concepts were developed and the best concept was chosen for production based on client, third party, and team input.

M05. Practical Fire Equipment Firefighting Scene Light
Shuhai Chen, Kyle Feeney, and Luke Walther
(Advisor: Dr. Brooks Byam)

The Practical Fire Equipment Scene Light is a light used to illuminate firefighting scenes. The light was designed to be portable, less bulky, more durable and have multiple purposes. The scene light is a new product for the company that is drastically different when compared to other products out on the market. The scene light has a temporary battery to power the light until the power supply is connected, giving firefighters more time with sufficient light. Given the light's size, it produces comparable light output when compared to current scene lights.

M06. B&P Process Independent Vertical Mixer Drive
Cody Megregian, Lucas Noleto, and Megan VanFleteren
(Advisor: Dr. Brooks Byam)

The vertical mixers designed by B&P have two blades, a fast-speed and a slow-speed blade. When the mixer is in use, these blades undergo three types of motion: rotational and two versions of planetary motion. The rotational motion describes each blade rotating about its own axis while the position within the mixing bowl remains constant. The first planetary motion describes the circulation of both blades around the mixing bowl. The second planetary motion describes the rotation of the fast-speed blade about the slow-speed blade. Because the second planetary motion is essentially a byproduct of the first, these two motions are considered one category of motion, called the planetary motion.

The current system has the capabilities to turn on or off all three motions at once. However, some products that are to be used in these mixers have high viscosities and require high energy inputs to begin mixing with the current system. The goal of this project is to redesign the current system to separate the rotational motion from the planetary motion in order to start only the rotational motion first, and then begin the planetary motion after the products have begun to mix. This redesign will require less energy input to mix products with high viscosities. This solution will improve the efficiency of mixing high viscosity fluids by reducing the possibility of blade deflection during the mixing process.

M07. Water-Jet Byproduct Dryer for Duro-Last Inc.
Joao Rafael de Paula, Caleb Samples, and Thomas Winne
(Advisor: Dr. Annamalai Pandian)

Duro-Last is concerned about their sustainability, and focuses on minimizing the waste produced from their processes. Currently all of the wet material is being sent to a landfill. The implemented system will reduce the environmental impact, as well as produce another source of revenue for Duro-Last. The Water-Jet Brick Dryer is being designed to recycle the byproduct being created by the Water Jet Cutting Machine. This product once dried can be sold or reused as a new product. The system will improve the byproduct removal from the water tank, dry the substance to the desired specification, and collect the dry material. A budget of $ 10,000 was established for the development of a drying system with a coupled collection system. The design was approved by client and faculty and it is now in the manufacturing and assembling phase.

M08. Wheelchair Docking System for School Bus
Ali Aljarody, Paul Bellegarde, Dalton O'Connor, and Eduardo Souza
(Advisor: Dr. Brooks Byam)

A Wheelchair Docking System for a School Bus was designed and built for Mr. Curt Tucker at TEAMTECH Motorsports Safety to reduce the amount of time it takes to secure a wheelchair occupant into place for transport. Compared to current systems, our system has fewer steps to secure the occupant while providing the proper strength, rigidity, and safety to meet safety standards of wheelchair transport. An added benefit to our wheelchair design is use of TEAMTECH's wide variety of racing seat selections and safety harnesses. Using TEAMTECH's equipment allows the occupant have added comfort while not compromising safety.

Saginaw Bay Environmental Science Institute Posters

ES01. *E. coli* Levels in Saginaw and Bay City Area Storm Drains During Fall 2015 – Winter 2016
Emily Short (Advisor: Dr. David Karpovich)

Escherichia coli levels in waterways are heavily monitored during the summer months because when the *E. coli* colony-forming units (CFU) count is too high, humans who come in contact with the water can become ill. This also leads to beach closures if the CFU count is above 300. *E. coli* CFU levels are very important to the public during the summer months because it affects both their recreational activities and their health. However, little is understood about the CFU levels of *E. coli* during the wintertime when bacteria productivity is hypothesized to be slowed due to cold water temperature. Additionally, little is known about *E. coli* levels in surface water in storm drains. This experiment explored *E. coli* levels during fall 2015 and winter of 2016 in storm drains that empty into the Saginaw River. There were nine sampling locations monitored. By monitoring the storm drains, there is potential to help track and source where *E. coli* is coming from, and see how much *E. coli* is being introduced into the Saginaw River from storm water in the Saginaw and Bay City areas.

ES02. Phosphate Adsorption to Soil upon Addition of Natural Soil Amendments
Katarina Keel (Advisor: Dr. David Karpovich)

The purpose of this study is to investigate the phosphate holding capacity of soil as well as soil amendments that may increase the anion holding capacity. Using sand as a base soil, the holding capacity can be compared when adding in various soil components such as organic matter and clay. Additionally, natural soil amendments such as gypsum (calcium sulfate) and lime (calcium carbonate) can be used to investigate if their addition can increase the phosphate holding capacity. It was found that gypsum increased adsorption capacity of phosphate most effectively while cellulose (organic matter) increased holding strength. This conclusion was confirmed by other research, yet there are many gaps in current research findings regarding gypsum's effectiveness contingent with soil variability. The second part of this study focuses on gypsum's effectiveness under a variety of soil parameters, including pH, organic matter content, texture of soil, and soluble reactive phosphate. Results indicate no reliable trends when plotting in 2D because of the amounts of variables at play within soils. 3D plotting was employed to determine correlations of variables versus the amount of soluble reactive phosphate (SRP) trapped by gypsum. Results indicate certain types of soils may benefit more from the addition of gypsum than others.

ES03. Phosphorus Transport through Agricultural Field Drainage Tiles

Justin Martin, Craig Coopersmith II, and Kathlyn Underwood
(Advisor: Dr. David Karpovich)

The Saginaw Bay Watershed is the largest watershed in Michigan and is nearly 8,700 square miles, consisting of 7,000 square miles of rivers and streams to which 1.4 million people call home. During the recent years, the Saginaw Bay has been classified as an Area of Concern (AOC) by the Environmental Protection Agency (EPA) due to environmental concerns. This project will determine whether subsurface runoff from field tiles is a contributing factor involved in phosphorus loading into Saginaw Bay. The data was derived from agricultural field drain tile runoff and its corresponding ditch water. Colorimetric methods were employed using a Hach DR 6000 spectrophotometer along with Hach TNT 843 phosphorus testing kits. Concentrations of total and soluble reactive phosphorus were compared to the recommended 0.015 mg/L value for the Saginaw Bay. Parameters such as soil composition, fertilizer application methods, and crop selection were also analyzed as variable in phosphorus transport through groundwater to field tiles. The results show that agricultural drainage tiles are a contributing factor in the source of phosphorus pollution to the Saginaw Bay Watershed.

ES04. Use of Naturally Occurring Minerals to Remove Phosphorus from the Saginaw Bay Watershed

Marissa Dobulis (Advisor: Dr. David Karpovich)

Naturally occurring minerals such as gypsum, limestone, and alum can used to remove phosphorus. This is necessary because high levels of phosphorus can lead to increased algae growth and eutrophication. The Saginaw Bay Watershed is known to have lower levels of dissolved oxygen and higher levels of nutrients than similar bodies of water. Lower levels of dissolved oxygen have decreased diversity of organisms in the area. The use of minerals to remove phosphorus has been done in tertiary water treatment (to levels of approximately 1.0 mg/L P), but not to reduce phosphorus in a watershed to healthy levels of below 0.015 mg/L. Alum, gypsum, and limestone were found to remove phosphorus but not in the expected stoichiometric ratio of 1:1 Al^{3+}:PO_4^{3-} or 3:2 Ca^{2+}:PO_4^{3-}. It was found that the most successful ratios were higher than 6:1 Al^{3+}:PO_4^{3-} or 5:1 Ca^{2+}:PO_4^{3-}, where about 90% of the phosphorus would be removed. Eventually these materials could be used to precipitate phosphorus from flowing water.

Oral Session A: Biology

Room: Pioneer-242

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

B01. Can crayfish distinguish between variable oxygen concentrations?

Alexandra N. Steele and Miranda L. Strasburg (Advisor: Dr. Arthur Martin)

Species inhabit a variety of aquatic habitats that can fluctuate between hypoxic and normoxic conditions throughout a season. Many aquatic species exhibit changes in behavior when exposed to hypoxic conditions. Crayfish have been shown to experience adverse physiological effects due to hypoxic waters, but little is known about crayfish's ability to exhibit a behavioral preference in the presence of variable oxygen concentrations. The purpose of this study was to analyze the responses of the invasive crayfish, *Orconectes rusticus*, when exposed to varying levels of oxygen. Animals were placed in a y-maze with each arm containing water of different oxygen concentrations, ranging from 2 to 8 mg O_2 l^{-1}. A current of 10 cm/sec was run through each arm. A series of three experimental scenarios were tested: 8 v. 2 mg O_2 l^{-1}, 8 v. 4 mg O_2 l^{-1}, and 8 v. 6 mg O_2 l^{-1}. A total of 25 trails were completed for each experimental setup. After each set of trials, data was analyzed based on initial arm choice, time spent in each arm, and time spent at the most upstream position. Data has been quantified and analyzed to assess if crayfish exhibit a preference for environments with higher O_2 concentrations.

B02. Environmental Effects on Crayfish Shelter Preference

Brady Nitschmann (Advisor: Dr. Arthur Martin)

Shelters are necessary in order for many animals to survive. It is well known that animals often use shelters for reasons such as protection, breeding, and territoriality. In natural settings it has been shown that crayfish use shelters for protection from predators and conspecifics. However, it is not well understood what types of shelter preference crayfish exhibit under these different environmental pressures. In this study crayfish were subjected to predators or conspecifics and observed on whether or not these factors affect the shelter preference they exhibit. A 152cm (diameter) circular experimental tank, filled with water up to 61 cm, was used as the arena for this project. Submerged in the center of the tank was a Plexiglas test chamber (35.6 x 35.6 x 20.3 cm). An experimental crayfish was placed in the test chamber that consisted of four different shelter types, each of which had a different number of openings. Focal crayfish placed in test chamber were tested in three different behavioral scenarios: 1) no external stimulus (control), 2) a competitor crayfish as the external stimulus, and 3) a small mouth bass acting as a predator. Each scenario consisted of 15 trials that were recorded for 24 hours and then analyzed by observing what shelter the crayfish chose and the duration in which it stayed there. The goal of this experiment is to illustrate that different environmental factors may cause a crayfish to exhibit a different preference based on shelter type.

B03. DNA Fingerprinting of Charity Island Phragmites (*Phragmites australis*)

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 and is dramatically affecting the tourist trade on the island. In partnership with Huron Pines, an eradication program is currently underway. Herbicide spraying on the island began this fall and will likely continue for the next few years.

In order to assess genetic variation, population substructure and the genetic effects of eradication efforts, a DNA fingerprinting survey was begun. Samples were taken from surrounding populations on Saginaw Bay and extensive sampling of Charity Island was conducted prior to herbicide treatment. The survey will be repeated next year in order to determine the susceptibility of particular clones to herbicide treatment. The data should also allow for the determination of modes of recruitment in post treatment populations. These results will have important implications for treatment strategies in this and other localities.

B04. DNA fingerprinting of zebra mussels (*Dreissena polymorpha*) from Higgins Lake, Michigan

Samantha Leslie (Advisor: Dr. David Stanton)

Zebra mussels are an invasive species introduced into the Great Lakes from Europe in 1986. Since then, they have spread aggressively throughout the United States and they have had a dramatic effect on water quality and biodiversity. Genetic studies of invasive species are critical in determining the viability and potential ecological impact of these populations. Samples were collected from Higgins Lake over the past eight years and from several populations in Lake Michigan and Lake Huron. We tracked changes in genetic composition over time and determined possible source populations for migrants. DNA was extracted from frozen samples and PCR was performed in order to amplify polymorphic fingerprint loci. The PCR products were analyzed using the CEQ 8000 automated DNA analysis system from Beckman-Coulter. Fragments sizes were determined and genotypes were identified using internal reference standards. The parameters investigated included number of alleles, observed (Ho) and expected (He) heterozygosity, population substructure (FST) and genetic distances (D) between populations. The results show that Higgins Lake has most likely received migrants from many different locations, including distant sources and that gene flow continues to occur. Human transport is undoubtedly responsible for the pattern observed.

B05. 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 undergone significant variation in size in recent years. In order to properly manage this population, genetic information is required. We obtained fin clips from walleye captured in Saginaw Bay in the last two summers by trolling and in the winter by ice fishing. With the help of the Department of Natural Resources (DNR), we also obtained fin clips from spawning populations of walleye on the Tittabawassee River, the Shiawassee River and the Kawkawlin River. In total, over 400 fin clips were obtained. DNA was extracted, using a DNeasy kit. PCR amplification and capillary electrophoresis were performed in order to determine genotypes for six fingerprint loci. This data provides genetic markers that allow for the assessment of genetic diversity and population substructure, as well as the determination of important spawning sites and assessment 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 — Room: Pioneer-240

Senior Design I
From 1:00-2:00p.m. (see Pages 13-14 for abstracts)

E01. Home Energy Distribution System (HEDS)
Faisal Alturaiki, Travis Depcinski, Bozhong Xue, and Lukacs Zimmerman
(Advisor: Dr. Rajani Muraleedharan)

E02. Long Range Load Allocation Planning
Jordan Holbrook and Matthew Koepke (Advisor: Dr. Rajani Muraleedharan)

E03. ECU Test Stand
Weston Appold, Kyle Middaugh, and Clifton Oaks (Advisor: Dr. Rajani Muraleedharan)

E04. SENT Communication Emulator
Timothy Maxwell and Lucas Ritter (Advisor: Dr. Rajani Muraleedharan)

E05. LED Swimming Pace Rope
Jason Ugartechea (Advisor: Dr. Rajani Muraleedharan)

Senior Design II
From 2:00-3:00p.m. (see Pages 14-15 for abstracts)

E06. P.A.N.C.A.K.E.
Shane Oberloier (Advisor: Dr.Rajani Muraleedharan)

E07. Amigo Mobility Solar-Assisted POV
Jassim Alhelal, Saad Alzoabi, Thomas Miller, and Brandon Peter
(Advisor: Dr. Rajani Muraleedharan)

E08. Practical Fire Equipment Scene Light
Bryce Gainer, Matthew Leser, Samuel Nelson, and Cameron Tompkins
(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 16-17 for abstracts)

M01. Small Square Bale Loading Attachment for Cook's Choice Produce LLC
Waheed Bahha, Brian Cook, and Caleb Palmer
(Advisor: Dr. Brooks Byam)

M02. Overnight Garage Car Wash
Cedric Daley, Mitch Delemeester, and Thomas Fayfer (Advisor: Dr. Thomas Mahank)

M03. The GRIPULL-Duro-Last
Anthony Brown, Lauren Moore, and Jeff Schalk
(Advisor: Dr. Brooks Byam)

M04. Kukla Performance Electronically Actuated Motorcycle Kickstand
Derek Keim, Andrew Maschke, Tyler Mausolf, and Josh Wilson
(Advisor: Dr. Brooks Byam)

M05. Practical Fire Equipment Firefighting Scene Light
Shuhai Chen, Kyle Feeney, and Luke Walther
(Advisor: Dr. Brooks Byam)

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

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

M06. B&P Process Independent Vertical Mixer Drive
Cody Megregian, Lucas Noleto, and Megan VanFleteren
(Advisor: Dr. Brooks Byam)

M07. Water-Jet Byproduct Dryer for Duro-Last Inc.
Joao Rafael de Paula, Caleb Samples, and Thomas Winne
(Advisor: Dr. Pandian)

M08. Wheelchair Docking System for School Bus
Ali Aljarody, Paul Bellegarde, Dalton O'Connor, and Eduardo Souza
(Advisor: Dr. Brooks Byam)

Oral Session E: Mathematical Sciences

Room: Pioneer-231

Presentation starts at 1:00 p.m.

MS01. A Model for Superior Risk-Adjusted Stock Market Returns

Juan Sancen (Advisor: Prof. Curtis Grosse)

The purpose of this project is to research and test growth investment strategies that generate superior risk-adjusted returns. A wide variety of statistical procedures have been applied including sound techniques of selecting and analyzing data. The primary purpose of the research is not to achieve individual wealth but rather to use an application of the model for generating funds for SVSU student scholarships. The overall value changes for the model are mostly independent of the broader stock market movements. Specifically, the stock selection process uses a hedge fund long/short strategy. It is not based on the popular "day-trading" or "buy-and-hold" approaches. The model does not require a prediction of future market performance, since theoretically it should perform better than the S&P 500 benchmark in both a bull and bear market. Its market-neutral approach consists of buying 10 stocks long and shorting 10 other stocks in such a way that portfolio risk is minimized. The research project uses various sources and databases for stock selection. These stocks are evaluated for both fundamental and quantitative factors. The former highlights accounting criteria while the latter captures institutional demand for the stocks. While the results for an individual year may vary, the goal is risk-adjusted returns over time compared to the overall market. We use standard measures of risk to assess the results. The main model has been able to outperform the S&P 500 11.02% to 9.76% annually and has consistently achieved a higher Sharpe ratio of 3.7 to 2.07 over the S&P 500.