

# POSTER ABSTRACTS

## Basic and Medical Sciences

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### 1 A Charge to Mass Ratio of the Electron

Amelia Rivas, Annelisa Monica, Erin Conway, Kaitlin Newcombe, Paul Palumbo  
Case Western Reserve University

In this experiment, the charge to mass ratio of an electron was calculated using an Uchida chassis, by measuring the radii and diameters of an electron beam inside the chassis' vacuum tube. In the tube, the electron beam was put under the influence of a Lorentz force and thus forced onto a circular path from which the diameter could be measured. Several measurements, with an uncertainty of  $\pm 0.05$  cm, were taken at varying voltages and at varying Helmholtz coil currents, and the data was used to plot graphs of the radii versus current or voltage. Using the slope from each graph, the charge to mass ratio for each set of data was found, and the ratio from the first set,  $e/m = 1.59 \times 10^{13} \pm 0.000008$  C/kg was proved to be the best value since it compared the best with the expected value of  $(1.75882017 \pm 0.0000007) \times 10^{11}$  C/kg.

### 2 B Comparative Study of Citrus Pectin and Its Effects on Cancer Cells

Andrew Wiecek, Aaron Yun, Alex Shimek, Gavin Wu  
Case Western Reserve University

Citrus pectin is used in the food industry as a thickening and gelling agent as well as drug delivery systems. While the antibacterial and lipid repression functions of citrus pectin have been established, we will use a modified Ames test to conclude mutagenicity and use that data to determine its functional relationship with cancer utilizing existing data.

### 3 A Muscular Dystrophy

Jalecia Fair, Jacob Brenkus  
Cleveland State University

Muscular dystrophy is a genetic disorder that causes deterioration of the muscles and eventually leads to muscle wasting, muscle weakness, bone deformities and disability. There are nine types of muscular dystrophy. We will discuss the two most common types which are Duchenne Muscular Dystrophy and Becker's Muscular Dystrophy. During this presentation we will identify the differences between the two diseases, general symptoms, the group of people the diseases affect and how, and lastly current treatments and experimental medicine that could help cure these two types of muscular dystrophy.

### 4 B Microwave Optics: Refraction and Polarization

John Liggett, Benjamin Nimrod, Stephen Kennedy  
Cleveland State University

*Kiril Streletzky, Mentor*

The purpose of this poster is to demonstrate Microwave Optics, specifically refraction and polarization of microwaves. Microwaves are a special type of electromagnetic radiation that behave identically to light besides having a different wavelength and frequency. In our experimentation, we used a microwave transmitter to emit microwaves and a receiver to measure microwaves that are received while facing the transmitter. In order to study refraction, we used a triangular ethafoam prism mold filled with styrene pellets, similar to how one can use a glass prism to study refraction of light. Likewise, we used thin pentagonal sheets of stainless steel which had slots within them to study polarization. We investigated how prisms would affect the angle of microwaves and how polarizers would affect the reading of the receiver.

**5 A The Good, The Bad, and The Ugly: Genetically Modified Embryos**

Kaylee Dworning, Rene Kizys, Christina Katsaras, Nadia Grynykha  
Cleveland State University

*Aaron Severson, Mentor*

Since the prehistoric era, genetically modified organisms have been used to improve the standards of living for humans. Now with enhanced technology we are approaching the ability to alter our own embryos. Through research we have discovered that there are possible advantages and disadvantages in the modification of human DNA.

**6 B Soil Toxicity Testing of PAH Contaminated Soil**

Kylie Kulon , Amanda Seidler  
Youngstown State University

*Felicia P. Armstrong, Mentor*

The Ravenna Army Ammunition Plant located in northeastern Ohio within Portage and Trumbull counties, has a total of 51 areas of concern with a variety of contaminants including polyaromatic hydrocarbons (PAH), heavy metals, polychlorinated biphenyls, and herbicides. The area was constructed in 1940-1941 and consisted of 21,683 acres, approximately 11 miles long by 3.5 miles wide. The space was used during World War 2, the Korean War, and the Vietnam conflict as a depot storage and ammunitions assembly site. Soil was collected from a site identified as PAH contaminated and plant and red worm toxicity test were conducted. Soil was dried and sieved and basic soil characteristics were analyzed to help describe the soil. Plant toxicity test were conducted using Paris cos Romaine lettuce over six weeks. Plant growth and vitality were evaluated as compared to a reference soil. Red worm toxicity testing was conducted over 14 days using ten worms per replicate. Growth and mortality of the worms were assessed. Lettuce growing in the contaminated soil suffered greatly in size, color and overall health as compared to the reference soil and soil with half reference and half PAH contaminated soil. Worms were much more tolerant of the PAH contamination. Overall worm mortality was minimal although worm weight decreased. Based on these results, remediation would be recommended to improve ecological health.

**7 A The Biology and Physics of an Electrocardiogram**

Madeline Goosmann, David Scarpitti  
Kent State University

*Jennifer Marcinkiewicz, Mentor*

Electrocardiograms (EKGs) measure the electromagnetic activity in the heart as it contracts and relaxes. This tool helps physicians detect problems in the heart. Our presentation investigates the biological and physical aspects of how an EKG works. We discuss the physics of the polarization waves which cause a heartbeat and the biological mechanisms by which the waves are transmitted. We also explain how cardiologists identify anomalous activity in an unhealthy heartbeat. Finally, we examine aspects of EKG readings of healthy heartbeats numerically using techniques in Fourier analysis.

**8 B The Impact of Educational Perfectionism on the Mental Health of Generation Z Students**

Maria Resendes  
Cleveland State University

*David Foley, Mentor*

This project aims to review the current literature in the medical databases relevant to the impact of educational perfectionism on the mental health of generation Z students. The project starts with an introduction as to what educational perfectionism is and then defines the population of generation Z students. Then the objectives of the review are stated before delving in to the historical context relevant to the topic. Next is the literature review itself where several scholarly pieces are identified and summarized. Then a viewpoint from the perspective of a middle school teacher is considered before ending the project with recommendations of areas for potential research.

## **9 A Contaminated Water: What's in your cup?**

Renee Justus, Lisa Thomas  
Cuyahoga Community College

*Clarence Johnson, Mentor*

Our poster will highlight complications that arise from people not being able to obtain clean drinking water. With contaminated drinking water being a major contributor to both disease and death in underdeveloped countries, we will attempt to shine a light on the struggles that people face on a daily basis. We also plan on illustrating changes that have helped, as well as possible solutions to this massive problem. With an estimated 650 million people that do not have access to clean drinking water, and 1,400 children dying each day from water-related diseases, we hope that bringing awareness to this travesty will inspire people to make a change. Beyond having to consume contaminated water, often times water sources are not within close vicinity to people's homes. This causes residents to have to travel several kilometers just to obtain unsafe water and to walk back long distances carrying jugs that can weigh up to 50 pounds. In America every year we spend millions of dollars on bottled water and usually never have to wonder if the cup of water we hand our children contains a parasite or a disease that will kill them. Countries with more resources have the ability to protect so many people from such a massive problem.

## **10 B The Role of Macrophage Migration Inhibitory Factor in Alcoholic Liver Disease**

Adam Morris  
Cleveland State University

*Laura Nagy, Mentor*

Alcoholic Liver Disease (ALD) is a progressive disease characterized by a spectrum of disorders. The pathogenesis of ALD is complex and not well-understood, but involves many aspects of the immune system. Macrophage Migration Inhibitory Factor (MIF) is seen as a key mediator in many disease pathways. As MIF is known to regulate pro-inflammatory mediator synthesis, bind to various leukocyte and macrophage cells and is increased in expression in hepatocytes with Alcoholic Hepatitis (AH), there is a strong indication that MIF plays a key role in regulating the pathogenesis of ALD. The focus of this work explores the role MIF may play in the infiltration of neutrophils into the liver which would affect the progression of ALD. In previous experiments in animals using a model of chronic ethanol exposure, MIF knockout (-/-) mice were protected from ethanol-mediated injury and had decreased infiltration of inflammatory macrophages into the liver. In the current study, a model of chronic ethanol exposure with a binge state added at the end of the trial was used to simulate the AH stage of ALD progression. In light of the data retrieved in this study, MIF serves a protective function in ALD in a specific ethanol binge situation by decreasing the infiltration of leukocytes into the liver.

## **11 A Quantifying mercury levels in fish oil supplements using inductively coupled plasma atomic emission spectroscopy**

Alex Johnson, Jemima Ukwela, Sho Tanaka, Josh Ryan  
Cleveland State University

*Anne O'Connor, Mentor*

There has been a growing concern over the amount of mercury in fish and consequently fish oil supplements used to reduce risk of heart attacks. The purpose of this study is to determine if fish oil supplements contain any concentration of mercury. Three common fish oil brands, Kirkland Signature, GNC Triple Strength, and Nature Made were collected and to experimentally quantify concentrations of mercury, inductively coupled plasma atomic emission spectroscopy (ICP) will be used. ICP uses electrically neutral partially ionized argon gas to excite particles which emit characteristic wavelength specific light when relaxing back to lower energy levels. This characteristic wavelength specific light can be quantified to find the concentration of mercury in the fish oil supplements, displayed on a calibration curve. In order to allow the ICP to read the samples, the samples will be digested in nitric acid. Standard solutions of known concentrations of mercury in the amounts of 20,10,5,1.25, and 0.625 parts per million will be used with the ICP in order to find the amount of mercury in the samples.

**12 B The effect Echinocandin class drug has on mixed species Aspergillus and MRSA biofilm formation**

Alexzondria Carter, Tessa Askew, Lisa Dollinger, Youngjun Park  
Case Western Reserve University

Biofilm formation occurs when microorganisms adopt a multicellular behavior to prolong survival on both biotic and abiotic surfaces. In healthcare, the existence of these biofilms on medical equipment or reservoirs can cause harm to the patient. As observed in the skin cells of Psoriatic patients, the fungus *Aspergillus* and the bacteria *Staphylococcus*, interacted in an unknown manner. As this interaction was taken into a biofilm model, the interaction between these two species became more clear. This interaction was studied further by studying the effect of Echinocandin drugs had on the biofilm formation.

**13 A Preliminary Detection of Antibiotic Resistance in Coliform Bacteria**

Austin Cunningham, Mike Dercoli, Jamielynn Doyle, Kristin LaTessa, Isaac Pearce  
Youngstown State University

*Carl Johnston, Mentor*

Coliform bacteria and water quality in shallow water and creeks near urban communities vary depending on factors such as runoff and temperature fluctuation. Yellow Creek in Poland, Ohio is subject to these factors, as well as possible combined sewage overflow (CSO), which could lead to increased antibiotic resistance in present coliform bacteria. This study seeks to evaluate the antibiotic resistance of coliform bacteria in Yellow Creek by measuring such factors as dissolved oxygen, biochemical oxygen demand, coliform units (CFU), nutrient levels, and antibiotic resistance gene levels to seven antibiotics. The study includes three sites located in Poland, Ohio. The hypothesis to be tested is to determine levels of antibiotic resistance in coliform bacteria in Yellow Creek.

**14 B Pharmacological and pre-clinical testing of 5-NIdR as a new therapeutic agent against brain cancer**

Casey Seol Kim  
Cleveland State University

*Anthony J. Berdis, Mentor*

Approximately 4,000 children in the United States are diagnosed annually with a brain tumor. Brain cancers are the deadliest of all pediatric cancers as they have survival rates of less than 20%. Although surgery and radiation therapy are widely used to treat adult patients, chemotherapy is the primary therapeutic option for children. One important chemotherapeutic agent is temozolomide, an alkylating agent that causes cell death by damaging DNA. In this project, we tested the ability of a specific non-natural nucleoside developed in our lab, designated 5-NIdR, to increase the efficacy of temozolomide against brain cancer. Cell-based studies demonstrate that the combination of 5-NIdR and temozolomide kills more cells compared to treatment with either temozolomide or 5-NIdR used alone. Microscopy techniques demonstrate that the combination of 5-NIdR and temozolomide causes cell death via apoptosis rather than necrosis. Animal studies using xenograft mice were performed to evaluate the in vivo efficacy and safety of this drug combination against brain cancer. Preliminary results indicate that treatment with 5-NIdR does not inhibit the rate of tumor growth. In contrast, treatment with temozolomide slows the rate of tumor growth by 2-fold but does not cause tumor regression. Striking results are obtained combining 5-NIdR with temozolomide as this drug combination causes complete tumor regression within two weeks of treatment. Collectively, these studies provide pharmacological evidence for combining 5-NIdR and temozolomide as a possible treatment strategy to effectively treat brain cancers.

**15 A S-Nitrosothiols augments CFTR maturation through Co-chaperone CHIP and Hop interaction in Human Airway Epithelial Cells**

Faraaz Hussain, Abdelrahman Rahmy, Abdallah Rahmy  
Case Western Reserve University

S-Nitrosothiols (SNOs) are cell signaling compounds that are of special interest in cystic fibrosis. The signaling of these SNOs is disrupted in CF patients. In CF, there is an up regulation of S-Nitrosoglutathione reductase which is thought to lead to a reduction in the amount of SNOs. SNOs help the cystic fibrosis transmembrane conductance mature and perform normal functions in the epithelial cell surface. The maturation occurs as a result of the transcriptional and post translational steps of CFTR. GSNO S-nitrosylates heat shock cognate organizing proteins called Hop. This nitrosylation causes Hop to dissociate from F508del CFTR leading to CFTR maturation and

transportation to the cell surface. There exists a GSNO reductase which degrades GSNO. Inhibition of this reductase would allow GSNO to remain active, which may hold a therapeutic effect in CF patients. The goal is to see the mechanism that SNOs take to mature CFTR, which is currently unknown. I hypothesize that S-Nitrosothiols have an effect on CHIP and Hop interaction in CFBE41o- cells expressing that both wild type and mutant F508del CFTR are used as they very closely mimic the human airway cells in vivo.

#### **16 B Does Physician Knowledge Of Patient Expectations Improve Emergency Department Length Of Stay And Patient Satisfaction?**

Jason Gilmore

Youngstown State University

*Jill Tall, Mentor*

Patient satisfaction has become a surrogate measure for the quality of care provided within hospitals and health care delivery systems. It has become the leading source for hospitals and physicians' reimbursement, as it is determined primarily on the patient satisfaction scoring system. It has become increasingly important to assure that quality of a patient's visit is satisfactory, as unsatisfied patients are likely to bring malpractice suits or decrease their utilization of health care. In recent years, total visits to the emergency department (ED) have greatly increased and research shows that this trend will continue. The present investigation seeks to determine if the effects of physician knowledge of patient expectations will significantly affect overall patient satisfaction and the total amount of time the patient is in the emergency department (ED), known as ED total length of stay (LOS). In order to do so, pre and post treatment questionnaires will be randomly distributed to patients at the time of registering to the ED and discharge. In addition to the survey data, patient demographics, acuity level, diagnosis and ED time-related factors will be collected.

#### **17 A Gas-Phase Ligand Exchange Studies of Calcium and Nickel Beta-Diketonates**

Jennifer Miller, Kate Fleming

Youngstown State University

*Brian Leskiw, Mentor*

The gas-phase ligand exchange reactions between bis-(2,4-pentanedionato)calcium(II),  $\text{Ca}(\text{acac})_2$ , and bis-(3,5-heptanedionato)nickel(II),  $\text{Ni}(\text{eeac})_2$ , were investigated using a triple quadrupole electron impact mass spectrometer. Co-sublimation reaction results show that gas-phase ligand exchanges between these complexes occur readily yielding both mixed-ligand and clustering products, both of which are reported herein for the first time. Mass-selected ion-neutral reactions were also investigated using the collision cell of the mass spectrometer to shed light on the mechanism of ligand exchange in the gas-phase of these metal beta-diketonate species.

#### **18 B Initial Sea Cucumber Based Implants in Rodents**

Jennifer Paiz, Mikhaylan Price, Rachel Boedicker, and Sarah Mortier

Case Western Reserve University

We present ongoing research that aims to improve the performance life of devices that are implanted in the brain to record and interpret cortical signals. Drs. Capadona and Erefej hypothesized that modifications to the surface topography of the implant, along with the use of resveratrol (a naturally produced antioxidant in plants), can improve the stability and quality of neural recordings obtained from implanted microelectrodes. In the initial stages of the study, a device that biomimics a sea cucumber is implanted into rodents' brains to minimize the effects of brain inflammation. The reaction of brain tissue to the implanted devices is measured through dye tests that track where blood passes the blood-brain barrier. The implanted rodents are compared to a control group of rodents who did not receive implants.

#### **19 A White Faced Saki and Reed Titi Monkeys interaction with mates**

Jermaine Coleman, Brianna Sealey

Case Western Reserve University

White faced Saki monkeys and reed titi monkeys are rarely studied in the wild so little is known about their reproduction behavior. In collaboration with the Cleveland Metroparks Zoo, behavioral observations will be conducted focusing on how these breeding pairs of these two species interact and whether or not certain behaviors

will lead to copulation and offspring. The behaviors of these two species will be compared to discover how these species breed in captivity which will hopefully lead to insights in how these species behave in the wild and interact with their mates.

#### **20 B Transposon Mutant Genesis of *Stenotrophomonas maltophilia* Oak Ridge Strain 02**

Kaylin Camp, Rae'ven Crum, Gabriella Hosack, Thomas Rebraca  
Youngstown State University

*Jonathan Caguiat, Mentor*

A multi-metal resistant strain of *Stenotrophomonas maltophilia* OR02 (*S. maltophilia* 02) grows when exposed to toxic salts of gold and selenite. An E-Z Tn5 transposome was introduced into *S. maltophilia* 02. Approximately 880 transformants were replica plated onto plates containing gold chloride, sodium selenite, mercuric chloride, sodium arsenite, potassium chromate and M-9 minimal salts medium to see if the transposon interrupted genes required for gold resistance, selenite resistance, arsenite resistance, mercury resistance, chromate resistance or growth on minimal media. One transformant was sensitive to selenite; 2 were sensitive to gold and selenite; 5 were sensitive to all five metals; and 1 failed to grow on M-9 minimal salts medium. The transposon contains a kanamycin resistance genes and an R6K $\gamma$  replication origin. The genomic DNA from the mutants was purified, digested, ligated and transformed into *E. coli*. These transformants will contain new plasmids consisting of the transposon flanked by the interrupted genes. We expect DNA sequencing to identify genes involved in oxidative stress response, metal efflux, metal transformation (reduction and oxidation) and sequestration.

#### **21 A Modelling Zernike Aberrations with a Spatial Light Modulator**

Kelsey Darrah  
Case Western Reserve University

*Brian Vohnsen (University College Dublin), Mentor*

This experiment will demonstrate the effect of aberrations on a collimated beam of monochromatic green light. Aberrations of the human eye effect our vision. These aberrations can be represented using Zernike Polynomials. This experiment creates four types of aberrations using Zernike Polynomials: defocus, oblique astigmatism, coma, and spherical. They are then observed with three different phase scaling factors: 1, 10, and 25. These aberrations are generated by means of a liquid crystal-based spa7al light modulator SLM (Holoeye LC2012). Their impact on the point-spread function PSF is recorded at the focal point of a lens with a CCD camera. Large-scale aberrations are represented via phase wrapping which causes increased scattering and should ideally be resolved with a modulator that would allow mapping of phase values beyond  $2\pi$ .

#### **22 B It's Just a SPECK**

Lydia White, Ralph Roth, Haley Gianfrancesco  
Youngstown State University

*Alan Jacobs, Mentor*

Our team was concerned about occupants of campus buildings who are breathing dust particles. The particle sizes posing the greatest risk are those whose diameters are less than 2.5 microns. Such particles penetrate our respiratory defenses. Nose hairs, mucous, and sneezing and coughing trap and eject larger particles, but allow PM2.5 to be lodged in lung tissue and pass through to the blood stream. We measured the concentration of fine particles with the use of a SPECK (Monitoring device developed at Carnegie Mellon University) in one building on the YSU campus.

Ward Beecher Hall on the YSU campus has an air circulatory system that has roof fans that vent science laboratory air pollutants up to the top story and exhaust them out the roof. This causes a vacuum producing a noticeable pull on doors to the outside. We measured the concentration of <2.5 micro dust in micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) at many locations on all six stories (levels) of the building. Level one (basement) through level 4 have doors to the outside. The highest concentrations can be summarized as follows:

- (1) At the time of the changing of classes
- (2) On levels 1-4,

When compared with US Environmental Protection Agency (EPA) limits of 35  $\mu\text{g}/\text{m}^3$  daily average, the particulate concentration during the times our measurements were taken meets EPA standards, however we found that during peak times and places the particulate concentration could be over 80  $\mu\text{g}/\text{m}^3$ . This poses possible health risks to the students who are frequently sitting the hall ways waiting for their next class to begin.

### **23 A Virtual Screening of Small Molecule Inhibitors of Duffy Binding Protein in Plasmodium vivax**

Maria Tickerhoof, Khailing Neoh, Maggie Wong, Kristin Kirkland  
Case Western Reserve University

*Plasmodium vivax* is one of the parasites that can cause malaria in humans, and is most prevalent in South America and Southeast Asia. Duffy Binding Protein (DBP) is a protein present in *P. vivax* parasites that binds to the Duffy Antigen Receptor for Chemokines (DARC) in human blood cells to initiate the blood phase of *P. vivax* malaria. Prior research has been done to determine the structure of the DBP-DARC complex, and mutagenesis experiments have been performed to determine which DBP residues are necessary for DARC binding. Using Schrodinger molecular visualization software, a series of small molecule databased have been screened against the DBP protein to determine candidate inhibitors of the protein's action. Ultimately, these molecules could inhibit the blood phase of *P. vivax* malaria.

### **24 A Effects of Caloric Restriction on Circadian Rhythms in Knockout Mice**

Marina Bykova  
Cleveland State University

*Roman Kondratov, Mentor*

Circadian rhythms are 24-hour rhythms existing in organisms ranging from bacteria to humans that govern activity levels, behavior, and gene expression. While an endogenous 24-hour clock persists in the absence of stimuli, it can be altered by exposure to stimuli such as light or a feeding schedule in a process called entrainment. Constant disruption of the circadian rhythm has been shown to reduce lifespan, increase rates of obesity, diabetes, and cancer, and can contribute to mental disorders such as depression, which is particularly relevant as many people work unpredictable hours. Caloric restriction has been known for years to increase lifespan, but in knockout mice for BMAL1, a gene controlling the circadian clock, have decreased lifespan and abnormal behavior. Knockout mice on a variety of feeding regimens (Ad Libitum, Time Restricted, and Fasting) were compared to control mice also on a variety of feeding regimens, and found that caloric restriction only increased lifespan in control mice, without affecting knockout mice. This indicates that caloric restriction has a significant effect on the circadian system, and can help in development of new treatments for circadian rhythm disorders.

### **25 A Synthesis of Glycopolymers via Modification of 4-Vinylbenzyl Chloride**

Matthew LaLama, Ismail Safi, Darian Wilson  
Youngstown State University

*Peter Norris, Mentor*

Glycopolymers have seen a rise in popularity recently due to their biomimetic analogues and their increasing potential for bio-commercial applications. Due to the "cluster glycosidic effect," which is the trend for glycopolymers to experience higher affinity through multivalency, glycopolymers have been recently studied for their effects in anti-cancer and anti-HIV drugs. This research is seeking to modify standard procedures of the synthesis by performing the reaction in atmospheric conditions as opposed to inert. Performing the reaction under atmospheric conditions, yielding an air-stable product, would prove beneficial for biological applications. This reaction synthesis followed a pathway utilizing SN<sub>2</sub>, alkylation, Huisgen cycloaddition, and polymerization reactions which were monitored via thin layer chromatography (TLC), nuclear magnetic resonance (NMR), and infrared spectroscopy (IR).

### **26 B Poxvirus Protein K7 Purification and Interaction with RNA Helicase DDX3**

McKenzie Clapp  
Case Western Reserve University

*Eckhard Jankowsky, Mentor*

Poxviruses are double stranded DNA viruses that replicate in the cellular cytoplasm of their human hosts. Members of the poxvirus family include the vaccinia and variola virus. Poxvirus K7 is a vaccinia virus that forms a complex with

DEAD Box RNA helicase DDX3. In order to gain a better understand of the mechanisms of poxvirus K7 infection, the K7 peptide was first purified and then utilized in unwinding assays in complex with DDX3.

### **27 A Toward Custom Made Optical Mounts on Demand using Additive Manufacturing**

Michael Baker, Nicholas McGuigan, Martin Strong  
Youngstown State University

*Donald Priour, Mentor*

An essential element of a stable experimental optics platform, optical mounts are often costly, require time to order, and can be a challenge to have custom made. The YSU Physics and Astronomy Department has had a very active optics program in recent years, a circumstance which inspired us to tackle a recurring issue in such experiments with a fairly new technology, 3-D printing. Conventional metallic optical mounts used for positioning lasers, photodiodes, and other components are typically expensive, and can often be restrictive when it comes to designing original layouts for experiments, often leading to improvising some rather unique optical equipment to meet our needs. To accommodate the need for inexpensive and robust custom made optical mounts, we sought to test the plausibility of enlisting the available YSU 3-D printing resources to reduce overall costs while expanding the range of possibilities for our experimental setups. The first iteration of our program has involved printing out various mounts of different filling densities, plastic type, and support structure (e.g. horizontal or vertical layering); these candidates will be exposed to mechanical, thermal, and magnetic tests for overall stability in order to determine which mount type offers the least amount of background noise on a desired signal, which will help determine the composition and configuration of subsequent iterations of 3D printed mounts. In tandem with the stability tests, theoretical modeling calculations will help relate test data to the robustness of the mount with respect to mechanical, thermal, and magnetic perturbations to determine its suitability in the context of optical experiments pursued in the department.

### **28 B Using Affinity to Overcome Drug Delivery Limitations of Microparticle Systems**

Mikayla Smith  
Case Western Reserve University

*Horst von Recum, Mentor*

Previous work by Dr. Horst von Recum and Dr. Sean Zuckerman have used insoluble cyclodextrin polymers (pCD) as a device coating to release sirolimus, an antiproliferative drug. Sirolimus forms an inclusion complex with pCD, where the molecular interactions between drug and polymer control release rate. Since diffusion release rate is dependent on thickness, traditional drug delivery devices show accelerated release rates when formulated into MPs due to increased surface-area-to-volume ratios compared to thick polymer slabs. However, if affinity is the rate-dependent step, then pCD microparticles (MPs) should be able to provide sustained release of sirolimus similar to that from pCD coatings. This work characterized sirolimus loading and release from pCD MPs and demonstrated the in vitro bioactivity of released sirolimus. Particles were loaded with drug which was released into 1xPBS with 0.1% Tween-80. The entire release media was collected daily for 100 days to mimic infinite sink conditions and analyzed by UV-vis. Release was normalized to the weight of MPs. MPs showed a small burst followed by release until ~ day 25 when release from  $\gamma$ CD slowed. Release from dextran (diffusion control) and  $\gamma$ CD were both negligible by day 75.  $\beta$ CD MPs continued releasing beyond day 100 at nearly a hundredfold concentration compared to dextran and  $\gamma$ CD MPs. This difference may be attributed to the different affinity of sirolimus for  $\beta$ CD versus  $\gamma$ CD MPs. This release frame is similar to that from pCD disks, which also showed release for >120 days.

### **29 A Fiber Type Properties of the Forelimb Muscles of Sloths (*Xenarthra: Pilosa*)**

P. Kiraly, A. Svenson, T. Tsangaris-Braatz, and A-R. Yusuf  
Youngstown State University

*Michael Butcher, Mentor*

Sloths exhibit a range of arboreal locomotion that involves suspension by one or more limbs for extended periods of time. Despite these abilities that require great strength, their skeletal muscle mass is quite low; however, their overall limb form has been extremely modified for suspensory behaviors. One modification may be the expression of only slow-twitch isoforms of myosin and muscle fibers with high fatigue resistance. This hypothesis was tested using a combination of histochemical (aerobic vs. anaerobic metabolism) and immunohistochemical analyses to determine muscle fiber types in the major forelimb flexors of both two-toed (*Choloepus hoffmanni*, N=2) and three-toed



(*Bradypus variegatus*, N=4) sloth species. The results indicate the primary expression of only two myosin fiber types, slow MHC-1 and fast MHC-2A. Both fiber types are strongly reactive for oxidative potential, and all muscles analyzed in both species show a relatively broad distribution of slow, oxidative fibers. It is also observed that sloth forelimb muscle have a large amount of extracellular matrix in between segregated regions of muscle contractile tissue. Collectively, the findings suggest that sloths have evolved slow-contracting, highly fatigue resistant muscles for suspensory behaviors. The physiological properties observed are further consistent with economical force production. However, while slow fiber type specialization provides a means to sustain muscle force, large amounts of force that may be required for suspension are more dependent on muscle architecture and the passive and active force properties of their muscles.

### **30 B Relationship between Intensity of Depressive Symptoms, Anxiety, Alcoholic Tendencies, and Cognitive Functioning**

Phillip Scheanon, Aemilee Ziganti, and Julia Gaspare-Pruchnicki  
Case Western Reserve University

*Arin Connell, Mentor*

Binge drinking and alcoholism – alcohol use disorders (AUDs) - are behaviors commonly found in cases of depression and anxiety. In these situations, the individual binge drinks in order to cope with the symptoms of these disorders. This study examines the comorbidity between alcohol use disorders, depression, and anxiety. 161 undergraduate students were polled on their consumption of alcohol, reason for drinking alcohol, and symptoms of depression and anxiety. Of the 155 students who completed the surveys without leaving out any information, twenty-seven reported experiencing high levels of depression symptoms. These students were examined using an electroencephalogram (EEG) and physiological markers. The EEG tracked cognitive and physiological arousal while the students were shown faces depicting happy, sad, neutral, and fearful emotions. Additionally, this study examined the correlation between students who have alcoholic parents and the student's own alcoholic tendencies. Although no statistically significant correlation ( $r=0.0094$  to  $r=0.1921$  with  $p$ -values much greater than 0.05) was found between the amount of alcohol consumption and the severity of depression symptoms,  $14.19\pm 4.71\%$  of individuals in the study were found to be at risk for depression and an AUD. Furthermore,  $10.97\pm 4.55\%$  of individuals were at risk for comorbidity of an AUD, anxiety, and depression.  $30.77\pm 2.07\%$  of participants who were at risk for an AUD also had a parent at risk for an AUD. Analysis of EEG data was not conducted due to time constraints.

### **31 A Biodegradable Tracheal Stents**

Rachel Hammond, Tyler Densmore  
Case Western Reserve University

*Ozan Akkus, Mentor*

Tracheal stenosis is the narrowing of the trachea which can be caused by birth defects, trauma, or disease. Currently, surgical reconstruction is the most common treatment although placement of stents is a popular and sometimes necessary option for patients whose narrowing may be inoperable.<sup>1</sup> There are currently various designs of stents made out of metal and silicone materials. Due to problems with migration, fracture rates and inability to biodegrade, research is moving toward biodegradable materials. Biodegradable stents are a promising alternative to permanent stents and may eventually be used to solve the lingering problem of in-stent restenosis.<sup>2</sup> Additionally, fully degradable stents have the ability to deliver more drugs to the target site than a thin coating of drug on metallic stents. The goal of this project was to prototype a biodegradable tracheal stent using Polylactic Acid (PLA) or Polydiacxonone Suture (PDS). Two different prototypes were made using multiple techniques to find the best option for implantation. The stents were subjected to mechanical testing to determine the most biomimetic option in order to best replicate the native tissue.

### **32 A Metabolic Activity Patterns in Overweight and Obese Adults in Physical Activity Weight Loss Program**

Riley Brown, Zachary Dallman, Matthew Canestraro (not in COF but conducted research: Asante Brown, Shreya Sekaran, Stephanie Logosh, Lynn Kam)

Case Western Reserve University

Changes in weight due to dietary, physical fitness, or other intervention factors typically result in altered metabolic activity patterns. These patterns are observed in total energy expenditure components such as resting metabolic rate (RMR). Weight loss characteristically results in increases in RMR due to increase in metabolically active lean muscle mass. These increases in RMR and their correlation with weight loss and muscle gain are observed in decreased body fat composition. Additionally, decreases in the overweight and obesity correlated measurement of body mass index (BMI) indicate adipose tissue loss and increased metabolic efficiency.

Though these measurements are effective at assessing metabolic activity through indirect calorimetry and physiological parameters, new technology aims to use movement and skin contact with advanced sensors to detect caloric expenditure. The BodyMedia® Fit CORE Armband uses such sensors and an online user interface to produce estimates of physical activity, movement, and energy expenditure. A system of observable metabolic indicators such a caloric expenditure and duration and intensity of physical activity can potentially contribute to weight loss and monitoring of metabolic activity patterns throughout the period of weight loss.

The purpose of this study was to evaluate whether patterns of calories burned (Metabolic Activity Patterns) as measured by BodyMedia® Fit armband could be used as a tool to monitor weight loss in overweight and obese individuals. If BodyMedia® Fit armband data is consistent with RMR increase and post weight loss metabolic patterns, this could indicate the technology's strength as a metabolic activity pattern monitor. Further, the mechanism through which weight is lost, whether by diet or physical activity regulation, may correlate with the strength of the armband as an indicator of metabolic activity patterns. Findings of this study could formulate better weight loss strategies using metabolic pattern observation.

### **33 A Construction of Indium derived Metal Organic Framework through a Hydroquinone Linker**

Samuel Dickson, Rebeca Eaken, Dante DeChellis, Bryan Ortiz, Bailey Varga

Youngstown State University

*Douglas Genna, Mentor*

Construction of a metal organic framework (MOF) with Indium (III) Chloride and hydroquinone (as the linker) has been attempted through a variety of methods. The problem in which this project hopes to tackle is whether or not hydroquinone can be used as a linker in lieu of MOFs created in which carboxylates were primarily used. When compared to carboxylates, hydroquinone is more nucleophilic than a similar carboxylate molecule, which would lead to a faster reaction than would be required for crystal formation. The experiments hope to lead to the successful synthesis of a hydroquinone/ Indium derived MOF.

### **34 A Determination of Protein Content and Amino Acid Composition of Farm Crickets**

Taylor Baum, Rachel Centofanti, Allison Guerrieri, Samantha Mock, Tayah Turocy

Youngstown State University

*Nina Stourman, Mentor*

Crickets are advertised as a high protein and low fat food source. In this study, we attempted to determine the protein content and proteins' amino acid composition of farm crickets. The extraction of proteins was done in three ways. In one sample, crickets were dried and proteins were extracted using sonication. In another sample, protein was extracted from frozen crickets by homogenization. Then, in a third sample, protein was extracted from frozen crickets using a combination of homogenization and sonication. The total amount of soluble protein present in each sample was determined using Bradford assay. The sizes of the proteins present in each sample were examined by SDS-PAGE gel. To analyze the amino acid composition, the sample of dried crickets underwent hydrolysis under acidic conditions or basic conditions. After hydrolysis, the amino acids were derivatized for fluorescent detection, and were subjected to high performance liquid chromatography (HPLC) analysis. The amino acid composition and the presence of essential versus nonessential amino acids were determined by comparing the HPLC chromatogram produced by the samples to those produced by standards. Overall, the study indicated that extraction of proteins

from the frozen crickets using sonication provided a higher yield of proteins compared to the extraction from dry crickets.

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## Engineering and Technology

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### 35 A 3D Printed Heat Exchanger

Alex Fitzgerald, Matt Manna, Matt Osiniak, Eric Haake, Mason Shaulis  
Youngstown State University

*Douglas Price, Mentor*

The purpose of the project is to 3D print a small scale simple heat exchanger. This item will be used in Dr. Price's lab for research purposes. The heat exchanger itself will be printed with ABS plastic.

### 36 B Multi-Well Muscle Stimulator

Amanda Herring  
Case Western Reserve University

*Steven Torontalli, Mentor*

Medical researchers at Case Western Reserve University (CWRU) use a Multi-Well Muscle Simulator to evaluate pharmaceutical drugs that affect muscle tissue. The first Stimulator was a purchased model that had many shortcomings. It was primitive and not user friendly, which made duplicating results difficult. The Design Fabrication Center at CWRU redesigned the Stimulator to try to remedy these issues. While this second iteration improved the overall function, it too had room for development. This project focuses on the third iteration of the Stimulator. With further improvements, the design will now be entirely modeled in SolidWorks, providing both 3-D models and drawings for all of the parts. From these models, parts will now have the ability to be 3-D printed and those that cannot be will be machined. The final product will be a fully assembled, tested, and functioning Multi-Well Muscle Stimulator.

### 37 A Web-Based Virtualization Management in Private Cloud

Anthony Hill, Kevin London, Sasha Monroe, Jon Mudrinich, Firaus Odeh  
Youngstown State University

*Feng Yu, Mentor*

Virtualization is the fundamental technology supporting cloud computing. A special software called hypervisor creates virtualized servers running in the cloud to provide virtualized computing services. In the enterprise and cloud market two of the major options for server virtualization include: VMWare or Microsoft Hyper-V. Both products have confusing licensing structures that can consume an IT department's budget. Linux based operating systems can provide similar but more reliable solutions for free or at a fraction of the price. The hypervisor KVM (Kernel-based Virtual Machine) is a powerful hypervisor can be used in Linux through the command line. However, it is not user friendly and cannot control a server cluster from one screen. The team is attempting to build a web interface to control KVM on a cluster of Linux servers. This project could potentially offer a tertiary option for enterprise and cloud virtualization.

### 38 B Mechanical Behavior of Aerogel with Different Poly (vinyl alcohol) Amounts

Arik Stewart, Yvonne Chappell  
Case Western Reserve University

*Hua Sun, Tryreno Sowell, David Schiraldi, Mentors*

This project is derived from research that I was assisted with during my high school chemical engineering research internship with Case Western Reserve University as part of the Polymer Envoy program. The project is centered around Aerogel. Aerogel is a solid material mostly known for its low density and unique structure. For this project we made Aerogel through a process of mixing clay ( ) with a substance that included normal deionized water with dissolved polyvinyl alcohol (PVOH) then freeze-drying it afterwards. We made four groups of six samples composed of different amounts of PVOH but with the same amount of clay. We later did a compression test for each individual

sample. The purpose of it all was to see how the aerogel mechanical properties would behave with the different PVOH amounts. Two groups with the same amount of PVOH were compared with one of them not having any clay. We concluded that the more PVOH included in the sample, the higher the modulus turned out to be. The group without the clay turned out to have a higher modulus.

### **39 A RF to DC Converter and its Applications**

Benjamin Wilson, Adam DeMarco, Mike Kacir, Daniel Martin  
Youngstown State University

*Salvatore Pansino, Lin Sun, Mentors*

We set out to determine if harvesting RF energy could be a sufficient source of power in the future. RF waves are almost found everywhere so being able to collect that and turn it into a free source of power would be ideal. Practically the power collected is small, and suited for microelectronics.

### **40 B Future Uses of Drones**

Bryan Stombaugh, Alia Almashni, Nathan Fine  
Cleveland State University

This research/expository report analyzes and discusses different uses and regulations on commercial drones. The goal of this report was to define the current and potential uses of commercial drones, while also defining the arguments against and regulations for commercial drone usage. Other uses include drones for aid and delivery. Two of the most widely known uses for drones are pure entertainment and photography/film making. All of these uses could be seen as commercial. Regulations against drones and public concerns about drones also are discussed within the report. Main public concerns include concerns about security of drone, safety of others and personal privacy from drones. Federal regulations from administrations, such as the Federal Aviation Administration (FAA) are also included. The FAA regulations include the Visual Line Of Sight (VLOS) rule, along with maximum altitude/speed rules.

### **41 A Application Release Automation with IBM UrbanCode Deploy**

Cedric Arthur, Matthew Hively, Tiffany Nguyen, Haley McAllister, James Hochadel  
Case Western Reserve University

Complex software goes through many phases of integration and testing before release. Ensuring that applications work as intended becomes more complicated with each additional feature, and simple human error can botch an otherwise successful release. IBM UrbanCode Deploy, an Application Release Automation server, solves this problem by automating the release process. This poster summarizes the typical development and release process for large software projects, explains the value of an ARA server, and explores UrbanCode Deploy's approach to modeling and abstracting software environments.

### **42 B Genetically Modified Corn and Wheat**

Chase Petti, Alexa Roberts, Marcus Lard, Madison Spahlinger  
Cleveland State University

*Barbara Margolius, Mentor*

Our research poster will present research about genetically modified crops, specifically the crops of corn and wheat. The processes of producing these genetically modified crops will be described. These new genetically modified corn and wheat will be compared to natural corn and wheat, including how much is produced, the size of the crops, nutritional facts, and more. Along with the genetics of the crops, controversies about GM crops will be discussed, including economic concerns and safety consumption. Regarding safety, possible hazards will be assessed. As a group, we will synthesize all the presented information to create our own generalizations on genetically modified corn and wheat.

#### **43 A True Impact of Additive Manufacturing in the Enterprise Market**

Dakesha Jordan, Mike Kunzer, James Limperos  
Youngstown State University

*Brett Conner, Mentor*

Additive Manufacturing is becoming common place and is revolutionizing today's world. New companies are introducing "the next best printer industry can buy." Juggernaut 3D in Youngstown, Ohio is working with a team of YSU Industrial Engineers to perform beta-testing on their new and revolutionary printer, which utilizes material extrusion as a means of production. The engineering grade 3D printer provides added benefits to existing rapid prototyping practices, and balances printer capacity for progressive companies moving towards digitally optimized design. Juggernaut 3D has simplified industrial size printers to a convenient state, while providing users with an intuitive, easy to use interface. YSU Industrial Engineers distributed the printers to local companies, Taylor-Winfield and Kiraly Tool & Die, for feedback on how the printers impact the company's operation. The feedback from each company will help Juggernaut 3D and YSU Industrial Engineers to categorize the potential value for using engineering grade 3D printers in their business. Feedback will also validate the 3D printers' capability and provide manufacturers with guidance during their purchasing journey.

#### **44 B Design of Submersible Remotely Operated Vehicle**

Eduardo Bustillos  
Youngstown State University

*Jason Zapka, Mentor*

The purpose of this project was to design and construct a submersible Remotely-Operated Vehicle (ROV) according to the competition rules specified by The Marine Advanced Technology Education (MATE) organization. The succeeding poster outlines the methods of design and analytical techniques used in the construction of the ROV.

The ROV was constructed according to the EXPLORER class specifications. These specifications stipulate that the ROV must fit within an eighty-five centimeter diameter circle, must weigh twenty-two kilograms or less and must utilize a forty-eight volt power source. The specified design goals include the ability to measure the temperature of a venting fluid, determine depth of a body of water using pressure measurements, retrieve and prepare specified underwater equipment, and to collect and take photographs of underwater samples.

To evaluate the efficacy of the presented design, the fundamental concepts of programming, buoyancy, fluid dynamics, and heat transfer were used. The ROV was programmed using an Arduino microcontroller. The Arduino received human input from a USB flight-simulation joystick, and used this input to activate the motors, enabling locomotion. The concepts of buoyancy and fluid dynamics were used to evaluate the drag behavior of the ROV. This analysis was done using commercial Computational Fluid Dynamics (CFD) software. Finally, the fundamental concepts from heat transfer were used to analyze the heat dissipation in the circuitry. A by-hand thermal circuit was constructed to evaluate the steady-state thermal performance of the electronics to determine whether the maximum junction temperature of the associated chips was reached.

#### **45 A Damped and Forced Oscillators**

Gary Baker, Neil Feldman, Paul Guativa, Justin McMahon  
Case Western Reserve University

In the LCR experiment, we were trying to measure the behavior of an inductor in a circuit and how we can control the output of the circuit when we combine the inductor with resistors and capacitors. To do this we looked at damped oscillations created by an LCR circuit and forced oscillations from another LCR circuit. We started with the damped oscillators by measuring different frequencies and time constants under different conditions. These measurements were recorded and attached the back of this report. From these calculations we were unsuccessful in matching the theory but we were able to see how different circuit elements effect the output frequency of the circuit we created. In the second part of the lab we looked at forced oscillations by using a function generator. We again were measuring frequencies, but used these measurements to eventually calculate the Quality Factor, Q. We found this value to be  $4.48 \pm .412$  which was within the limits of the theoretical Q value once we took the resistance

due to the function generator into account. From this we were able to see the natural resonant frequency of the circuit and how if the driving force is at the right frequency then we will get large oscillations near the natural resonance frequency.

#### **46 B Growth of Prosthetics**

James Ellis, Lisa Stelmarski, Danny Arrha, Christina Pope  
Cleveland State University

The topic for our poster is prosthetics. We were going to talk about how far we have come, and what the future could hold. Going into detail about each period of advancement. Along with what modern day technology is used.

#### **47 A The Jansen Linkage**

Kyra Rudy, Lydia Fawzy, Santino Bianco, Taylor Santelle, Grant Wethington  
Cleveland State University

*Antonie J. van den Bogert, Mentor*

The Jansen linkage is an eleven-bar mechanism designed by Dutch artist Theo Jansen. The mechanism is crank driven and mimics the motion of a leg. Its scalable design, energy efficiency, and deterministic foot trajectory show promise of applicability in legged robotics. Theo Jansen himself has demonstrated the usefulness of the mechanism through his "standbeest" sculptures that utilize duplicates of the linkage whose cranks are turned by wind sails to produce a walking motion. The resultant motion is smooth flowing and relatively agile. Because the linkage has been recently invented within the last few decades, walking movement is currently the primary application. Further investigation and optimization could bring about more useful applications that require a similar output path when simplicity in design is necessary.

#### **48 B How Two-stage Expansion Affects Efficiency of Gas Turbine**

Lucas Kuhns  
Cleveland State University

*Mounir Ibrahim, Mentor*

Today the world demands more energy than ever before. Because of the economic and environmental costs of electricity production, it is important that the most efficient methods are used. This project seeks to compare the gains in thermal efficiency of a 350 MW gas turbine by adding two-stage expansion. Both designs will have the same compressor inlet conditions, the same maximum temperature, and will both use regeneration.

#### **49 A Blue Carbon as Buffer to Global Climate Change: Value to Increase with Installation of Polluter Pays Policy**

Nadia Swit, Jordyn Stoll, Rachael Bucey Leopold  
Cleveland State University

*Julie Wolin, Mentor*

Climate change is described as the change in patterns of regional precipitation, wind, humidity, and seasons. It has become a significant environmental issue since the 20th century due to the escalation of anthropogenic CO<sub>2</sub> emissions. Blue carbon, or the CO<sub>2</sub> sequestered by coastal ecosystems such as mangroves and salt marshes, is of utmost importance to reduce the amount of CO<sub>2</sub> in the atmosphere because it is most efficient sink for atmospheric CO<sub>2</sub>. Blue carbon sites are predicted to become even more valuable if 'polluter pays' policies are implemented. 'Polluter pays' policies entail allocating costs for greenhouse gas emissions in the form of either cap and trade or carbon taxing. Both would lead to polluters paying for the amount of CO<sub>2</sub> they release and the price would be offset by how much carbon sequestration is occurring on a given area of land; hence adding value to coastal ecosystems that sequester more CO<sub>2</sub> than any other ecosystem.

#### **50 B Optical Cloak**

Nia Simmonds, Destinee Battle, Precious Adeleye  
Case Western Reserve University

*Cory Christenson, Harsh Mathur, Mentors*

The purpose of this optical cloak experiment is to explore the results of "Paraxial Ray Optics Cloaking" by Choi and Howell at the University of Rochester. This experiment will be used in introductory physics courses for student interaction. The system consists of four optical lenses, two with focal length of 200mm and two with focal length of 75mm, separated by a distance determined by basic ray optics theory and equations. The object, such as a pencil or

a ruler, is cloaked in the region between the two middle lenses. Results and data for this project are still in the process of finalizing.

### **51 A GrowDrum**

Patrick Hyden

Youngstown State University

*Kyosung Choo, Salvatore Pansino, Mentors*

GrowDrum is an adjustable climate for an individual plant. Designed for the consumer level market, the Growdrum is user-friendly, and fully adjustable unit capable of growing plants faster, with higher yields. The environment is controlled from a control panel, creating a set-point for environment variables such as temperature, humidity, soil moisture, and the lighting schedule. The unit compensates for any error in set-point values to the measured values by controlling a heater, dehumidifier, humidifier, LED full spectrum light, and a solenoid valve watering mechanism. The drum is coated with a gloss white liner to fully reflect the light around the plant. Additionally, there is an active carbon filter within the air circulation system, along with neoprene seals along the door. A capacitive sensor is used to determine the volumetric water content of the soil, which follows a general curve from previous irrigation studies to begin the watering sequence.

### **52 B Knitting Machine for Biomedical Purposes**

Spencer Boyd, Elizabeth Young, Libby Mitchem, Tony Spalding, and Abigail Fogle

Case Western Reserve University

*Ozan Akkus, Mentor*

Our group is developing a machine to consistently knit a small sling made of collagen that could be implanted in the body. The sling would be used to address the issue of stress urinary incontinence, which affects about 15 million Americans. Stress urinary incontinence occurs in patients who have a weakened pelvic floor and sphincter muscles. When pressure is applied to the bladder of those with weakened muscles, commonly by sneezing or coughing, the muscles cannot support the urethra and therefore incontinence occurs. If stress urinary incontinence cannot be helped by pelvic floor muscle training or through behavior changes, patients can opt to have a sling surgically implanted underneath their urethra. These slings help decrease urinary incontinence by providing support to the urethra that the pelvic floor and sphincter muscles no longer can. Currently, slings implanted during these procedures are made of a polypropylene mesh. There are a few risks involving the implantation of polypropylene including breaking down after implantation and eroding through the patient's tissue. We have chosen to use collagen in the place of polypropylene because it is a biodegradable material and when implanted underneath the urethra would support tissue growth. While the sling would eventually degrade, the natural tissue growth would replace this degradation and in turn support the urethra. The design of this knitting machine not only improves production speed, but also reduces production costs.

### **53 A The Changing Importance of Petroleum in the 21st Century**

Tim Szeltner, Jeremy Harper, Luka Komlijenovic, Johnny Wright, Matt Weiler

Cleveland State University

*Jon Negrelli, Mentor*

The exploitation of oil resources and the internal combustion engine caused a second Industrial Revolution in the 20th century. Petroleum indisputably changed the fields of chemistry, agriculture, transportation, and others too numerous to list. However, these improvements in the standard of living are proving to have come with drawbacks. Fossil fuels, especially petroleum, are coming under increased scrutiny from critics citing concerns of unsustainability and pollution. This report seeks to put in context the advancements in oil extraction technology and applications, with emerging pressures towards renewable energy sources. The state of Ohio's own hydraulic fracturing boom has produced regional prosperity, but this depends heavily on high oil prices to remain profitable. The energy demands of the future must be provided for in a way that maintains productivity and innovation, while working towards cleaner, more renewable energy sources.

#### **54 B VFD Optics Program**

Zachary McCarthy, Nicholas Lees, Dane Elliott, Ogo Okolo  
Case Western Reserve University

The VFD Optics Program is a multi-phase project completed at SIFCO Forge. The project was initiated as a way to improve productivity within the forge and improve the quality of the completed parts. Since one of the most important aspects of any forge is the heating of stock, this project focused on improving this process. The first step of the project was the implementation of variable frequency drives (VFDs) on each rotary furnace to improve the part quality. The VFDs were included as a way to ensure that each part spent the same amount of time exposed to furnace conditions, thus increasing the uniformity of each batch. The second step of the project was the installation of optical pyrometers and position sensors on each furnace. These two components work together in order to decrease the time at temperature of each piece of stock and also confirm that each piece is within the acceptable temperature range. This implementation allows for improved data collection and a more complete thermal picture.

#### **55 A It's SAND vs SOIL!!!**

Anita Whitlow, Steve Fairley, Aminat Adebayo, Shavon Castro, Raekwon Brown, Charielle Lewis  
Cuyahoga Community College *Vanitha Parameswaran, Bilal M. M. Bomani,, Mentors*

The three most important global resources are water, food, and energy. We investigated using an eXtreme Green solution that can potentially optimize the world's water and food resources. eXtreme Green is a concept originally developed at NASA's GreenLab Research Facility where renewable, alternative, and sustainable techniques are researched and implemented. We conducted an eight week feasibility study optimizing a portable self-sustainable renewable ecosystem by evaluating three plant species (Lima camelina, Salicornia virginica and Salicornia subterminalis). We used Poecilia species fish (Black Freshwater Mollies) waste as a natural fertilizer to provide essential nutrients for the plants. Our goal is to develop portable self-sustainable renewable ecosystems that can be implemented worldwide. We present the results of our eight-week study, and our recommendations for adapting our ecosystem to future eXtreme Green Concepts.

#### **56 B Three-Dimensional Printing used for Mobility Assistance of a Dog**

Abdullah Alsairaf, Jared Clark, Jason Doll, Craig Householder, Jennifer McAnallen, Karen Schilling  
Youngstown State University *Guha Manogharan, Mentor*

Three-dimensional (3D) printing was used to aid in the mobility assistance of a 12 year old border collie named Shelby. The dog was crippled for many years prior to the task given to engineering students at Youngstown State University as their graduating senior capstone project. The dog had deteriorating disks in her back that caused disfiguration and pain in her joints. A brace was designed to help correct the alignment of her front left paw and to add aid to her carpal joint to relieve the stresses applied to her front paw. Different materials were used in the design of the brace to aid in comfort, support and traction while assisting in the mobility of the dog.

#### **57 A Alternate Battery Effects on Airsoft Firearms**

Barnabas Brennan, Quinten Hutchison, Sydney Tenaglia  
Case Western Reserve University

Airsoft firearms constitute a major industry for amateur sporting as well as police force training in the United States. The quality and characteristics of internal components have a considerable impact on cost and efficiency. Batteries of various types and ratings are used in the industry, the two most common chemical makeups being nickel-metal hydride (NiMH) and lithium-ion polymer battery (LiPo). NiMH and LiPo batteries are often used interchangeably in airsoft gearboxes, yielding consistent muzzle velocity, however, the rounds per minute (RPM) output in a typical gearbox differs between the two battery types. Airsoft enthusiasts have reported the augmented effects of using a lower voltage-rated LiPo batteries in place of higher-rated NiMH batteries, claiming the former yields greater RPM than the latter. The goal of this project is to measure the effects on RPM of using both NiMH and LiPo batteries and establish an empirical relationship. An 8.4 Volt NiMH and a 7.4 Volt LiPo battery are the primary points of comparison, but a 9.6 Volt NiMH and an 11.1 Volt LiPo are included for addition comparison. The batteries are tested on an airsoft UAR gearbox platform using a portable chronograph.



### **58 B VHDL Equalizer**

Brandon Mirto  
Youngstown State University

*Jalal Jalali, Mentor*

In recent years there has been a digital revolution in the music industry. This change has inadvertently caused a decrease in ease of control over the equalization of music. That is in layman's terms the bass, mids, and treble are more difficult to adjust without the use of some type of software or third party app. The goal of VHDL Equalizer is twofold. First and foremost, it brings back the knobs and slides that controlled older analog speakers but with a modern twist. The equalizer controller is a touchscreen LCD display built into the speaker box. The second major goal of VHDL Equalizer is the development of an equalizer and associated Digital Signal Processing (DSP) using a Field Programmable Gate Array (FPGA). This is different from traditional audio DSP methods in that it lacks a microprocessor in the design of the equalizer. Fast Fourier Transforms (FFTs) allow the FPGA to quickly alter the input audio signals based on the user controlled equalization levels on the LCD screen. Then inverse FFTs convert the signals back into the proper format to play through the speakers, of which there are three (one for each major range of frequencies). Future work on VHDL Equalizer may consist of improvements to the FFT algorithms, increased functionality of the LCD display, or a combination of the two.

### **59 A Digital Corn Hole**

Brennen Morrison, Brent Cole, Matthew Pilch  
Youngstown State University

*Jalal Jalali, Mentor*

For our Capstone Design Project we designed and implemented Digital Corn Hole Boards. This project takes the traditional collegian tailgating game and brings the idea into the 21st first century by implementing automated scoring and interactive visual displays. It works by using visual detection software to detect and score bags on the boards, as well as an RFID tag reader in the hole to detect and score ringers. The boards will bring excitement and innovation to a favorite back yard activity.

### **60 B Development of a Wind Measurement Tool Using a Hovering Drone**

David Pendleton  
Cleveland State University

Wind energy has become a major contributor for renewable sources and is expected to increase its portion to the overall energy supply continuously. As the investments and technology of wind turbines continue to grow, installation locations of wind turbines are spreading as well. Locations include offshore sites such as the Gulf of Mexico, Outer Continental Shelf and the Great Lakes. It is essential to accurately measure wind information to assess wind resources, predict power production efficiency and ensure timely maintenance of wind turbines. Current measurement methods of wind data involve equipment that lack flexibility or very expensive. This research aims to develop a new wind measurement tool based on a hovering drone. The tool will allow for desired flexibility regarding locations up to a couple of hundred meters above the land/water surface and at the fraction of the cost. This paper explains the construction of the measurement system and preliminary tests. Using a wind tunnel, optimal mounting of the velocity and temperature sensors on the drone are tested. In addition, a micro-processor (raspberry pi zero) is integrated to save data for post-processing. This work is funded by Cleveland State University undergraduate research program.

### **61 A Reciprocating vs. Wankel Engine**

Fadi Abas, Mark Bowling, Wayne Gyorgak, August Wright  
Cleveland State University

*Michael Adams, Mentor*

A comparison of the Wankel and Reciprocating Engines.

## **62 B Nanotechnology**

Hussam Taha, Haitham Nofal, Matthew Stewart  
Cleveland State University

*Marvin Thrash, Mentor*

Nanotechnology is the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering. The amazing field of technology first began in 1981, when the development of the scanning tunneling microscope was able to view individual atoms. It is very hard to visualize how nanotechnology is designed, because the measurement is one nanometer, or one billionth of a meter. To put it in perspective, there is 25,400,000 nanometers in an inch, and one sheet of a newspaper is 100,000 nanometers thick. Something we are going to focus on in nanotechnology is the way holograms are formed. A hologram is a three-dimensional image that is displayed by light beams and nanoparticles. The devices used to display the hologram are between 10 and 100 times smaller than just one of the millions of pixels used to produce a color image on a typical laptop screen, and they can also project a complete multi-color image to the eye. There is still research going on regarding the creations of holograms, and how nanotechnology can be used to assist the process, but there is definitely an open space for nanotechnology to thrive in the hologram market because nanotechnology will be used to create information storage for holograms, and much more.

## **63 A Design and Fabrication (3 D Printing) of Adaptive Grip Capable Prosthetic Hand**

Jason Huey, Blake Walker, Austin Snovak, Tyce Gall, Joshua Masters  
Youngstown State University

*Kin P. Moy, Theodore R. Bosela, Mentors*

Designed a prosthetic hand that can be 3-D printed with compliant gripping capabilities, as well as the ability to grasp and hold objects weighing up to ten pounds. The Whippletree Tensioner for Prosthetic Hands was the primary source for the compliance mechanism to give the gripping action and range of motion needed to achieve the goals. The current design and complaint mechanism, will allow testing of different control systems. Additional research on Myoelectric and body powered control system are being investigated.

## **64 B Predicting the Likelihood and Effects of Ice Jams in Waterways**

Jesse Saluga, Kelly Kovacevich, Kyle Bryan, Michael Craver, Efrain Velez  
Youngstown State University

*Suresh Sharma, Mentor*

An ice jam is a dam on a river formed by blocks of fragmented ice. Knowledge of ice jams is important in the design of structures being built near waterways as these fragments of ice can cause significant damage if not properly accounted for. Being able to predict where ice jams are likely to occur can have a huge benefit on hydraulic and structural engineering. Because ice jams can only form under certain temperatures, our project used various spreadsheets and historical temperature databases to analyze past temperature data in three regions where ice jams are likely to occur. We then used this past model to make future predictions about whether ice jams are likely to occur in these regions in the future. This data we will be able to determine if there needs to be any changes made to the current infrastructure.

## **65 B Design of a CNC Small Hole EDM**

Jon Bancroft, Cory Merlo, Kyle Spickler  
Youngstown State University

*Jalal Jalali, Mentor*

Our design team is constructing a machine known as an EDM, Electrical Discharge Machine. Its purpose is to use electrical arcs to progressively erode through a conductive workpiece. The end result is a hole which has the same shape of the electrode to be eroded through the workpiece. Our design goals are to build such a machine and to include several functionalities into the design. First, our machine will be able to drill small holes into any conductive workpiece using the EDM technique. Second, our machine will utilize motors to position the workpiece into different locations for drilling subsequent holes (also known as Computer Numerical Control). And third, our machine will present the user with a graphical user interface, GUI, which will allow them to interactively control the machine.

## **66 B Effects of Thin-film Interfacial Layer on P3HT:PCBM Standard Architecture OPVs**

Kevin Laverty

Case Western Reserve University

*Ina T. Martin, Mentor*

In standard-architecture organic solar cells, the most commonly used transparent conductive oxide (TCO) is indium tin oxide (ITO), and the most common electron blocking layer (EBL) is poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS). Studies have demonstrated that PEDOT:PSS corrodes ITO, which deteriorates cell performance over time. The addition of a thin organofunctional silane layer has been shown to mitigate the corrosion. Additionally, silanes have been used as both EBLs and hole blocking layers (HBLs) in standard and inverted architecture OPVs, respectively. In this work, the deposition of a thin monolayer of diphenyldiethoxysilane (DPDES) was investigated as an interlayer between the ITO and PEDOT:PSS and also as a standalone EBL.

## **67 A Modifying a 4 Stroke Engine**

Mackenzie Scrocco, Justin Stellmar, Matthew Hetzel, Logan Weinreber, Chase Persing

Youngstown State University

*Richard Goldthwait, Mentor*

Different schemes have been proposed to make internal engines more fuel efficient and less harmful to the environment. Some of these proposals fall into the category of “6 stroke engines”. The idea is to include an extra expansion stroke in the engine cycle in which the power for the extra stroke comes from recaptured waste heat. The only known working prototype for a 6 stroke engine uses water as the working fluid. Water droplets are injected after the combustion stroke, and heat converts the droplets into superheated steam which powers a second expansion stroke. Water-based 6 stroke engines have certain disadvantages. One disadvantage of using water centers around safety; the cylinder and cylinder head become a boiler. A second disadvantage is the need for a water reservoir. Because some researchers have proposed using air instead of water for 6 stroke engines, the team performed experiments on a small model engine to determine if air provides a feasible alternative to water.

## **68 B Attempted Recrystallization of Bisphenol A Based Benzoxazines**

Matthew Szigeti, Patrick Bonano, Wilmel Cosme, Tulibona Namulemo, Beoline Uwampamo

Case Western Reserve University

*Qichao Ran, Mentor*

Benzoxazine thermoset resins are promising, high-performance materials. Polybenzoxazines have useful properties including high glass transition temperature, high char yield, low water uptake, near-zero shrinkage during curing, and excellent mechanical properties. The technique of recrystallization has been successfully employed to purify certain benzoxazine monomers, resulting in very pure samples which are useful for characterization. In this study, benzoxazine monomers were synthesized, and purification by recrystallization was attempted. Benzoxazines were synthesized from bisphenol A, paraformaldehyde, and either aniline (BA-a), ethylamine (BA-e), or n-propylamine (BA-np). The recrystallization of BA-a is an established practice, and similar methods were pursued to attempt to recrystallize BA-e and BA-np. The samples were dissolved in different solvents and observed over a period of two weeks. However, neither BA-e nor BA-np underwent successful recrystallization.

## **69 A Cerebro - Campus Security Re-envisioned**

Nicholas White

Cleveland State University

*Pong P. Chu, Mentor*

Campus safety is at an all-time low. Email reports sent to students indicate that suspects are usually not apprehended, and victims are left in the dark for indeterminate amounts of time afterward. It is confusing that Campus Police Departments are left with the hand-me-downs of city police departments. This was confusing to us students since the best and brightest in the tech industry, the latest and greatest are right here, in the STEM departments of these universities. The cutting edge technology should be flowing upwards, starting with us, not downward. Using what we've learned over the past four years and in our professional careers, we are developing a Full Stack Security Suite which uses computer vision to detect and report crimes on campuses. We are also providing police with a new and improved interface through which they can analyze, report, and stop criminals. As a crime takes place, the individuals committing that crime are tracked through the city by a network of cameras until they are caught, all the way having their location and video feed streamed to client devices in police cruisers. This system

targets a growing \$50 billion market, and is currently in the process of being deployed to Cleveland State University's campus.

#### **70 B Modifying a bioactive polymer by embedding Hydroxyapatite & Antibiotics**

Rana Abu-Hashim, Seth Egry, Richard Ferry, & Vincent Pilolli  
Youngstown State University

*Holly Martin, Mentor*

In this research hydroxyapatite and antibiotics were embedded in the bioactive polymer, chitosan. Chitosan successfully attaches and grows bone cells. While hydroxyapatite is net needed for the bone matrix and gentamycin would prevent bio film infections. However embedding hydroxyapatite and gentamycin results in a very brittle material that likely could not with stand implementation stresses. Therefore a method to embed hydroxyapatite and gentamycin with minimal to moderate changes to the behavior of the chitosan polymer. The mechanical properties non-steady state mass transfer rate and diffusion rate were determine using the simulated body fluid.

#### **71 A Reinforced 3D Printing Filament**

Samuel Cappelli, Antonio DiSalvo, Claire Dodrill, Cameron Syersak  
Youngstown State University

*Pedro Cortes, Robert Marsch, Mentors*

The motivation behind this research experiment focused on attaining two different goals. The first was to determine the plausibility of creating a continuously reinforced, 3D printable filament using various compounds such as a carbon fiber or fiberglass strand as the core. If the first were to prove successful, the second goal aimed to test the practicability of this filament by successfully 3D printing a specimen, then testing this specimen for different characteristics and qualities relative to the reinforcement material used.

Through experimentation, a filament featuring a reinforced core was successfully produced and is under preparations for preliminary testing. Additionally, the research team is currently drafting proposals and readying the equipment necessary for further testing. Should this prove effective, other avenues for research and development of the technique and process can be explored.

#### **72 B Diabetic Medical Device Advancement**

Taylor Catri-Eakes, Hamza Abouabdalla, Ashleigh Bryson  
Cleveland State University

*Thomas Slaven, Mentor*

No more pricking your finger; no more hassles or interruptions for diabetics. Using nanotechnology, the Insulin Tech 2.0 device monitors and checks blood glucose levels internally and sends messages to a wireless insulin pump that administers the proper amount of insulin accordingly- on its own. The life of a diabetic will not differ much from a non-diabetic's anymore. We created a theoretical medical device that could be placed into the body using a vein graft. The research that we conducted for this project, involved running several tests to find a suitable glucose detector that could be safely placed into the body.

#### **73 A Variation in Recruitment Curves**

Tyler Kaptain  
Cleveland State University

*Eric Schearer, Mentor*

Functional electrical stimulation, or FES for short, is a method to control muscles in people with disabilities that impair muscle control such as spinal cord injuries. We would like to use FES to control a patients arm in a non-constrained manner. The goal of this research is to answer how recruitment curves in several trials differ. The relationship between the force outputted by a muscle group and the corresponding amount of stimulation used is called a recruitment curve. It is very important to know how much stimulation is needed to begin to output a force and the amount of stimulation needed to achieve the maximum force able to be produced. In real world scenarios, this is challenging. Muscles change day by day and as a result recruitment curves may vary. Using provided experimental data recorded on the same patient over a period of a several years, recruitment curves were generated and analyzed in how they varied.

#### **74 A Using ISAM to Understand The Effects of Our Carbon Output**

Hannah Goldberg, Colter Flynn, Matthew Miller  
Case Western Reserve University

ISAM is an online integrated assessment model that allows a user to analyze the relationship between the output of carbon into the atmosphere at several different rates and entities this Carbon effects on the timescale of the next 84 years. This group chose to focus on the output of carbon's effects on radiative forcings and sea level. For both radiative forcings and sea level, two hypothetical outputs of carbon were applied. The first being continuation of human's current output projected, and the second being an 80% ramp down in carbon emitted by humans. This application of ISAM allows one to see the detrimental effects that "business as usual" could lead to and what one of the most optimistic plans of reduction could help humanity save.

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## **Mathematics, Statistics, and Computer Science**

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#### **75 A Improved Newton's Method in Optimization Problems**

Abigail Kramer  
Kent State University

*Jing Li, Mentor*

This study evaluates the effectiveness of modifications on the Newton's Method, in application to optimization problems. The Newton's Method is unreliable, based on the starting point, however modifications reduce the amount of iterations and increase the probability that the minimum is found. The various methods are investigated, then tested for multiple scenarios to find what criteria they work best under and which is most robust. This allows the most efficient method to be used depending on the function and the initial point given.

#### **76 B L'Hospital's Rule Can Be Used to Evaluate $\lim_{x \rightarrow 0} \{\sin x/x\}$**

Anita Mizer  
Kent State University

*Jeffrey Osikiewicz, Mentor*

A practical way of evaluating the derivative of  $\sin x$  is to use a limit. This limit is indeterminate form of  $0/0$ , which leads to a contradiction. L'Hospital's Rule cannot be used on this limit when that limit is used to evaluate the derivative. The objective of this project is to examine another method to find the derivative of  $\sin(x)$  without using a limit. Once this proof is established, L'Hospital's Rule can be used on this limit without any contradictions.

#### **77 A Detecting Algorithmically Generated Strings**

Barton Yadowski  
Kent State University

*Fedor Nazarov, Mentor*

A demonstration of various techniques to distinguish between strings generated algorithmically and those created by humans. Techniques such as n-grams, Markov chains, binary classifiers, and Levenshtein distance are considered. Practical applications with a focus on information security industry.

#### **78 B Banach-Tarski Paradox**

David Carlyn, Corey Bryant, Rebecca Leppelmeier  
Kent State University

*Mikhail Chebotar, Mentor*

In our study of the Banach-Tarski Paradox, we studied sets, including the definition of the empty set. This led us to study paradoxes involving sets and infinity. These paradoxes include the Barber paradox, and the Santa Claus paradox. This led us into further study of the axiom of choice and Lebesgue's immeasurable sets. Lastly, before we get into the paradox of Banach-Tarski, we studied transfinite induction. After understanding all of the topics discussed, we dug into the paradox. This paradox involves a deep understanding of free-groups. Then we are able to understand and explain the Banach-Tarski paradox, which states that if we have a sphere, we can decompose it into disjoint subsets and reassemble those subsets to obtain two identical replicas of the original sphere.

**79 A Fractals**

Drew Dunlap  
Kent State University

*Mikhail Chebotar, Mentor*

I plan to research previously known properties of fractals. How they were discovered, what they do, how they do it and everyday useful applications.

**80 B Knight Tours and the 1-Skeleton of a Hypercube**

Elliot Golias  
Kent State University

Chess has paralleled mathematics in its ability to provide endless challenges. In fact, one piece deserves its own veneration: the knight. We will investigate the properties of paths a knight can traverse on a chessboard, and we will comment on the relationship between one particular path and a projection of the 1-skeleton of a hypercube.

**81 A Card Shuffling**

Emily White , Alana Kemp  
Kent State University

*Adam Parr, Mentor*

Our project will focus on the different types of card shuffling. The main purpose is to identify how many times of shuffling it takes for the deck to become completely random again. We will discuss the rising sequences of permutations and measures of randomness. There will be an explanation of why each form of shuffling requires so many times to become random. This project will demonstrate which form of card shuffling is the most efficient in order to produce a completely random deck.

**82 B Battleship Playing Program Utilizing Probability Density Functions**

Jacob Boyd, Jonathan Boyd  
Kent State University

*Darwin Boyd, Mentor*

The classic game Battleship has been played since the early 1900s as a two player Navy strategy game. As an extension of a computer science class project of creating a simplified version, we have coded a complete working version of the game as well as created a computer algorithm that is capable of playing against a human player. The algorithm utilizes probability density functions to predict the most probable positions of an opponent's game pieces. It analyzes parameters such as previous moves as well as known hit locations to select an optimal move to sink the opponent's ships.

**83 A Blackjack Math**

Jacob Tompkins, Jaime Eiben, Anna Lombardo  
Kent State University

*Corey Lyons, Mentor*

Card counting is a mathematical strategy used in the game "blackjack" to help players capitalize from their bets. The most common strategy used for card counting is called the "Hi-Lo" system, which ranks groupings of card values based on how high or low the cards are and assigns them a numerical value of either -1,0, or +1. As each card is dealt, the numerical value assigned to each card is added together. This sum is known as the count. Once the player has a count for the cards dealt on the table, he or she can approximate which cards are more likely to appear in the next hand. With this edge, players can more accurately determine when to bet bigger, cultivating a 1% improvement in the odds of winning. Our poster is designed to illustrate the mathematical process behind counting cards and how it can improve a player's prediction of the possibility of being dealt certain cards. The purpose of our research is to validate that the math behind counting cards is accurate and prove that the method can improve a player's chance in winning.

**84 B A Blind Date With Computers**

Jalen McKinnie, Alexander Thornton  
Cleveland State University

*Nigamanth Sridhar, Mentor*

The poster is going to be about where level of technology currently is to help visually impaired people use computers. Emphasis will be on the hardware involved, including what visually impaired actually need to use a computer. Software using sound will also be emphasized as audio files will be manipulated to improve understanding of the contents on the screen. Our conclusion will ultimately be what we found in our analysis to be this technology's current point, as well as a proposal to move it forward.

**85 A Common Sorting Algorithms**

Michael Hinton, Jacob Katzenmeyer  
Cleveland State University

Sorting algorithms are very important for computer programmers, and there have been many developed throughout the years. Each algorithm has the same objective: to sort a collection of data in ascending or descending order. We will explore some of the most common (and easy to implement) sorting algorithms, including Bubble Sort, Selection Sort, and Quick Sort, and prove their time complexities.

**86 B The Birthday Paradox**

Michael Skowrons, Michelle Waugh  
Kent State University

*Artem Zvavitch, Mentor*

We explored approaches to solving and explaining the Birthday Paradox, as well as the underlying probability theory. The problem is concerned with the probability of two people sharing a birthday within a finite group, and the solution shows this probability is surprisingly high. Solving this problem makes use of the Pigeonhole Principle, Central Limit Theorem, and numerical techniques. The solution appears counterintuitive, even paradoxical, but follows from basic probability theory.

**87 A The Lawn Sprinkler Problem**

Stanley Zalewski, Matthew Grissom  
Kent State University

A common lawn sprinkler sprays water in a circular motion. If we know the landing spots of each drop, can we surmise the placement of the sprinkler itself? We attempted to model this problem by dropping coins on a grid, resulting in a random spread similar to the sprinkler. We then used classical statistical calculations (range, mean, median) in an attempt to regressively find the origin point from which the coins were dropped. Finally, we applied Rossmo's Formula, which was originally used to hunt serial killers, in order to probabilistically model our experiment with a more sophisticated approach.

**88 B The Calculus of Finite Differences and Difference Equations**

Alexander Margetis, Rebecca Finley, Daniel Squeri  
Kent State University

*Richard Shoop, Mentor*

We try to lay the foundations of the theory of difference and sum calculus and difference equations analogous to those of the differential and integral calculus and differential equations. We are trying to prove the Dirichlet kernel equation using calculus of finite differences, and show the importance of it to the Fourier series. The Dirichlet kernel is a collection of functions named after Peter Gustav Lejeune Dirichlet. The Fourier series relates with the Dirichlet Kernel, from the convolution of  $D_n(x)$  with any function  $f$  of period  $2\pi$  in the  $n$ th degree Fourier series approximation to  $f$ . A Fourier series is a way to represent a function as the sum of simple sine and cosine waves. Basically, it decomposes any periodic function into the sum of a set of simple oscillating functions, namely sines and cosines.

## **89 A Mathematical Approach of 3D Printing of Satellite Thermal Management Systems**

Caitlyn Rodomsky

Youngstown State University

*Brett Conner, George Yates, Mentors*

A CubeSat is a miniature satellite with dimensions based on a cube unit-cell with a 10cm side length. This type of satellite has been historically used for university-developed space research, but NASA is examining CubeSats as a low-cost means for more capable space missions such as lunar-orbit missions. These missions would require the CubeSat to carry multiple experiments each generating waste heat that must be managed so temperature-sensitive electronics will not be damaged. The vehicle also has significant internal volume and exterior surface constraints. With this in mind, NASA must implement a structurally-efficient thermal management system to regulate the temperature inside the CubeSat and eliminate during experiment testing in space. One approach would be a multi-functional 3D printed structure incorporating a phase change material (PCM). A PCM melts or solidifies at a relatively low temperature thereby regulating heat by storing and releasing energy. Analysis and simulation results are provided showing that incorporating a PCM will enable longer run times for the on-board experiments and will regulate the heat in the CubeSat.

## **90 A Fielding Error Correcting Codes**

Donald (Wayne) Fincher, Jeremy Bousa

Kent State University

*Donald White, Mentor*

In this research project, single error correcting binary codes of arbitrary finite length were investigated via the use of combinatorics, linear algebra, and finite fields. Answers were sought to questions such as what is the largest number of code words that can be contained in a dictionary of possible messages such that errors in the sent message can be detected or even corrected. The results of this research make it possible to find the densest packing of code words, i.e., the most efficient set of code words. This is an important area of research because of the increasing reliance on digital communications, which are based on binary messages. We build on the work of Richard Hamming who contributed the Hamming distance, which is a method for measuring the difference between two segments, i.e., words, of a message. Our results suggest that for a message of length  $n$ , where  $n$  is at least 4, there are  $2^{n-3}$  single-error correctable code words out of  $2^n$  possible words. These results will allow us to make further strides toward finding efficient multiple-error correcting codes in the future.

## **91 A Probability of Winning Solitaire**

Garrett Anderson, Ian Wentzlaff

Kent State University

*Christos Saroglou, Mentor*

We are researching the probability of winning a game of solitaire if we are given an ace in the first hand. We will test the winning percentage of each spot and compare to see if one spot has a greater winning percentage than another.

## **92 B Cyclic and Constacyclic Codes in Accordance with Algebraic Coding Theory**

Jillian Gaietto

Kent State University

*Hai Q Dinh, Mentor*

Coding theory has developed alongside the use of communication. When communicating across a channel, it is inevitable that such pathways of communication be "noisy". The absence of noise is virtually impossible to attain, thus there is always some sort of interference across the communication channel. This results in messages not always being received as they were originally sent. In order to solve these problems, coding theory developed. It is used both to detect and correct errors in a variety of codes. Coding theory has grown into a discipline affecting all sorts of areas including but not limited to computer science, mathematics, and engineering. The codes can be used for data compression (or source coding), error correction (or channel coding), cryptography and even network coding. Primarily in error correction do we find codes which we are able to transmit quickly, contain many codewords, and also can correct or detect many errors. Within this discipline, a concentration on algebraic coding theory lies with linear codes. There are a variety of different codes discovered within this set of linear codes, including cyclic and constacyclic codes. In this poster presentation, we will discuss the history of coding theory, going



in depth with cyclic and constacyclic codes, as well as discussing the many applications and current problems being resolved using algebraic coding theory.

### 93 A An Analysis of Path Optimization Using Critical Volume Density

Julian Sobieski

Kent State University

*Shawn Ryan, Mentor*

Many studies have been conducted for the optimization of paths between two points. The problem becomes complicated when obstructions occur along the optimal path. By how much does the path length change? Is there some density where it is better to just avoid the obstacles all together?

We start with a small two-dimensional system to investigate this problem. Based on intuition from studying the small system, we suspect there is a critical density where the complexity of the problem is significantly increased, resulting in a much longer path. Many real-life systems from physics and biology exhibit a critical volume density around 30%; we expect to observe something similar in this system. To study this, we will consider a plot of obstacle volume density vs. distance travelled for a larger system. This ordered system will be primarily examined to gain a general idea for application. With the results of an ordered system, we will make predictions about real life systems which exhibit a degree of disorder. Time permitting, we will also look at the role of order and randomness in the placement of obstacles.

### 94 B NFL Coaching Decisions

Kory Slusser, Bryan Ritchie

Kent State University

*Jun Li, Mentor*

In an industry that does not tolerate failure, NFL coaches face extreme pressure to succeed in the NFL. While a lot of a coaches success can be attributed to the skill of the players he coaches, this is not enough to be a successful coach in the NFL. What makes a coach great is his ability to make the right decision during crucial game situations. These critical decisions include attempting an onside kick, going for a two point conversion, leaving the offense on the field on fourth down, and many more. This project looks at the statistical breakdown of these decisions to determine the best decisions for coaches in various crucial game situations.

### 95 A Exploring Infinite Series

Lexi Rager, Jenna Wise

Youngstown State University

*Padraic Taylor, Mentor*

In this project we investigate two important problems in the history and development of infinite series, and we use an infinite series to study an intriguing spin on the famous Cantor Set.

In 1644, Pietro Mengoli posed the problem of finding the sum of the series  $\sum_{n=1}^{\infty} \frac{1}{n^2}$ . This problem remained unsolved for nearly one hundred years until 1735, when Leonhard Euler used a novel approach to discover a closed form for this sum, and eventually for series of the form  $\sum_{n=1}^{\infty} \frac{1}{n^{2k}}$ . We will share his method of discovery and apply it to give closed forms for  $\sum_{n=1}^{\infty} \frac{1}{n^2}$ ,  $\sum_{n=1}^{\infty} \frac{1}{n^4}$ , and  $\sum_{n=1}^{\infty} \frac{1}{n^6}$ .

Every very calculus student learns  $\sum_{n=1}^{\infty} \frac{1}{n}$  diverges. However, what happens when one considers

$\lim_{n \rightarrow \infty} 1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n} - \ln(n)$ ? In this project, we use a geometric argument to show this series converges to a famous number known as Euler's constant.

Finally, consider the problem of removing the middle fourth of a table, then the middle sixteenth from each of the two remaining pieces and so on. Using geometric series, we investigate this problem, known as "Cantor's Disappearing Table", and discover a surprising result.

**96 B Student Debt: Distributional Analysis**

Matthew Cremean, Kathryn Palmucci, Matthew Waaland, Daniel Wilkerson  
Kent State University

*Oana Mocioalca, Mentor*

Our poster will display findings regarding the average student debt amounts for students attending Kent State University. After surveying students, we will use statistical concepts to find the distribution of student debt. We will specifically be looking at over all debt amounts, debt between colleges, and also other variables. We will compare our findings with state and national averages.

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LaLama, Matthew	25	A
LaTessa, Kristin	13	A
Limperos, James	43	A
London, Kevin	37	A
Manna, Matt	35	A
Martin, Daniel	39	A
Masters, Joshua	63	A
McAnallen, Jennifer	56	B
McGuigan, Nicholas	27	A
Merlo, Cory	65	B
Miller, Jennifer	17	A

Mirto, Brandon	58	B
Mock, Samantha	34	A
Monroe, Sasha	37	A
Morrison, Brennen	59	A
Mudrinich, Jon	37	A
Odeh, Firaus	37	A
Ortiz, Bryan	33	A
Osiniak, Matt	35	A
Patrick Hyden	51	A
Pearce, Isaac	13	A
Persing, Chase	67	A
Pilch, Matthew	59	A
Pilolli, Vincent	70	B
Rager, Lexi	95	A
Rebraca, Thomas	20	B
Rodonsky, Caitlyn	89	A
Roth, Ralph	22	B
Safi, Ismail	25	A
Saluga, Jesse	64	B
Schantz, Ian	44	B
Schilling, Karen	56	B
Scrococo, Mackenzie	67	A
Seidler, Amanda	6	B
Shaulis, Mason	35	A
Snovak, Austin	63	A
Spickler, Kyle	65	B
Stellmar, Justin	67	A
Strong, Martin	27	A
Svenson, A.	29	A
Syersak, Cameron	71	A
Tsangaris-Braatz, T.	29	A
Turocy, Tayah	34	A
Varga, Bailey	33	A
Velez, Efrain	64	B
Walker, Blake	63	A
Weinreber, Logan	67	A
White, Lydia	22	B
Wilson, Benjamin	39	A
Wilson, Darian	25	A
Wise, Jenna	95	A
Yusuf, A-R.	29	