

Case Western Reserve University  
Cleveland State University  
Cuyahoga Community College  
Kent State University  
Youngstown State University

Present

Choose  hio First

**Research Poster Conference**

**Sunday, April 15, 2018**  
**Youngstown State University**  
**Kilcawley Center**

# Schedule of Events



Look for this penguin image on the Kilcawley map.

12:00 – 12:45 p.m.	Check-In – Upper Level, Cafaro Lobby Poster Set-up – Lower Level, Chestnut Room Extension/Thomson Fountain Commons Box Lunch Pickup – Lower Level, Wendy’s
12:15 – 12:45 p.m.	Judges Orientation and Lunch Upper Level, Ohio Room
12:50– 1:50 p.m.	Session A – Poster Presentations Lower Level, Chestnut Room Extension/Thomson Fountain Commons
2:00 – 3:00 p.m.	Session B – Posters Presentations Lower Level, Chestnut Room Extension/Thomson Fountain Commons
3:00 – 4:00 p.m.	Judges’ Meeting Upper Level, Ohio Room
3:10 – 4:00 p.m.	<i>“The Impact and Importance of Research and Innovation”</i> –Panel Discussion Lower Level, Chestnut Room
4:15 – 4:45 p.m.	Recognition Ceremony Lower Level, Chestnut Room Extension
4:45 – 5:00 p.m.	Poster Take-Down by Student Teams and Departure Clean up

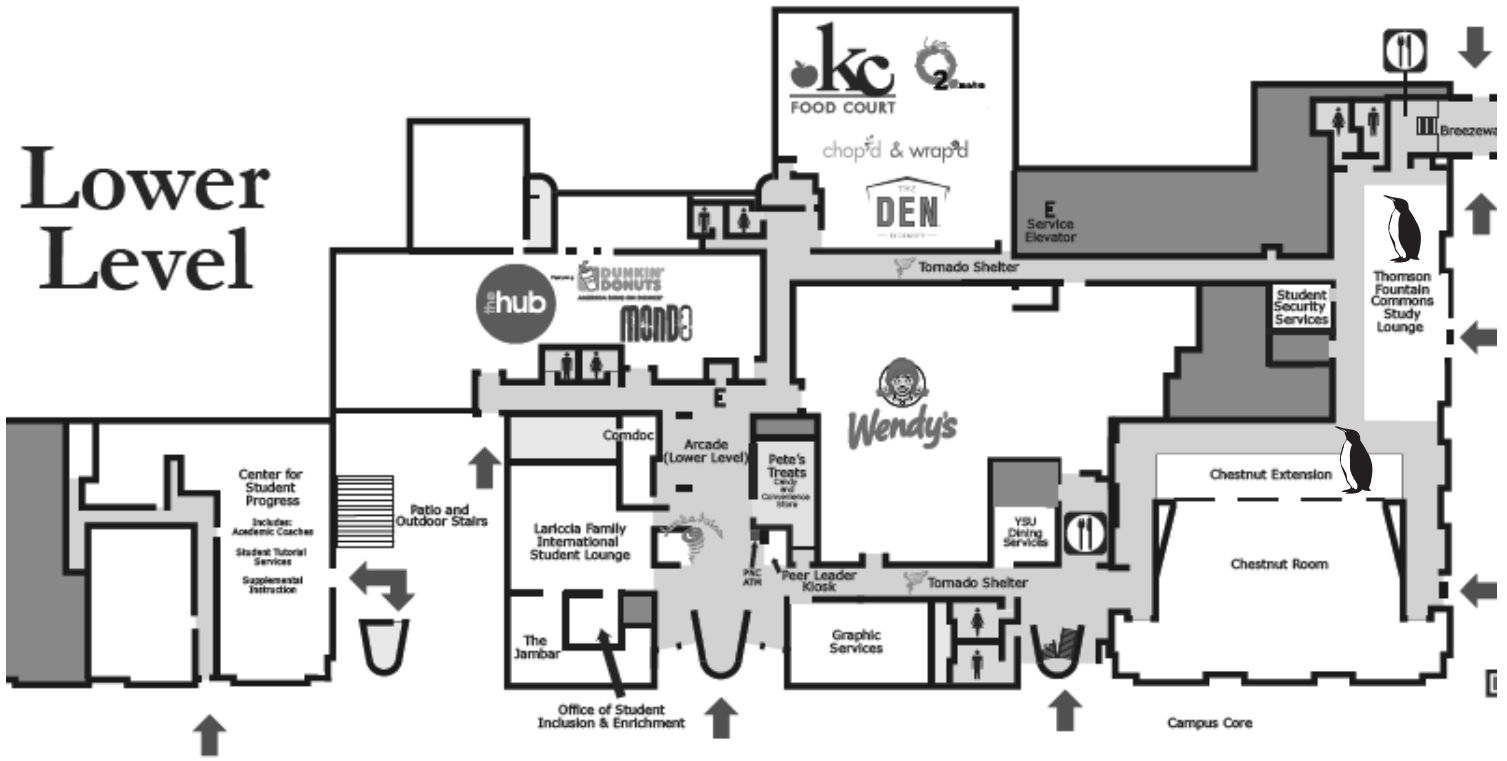
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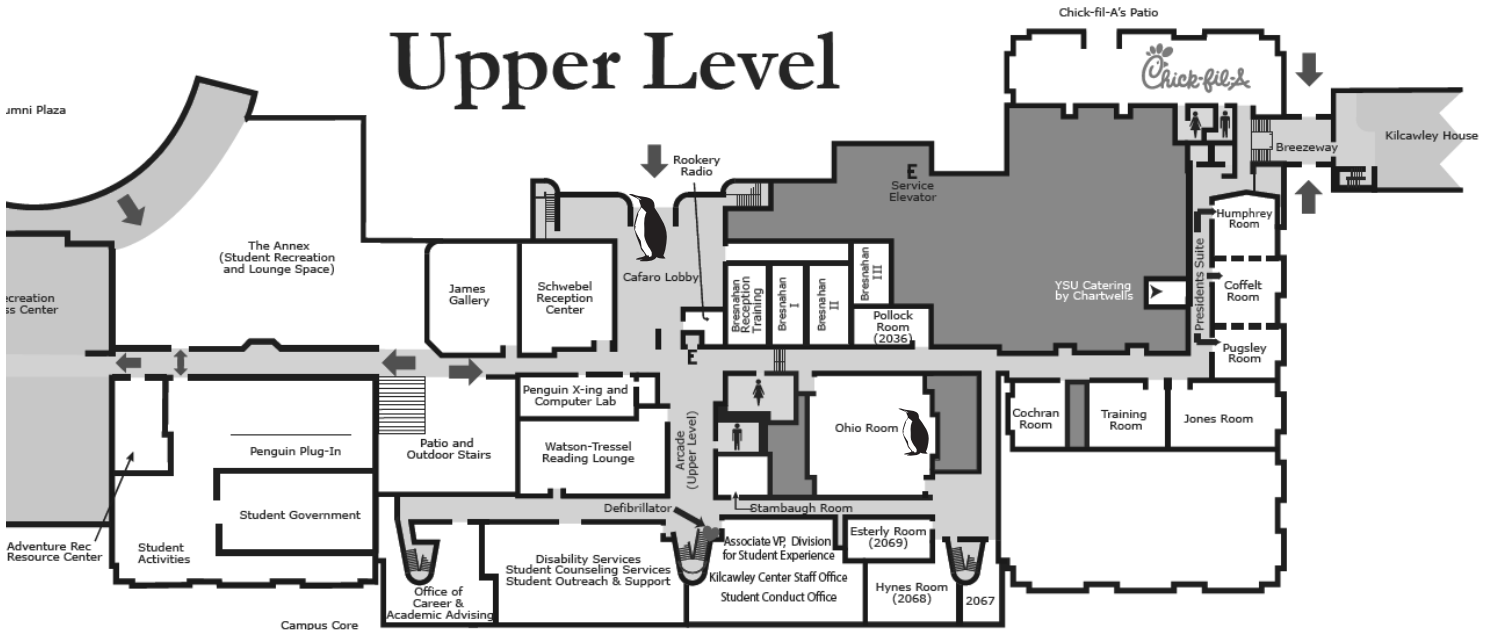
# Kilcawley Center Map

## Lower Level



▲North

## Upper Level



# Panel Discussion

## *The Impact and Importance of Research and Innovation*

### **Dr. Peyman Givi, University of Pittsburgh**



Dr. Peyman Givi is Distinguished Professor, and the James T. MacLeod Professor of Mechanical & Petroleum Engineering at the University of Pittsburgh. Previously he held the position of Distinguished Professor of Aerospace Engineering at SUNY-Buffalo. He has also had frequent visiting appointments at the NASA Langley and Glenn (Lewis) centers, and received the NASA Public Service Medal (2005).

Dr. Givi is among the first 15 engineering professors who received the White House Presidential Faculty Fellowship from President George H.W. Bush. He is Fellow of AAAS, AIAA, APS and ASME and was named ASME Engineer of the Year 2007 in Pittsburgh. He is the Deputy Editor of AIAA Journal and serves on the editorial boards of several other publications. An alumnus of STEM-YSU (BE in Mechanical Engineering), he received his MS and PhD from Carnegie Mellon University.

### **Elliott Reed, Northeast Ohio Medical University/REDIzone**



Elliot Reed, has been involved in the commercialization of over 20 university and research institution patents. At NEOMED, he serves as the Program Manager for the REDIzone business incubator, Entrepreneur in Residence, and as a Graduate Faculty member of the College of Graduate Studies. Prior to NEOMED, he was running two orthopedic-focused medical device companies as CEO for 9 years. Additionally, he served in the technology transfer office at Los Alamos National Laboratory and supported the translation of over 15 early-stage disruptive technologies. He holds a Bachelor of Science in Microbiology from Arizona State University and a Masters of Business Administration and Juris Doctor from Case Western Reserve University

# POSTER ABSTRACTS

## Basic and Medical Sciences

### **1A Pathogenic mechanism of epilepsy-associated gamma-amino butyric type A receptors**

Angela Whittsette, Omar Mahmoud, Omar Sumrain, Nadia  
Case Western Reserve University

*Tingwei Mu, Mentor*

Recent advances in genetics identified many mutations in gamma-amino butyric type A (GABAA) receptors that are associated with Idiopathic Epilepsy. Such mutations lead to loss of their function on the PM and disrupt neural circuits. We identified mutations that lead to their misfolding and excessive protein degradation in cells and loss of their protein levels, the plasma membrane. We used cellular assays that evaluate protein aggregation and protein levels to find out causes of epilepsy-associated mutant gamma2 subunits. In the experiment we cultured human embryonic kidney cells (HEK293 cells), expressed GABAA receptor variants in HEK293 cells by transfection, performed SDS-PAGE protein electrophoresis, and concluded with a Western blot analysis. We demonstrated that two specific mutations in gamma2 subunits, R177G and G257R, caused excessive misfolding of the mutant subunits.

### **2B The effects of road salt runoff on seed germination**

Dan Londrico, Joshua Ryan  
Cleveland State University

*Dr. Andrew Resnick, Mentor*

Halite rock salt is frequently used in areas that experience large amounts of snow, as a means to melt ice, making it easier to clear and clean roadways. Much of this rock salt is usually picked up as runoff, where it can make its way into the local soil, and affect the local environment. From here it can interact with root systems and produce adverse effects in the local plant life. Because of this, an experiment was put together to test the effects of this on seed germination. Research has shown that different plants can have different tolerances for sodium chloride, so to encompass this spectrum of tolerances, four different plants were chosen, with different tolerances, ranging from low, to moderate/high, in order to develop a broader sense of the effects which using halite has on the local environment.

### **3A 3D Bio-Printing of Muscle Tissue**

Ashley Labatte, Sreya Brahmandam, Evan Leek, Allison Rea, Randah Abubashim  
Youngstown State University

*Dr Gary Walker, Mentor*

Myoblasts, Myogenic stem cells are capable of differentiating into functioning contractile myocytes (muscle fibers). In skeletal muscle, myocytes are aligned in parallel arrays. This allows for contraction in only one direction, all myocytes working together collectively to provide contractile force in a functional manner. This geometry cannot be achieved by traditional culturing methods. Bio-Printing offers a method of achieving this geometry, aligning cells in parallel arrays in culture. Using the Inkredible® bio-printer to print out grid like structures containing myoblasts allows us to control the tissue geometry. In order to confirm we have live muscle tissue we utilize a number of assays: nuclear staining to observe the present nuclear morphology by microscopy, scanning electron microscopy to observe structure of the matrix, qPCR to access biological function.

### **4B ACEs in Relation to Behavioral Health Screening Tools**

Ashley Amendol, Hannah Haynie, Isna Khaliq, Samantha Koullias, Konnor McCoy  
Youngstown State University

*Dr. Ronald Dwinnells, Mentor*

Adverse Childhood Experiences, or ACEs, have a tremendous impact on lifelong health: physical and behavioral, as well as future violence victimization and perpetration. As such, ACEs are an important public health issue being the fastest growing health concern in the country. However, most people are unaware that they exist. Our group hypothesized that ACEs scores would correspond with behavioral health screening tools measuring depression, addiction, and trauma. After collecting the behavioral health history from 100 adult patients, a correlation was commonly present. The importance of individuals seeking help to overcome trauma and develop resiliency is crucial but not limited to, combatting future health issues such as physical illness or mental illness (including addiction) which may lead to early death.

## **5A Common Iliac Aneurysms**

Lauren Satterlee

Cuyahoga Community College

*Prof. Bassem Al-Kaimari, Mentor*

A case study on common iliac aneurysms and how they are diagnosed and commonly treated is presented. Aneurysms are a weakening of the walls of an artery that can occur in many different areas of the body. The common iliac arteries are located in the pelvis, bifurcating from the abdominal aorta. Treatment of common iliac aneurysms may include: controlling risk factors; close monitoring; and/or surgical repair/stenting.

## **6B Improving Paramedic Cardiology Training**

Quinten Hutchison, Paul Palumbo

Case Western Reserve University

Paramedic students spend approximately one quarter of their training learning cardiology and EKG rhythm interpretation. Currently, the number of unique EKGs, particularly rare or highly lethal rhythms, is limited. Because of this, students must continually train on the same set of common EKGs throughout their entire multi-month cardiology unit, and receive little to no training for rarer rhythms. Another major issue is the dissimilarity in cleanliness and readability between the relatively clean, and polished training EKGs and those encountered in the field, that are often dirty and full of background noise. Because of these major discrepancies, new paramedics are often overwhelmed when they first encounter an EKG in the field.

## **7A Construction of Fluorinated Metal Organic Frameworks**

Samuel Dickson

Youngstown State University

*Dr. Douglas Genna, Mentor*

Construction of Metal Organic Frameworks has been on the forefront of research over the past few decades due to their versatility in medicine and engineering. Fluorinated linkers that are connected to the metal nodes would give more functional possibilities to the framework and, thus, have been the central purpose of this research. Details will be given to how the linkers were synthesized due to the difficulty it presented, followed by the synthesis details of the metal organic framework that followed.

## **8B Brain Activation Across Timbre in Musicians and Non-Musicians**

Nicholas Bryson, Taylor Catri-Eakes

Cleveland State University

*Dr. Tatiana Gracyk, Mentor*

Timbre is a characteristic of sound perception that aids in the identification of sound quality and source. When a sound is identical in other characteristics of its envelope, timbre is the defining feature that helps distinguish it. It is timbre that allows a listener to hear the difference in sound source when both a trombone and a trumpet play the same note simultaneously. Timbre can be understood as the reason we distinguish between the howl of the wind, and the whistle of a passerby. There have been numerous studies associated with research on sound perception; however, there has been limited research on the specific influence that timbre has on brain activation in sound perception. In this presentation, we will be going over the current research that has been done on brain activation in timbre, and what still needs to be done.

## **9A Exploration of the Sensitivity and Visual Field of African Clawed Frogs to Visual and Lateral Line Stimuli.**

Marcus Lard, Madison Spahlinger

Cleveland State University

*Jeffrey Dean, Mentor*

This poster deals with research performed upon the African Clawed Frog, *Xenopus laevis*, inside of an aquatic testing tank. The testing on the frogs focuses on either the lateral line system or the visual system. The primary focus of this research is testing the visual system of the African Clawed Frog, being its eyes. The main goal for this research was to explore the original hypothesis set prior to testing. The hypothesis was tested using a testing arena with four plexiglass rods, two clear and two black marked, hanging above the water. It was hypothesized that the frogs would not be able to see the completely clear rods and would not respond to them. In addition, it was hypothesized that the frogs would not respond to visual stimuli released towards their posterior and stimuli at larger distances. The rods were released in multiple different distances and angles relative to the frog.

### **10B The Negative Effects of Sleep Deprivation**

Gage Faison, Polina Bufogle  
Cuyahoga Community College

*Cathleen Rossman, Vanitha Parameswaran, Mentors*

Sleep deprivation is no laughing matter, every year millions of Americans are affected by the savage condition. It is also blamed for many major disasters such as the Chernobyl nuclear disaster and grounding of the Exxon Valdez oil freighter. Something even scarier to normal people is studies have found that 40.6 million American adults get six or fewer hours of sleep a night. The scary part about that is people that are sleep deprived enough have the same impairment as a drunk driver. Sleep depravity is also the cause of a host of health issues. I even find myself constantly battling the horrible beast. This leads me to question what causes sleep depravity? There are three main factors that lead to sleep deprivation. Sleep deprivation is very preventable if a few steps are followed. The idea of this poster is to bring to the forefront the problem that millions of Americans face daily.

### **11A Feeding Behavior Analysis of Manduca sexta**

Carmaletta Hinson, Caroline Theile, Makayla Hardin  
Case Western Reserve University

*Mark Willis, Kim Thompson, Mentors*

In this study, our team will examine the effects of manipulating the variables of flower height and position of makeshift flowers in order to see how these variables affect the feeding pattern of a moth. In order to do so, flowers will be made from a paperlike material, and feeding will be stimulated through natural hunger (of four day old female moths) as well as sucrose feeding solution and the presence of a common floral odor. Data will be analyzed utilizing angles and statistical significance to determine the pattern if any. Our conclusion to this research however, is still pending at this time.

### **12B Percolation Through Voids Around Structurally Disordered Sand Grains**

Nicholas McGuigan  
Youngstown State University

*Dr. Donald Priour, Mentor*

Fluid flow or charge transport through porous materials takes place within voids around impermeable grains. With increasing density of grains, fluid flow diminishes, ultimately ceasing at the percolation transition separating configurations macroscopically navigable; and those which block fluid flow in the bulk limit. Theoretical studies of void networks have generally been confined to monodispersed systems of uniform particles, with no calculations of percolation thresholds for diverse grains. In addition to positional and orientational disorder, we incorporate structural disorder by imposing random variations in the geometries and sizes of grains. We consider cubes distorted into rectangular solids with random proportions. More comprehensibly, we also examine configurations of structurally disordered tetrahedra with both random perturbations in edge lengths and dihedral angles.

### **13A The Efficacy of UV Disinfection in Relation to the Physical Properties of the Surface**

James Ellis  
Cleveland State University

*Dr. Petru Fodor, Mentor*

UV radiation is a common disinfection technique that kills bacteria without increasing the risk of antibiotic resistance. This study seeks to understand the relationship between the properties of the surface being treated and the efficacy of treatment. Bacteria cultures are applied to glass, steel, aluminum, lead, polystyrene, and synthetic sponge before being exposed to UV radiation. Survival rates of bacteria are tested using plate count agar method. The efficacy of disinfection is determined by how many colonies are able to grow from the disinfected samples.

### **14B Physical Properties: Determination of Melting Points**

Youngjun Park, Beatrice Anne Malala, Gavin Wu, Patrick Bonano  
Case Western Reserve University

Unknown solid was given to identify from a list of various solids (0617 MP-449). With the concept of melting points, the unknown compound was first melted and was recorded to be 131-134 degree C. Then the unknown compound plus another similar melting point compound was melted together followed by another similar melting point compound. From the data gathered the unknown compound given was predicted to be urea .



### **15A Prevalence and Cost of Obesity**

Jason Lee, Ramandeep Gill, Hunter Flati, Vi-Trinh Luu,  
Youngstown State University

*Dr. Charles McGowen, Mentor*

Studies have shown America has spent about one hundred fifty billion dollars to help treat obesity a year. Looking at the past six months, data was taken from several clinics in northeast Ohio to estimate the amount of money was being spent to treat obesity in the region as well as the commodities associated with the disease. With over a hundred patients in the area considered morbidly obese, the cost is over twenty thousand dollars a year for just obesity. There are easy solutions, both for those suffering from obesity and those who want to help.

### **16B Zero-point Energy and its Effects**

Victor Ipinmoroti, Sarah Alabsi, Caitlin Cole  
Cleveland State University

*Jearl Walker, Mentor*

Zero-point energy (ZPE) is energy that is associated with a vacuum, or where temperature is near absolute zero. In 1911, Maxwell Plank derived an equation for the energy emitted by a black body. This equation included the temperature for the black body, which when set to zero shows that a certain amount of energy being absorbed exists. This would be the first occurrence of zero-point energy. Later the likes of Dirac, Lamb, Casimir and even Einstein will make significant progress in proving the existence of ZPE. In this poster we will discuss the various contributions of these individuals. We will look at the Heisenberg Uncertainty principle and how ZPE is a direct implication of this principle. Additionally, we will also mention some aspects of Quantum field theory, the Casimir effect and Dynamic Casimir, and some experiments attempting to use the Casimir effect in nanotechnology.

### **17A Relationship between oxalate-degrading bacteria and urolithiasis of *Aonyx cinereus* in captivity**

Claire Holliday  
Case Western Reserve University

*Dr. Pam Dennis, Dr. Dianne Kube, Mentors*

Oxalate-degrading bacteria, such as *Oxalobacter formigenes*, often populates the gastrointestinal tract. This bacteria is attributed with maintaining oxalate homeostasis and preventing hyperoxaluria which leads to the formation of calcium oxalate (CaOx) calculi. CaOx calculi is the main composition of uroliths in Asian small-clawed (ASC) otters. While the status of urolithiasis in wild ASC otters is unknown, it has posed a significant health problem to ASC otters in captivity. According to a 1988 survey of the North American ASC otter population: 66% of 56 otters surveyed had renal calculi and 23% cystic calculi. Our hypothesis is that there is a negative correlation between oxalate-degrading bacteria and ASC otters with present urolithiasis. Furthermore, it may be that oxalate levels in captive ASC otter diet are a compounding factor to this high rate of disease.

### **18B Random Lasing in Liquid Crystals Doped with Dyes and Plasmonic Nanoparticles**

Kelsey Darrah, Mary McPheeters  
Case Western Reserve University

*Giuseppe Strangi, Mentor*

Laser light is generated by merging two important physical mechanisms, amplification and optical feedback. Amplification is mainly due to gain materials, whereas the optical feedback is obtained through an optical cavity that allows for mode selection via light localization. This light localization mechanism is typically created using two mirrors. However, it is possible to replace this cavity with a multiple scattering material, such as a dielectric particles or nematic liquid crystals. This partially-ordered system has demonstrated the ability to produce random laser action, using the fluctuations of the dielectric tensor to scatter and coherently amplify lightwaves. This phenomenon can be examined in both confined and boundary-free systems. This project will examine properties of this random lasing action in liquid crystals doped with dye and plasmonic nanoparticles.

### **19A Transposon Mutagenesis of *Stenotrophomonas Maltophilia* Oak Ridge Strain 02**

Gabriella Hosack, Haley Gianfrancesco, Hanna Gilligan, Dionne Trammell  
Youngstown State University

*Dr. Jonathan Caguiat, Mentor*

A metal resistant strain of *S. maltophilia* OR02 was isolated from a metal contaminated site in Oak Ridge, TN. An EZ-Tn5 transposome was introduced. Approximately 880 transformants were replica plated onto plates containing various media to see if the transposon interrupted genes required for metal resistance or growth on minimal media. 13 mutants were discovered. Of the mutants, 5 failed to grow on minimal media, 1 failed to grow on selenite, 1 failed grow on copper, 1 failed to grow on zinc, and 5 failed to grow on 2 or more metals. The transposon contains kanamycin



resistance genes and an R6Ky replication origin. The DNA from the mutants was transformed into *E. coli*. Transformants will contain new plasmids of the transposon flanked by the interrupted genes. DNA sequencing can identify genes involved in oxidative stress response, metal efflux, metal transformation and sequestration.

**20B Redheads: Fact vs. Fiction**

Renee Justus

Cuyahoga Community College

*Vanitha Parameswaran, Mentor*

We all have genetic characteristics that make us different. While redheads only make up 2% of the world population there are many studies that show their differences are more than just cosmetic. From the way they process pain to the acidity of their skin redhead genetics go much farther than just the color of their hair. So how do genes play a role in the redheaded difference. From genetics to myths, redheads have played a unique role in history.

**21A Suppressive Transcriptional Regulation on Dendritic Morphology in *Drosophila Melanogaster***

Ogoegbunam Okolo

Case Western Reserve University

For my project, we investigated micro RNA molecules in order to understand its regulatory effects on cut expression levels and consequent dendritic branch morphology. We hypothesize that there may be mir-RNA-related mechanisms sought to buffer the normal variation in transcription factor levels, to ensure that cells attain a reproducible and class-specific morphology. We utilized *Drosophila Melanogaster* as a model to examine and manipulate the transgenic expression patterns of two specific classes of micro-RNAs: mir-310 and mir-315 (overexpression & loss of function). Experimental data indicate that overexpression of micro RNA molecules result in a significant decrease in cut expression levels. Additionally, overexpression exhibited suppressive effects on the development of dendritic spikes/protrusions.

**22B Restoration and Characterization of a Sub-critical Assembly: A Middle Act**

Steven Littell, Joseph Shives, Brandon Sharp, Martin Strong

Youngstown State University

*Donald Priour, Mentor*

Sub-critical assemblies are devices which undergo a chain reaction only with an external neutron source incorporated. Building on earlier efforts, we have completed the mechanical support hardware to wirelessly maneuver a multiprobe detector (i.e. sensitive to gamma and beta rays and capable of photograph and video acquisition) in the context of the assembly. The detector will be part of an apparatus to accompany a Nuclear Chicago Model 9000 Chamber on a permanent basis. As a test of the multiprobe, we have measured spatially dependent gamma counts in the vicinity of irradiated sources. Theoretical simulations and calculations are presented in support of our experimental measurements. We make concrete projections as to the role the reaction chamber apparatus will play in research efforts and its ability to enhance educational opportunities for the broader community.

**23A Terrestrial Habitat Selection of American Toads in Response to Changes in Forest Composition**

Erin Conway, Tessa Askew, Cierra Spriggs

Case Western Reserve University

*Mike Benard, Mentor*

Climate change is proving a catalyst to changing the composition of northeastern hardwood forests. The ranges of maples and oaks are predicted to continue shifting as warmer annual temperatures allow traditionally more southern woodland species to dominate in more northern latitudes. Oaks and Maples both produce chemical defenses against herbivory and disease, but the composition of those chemicals differ. In order to test if this difference in chemistry has an impact on the forest community I examined if American toads chose habitats based on the type of leaf litter present. My study consisted of a series of choice tests, from which we concluded that the toads showed no preference between Oak and Maple leaves. This finding helps give a broader idea of how northeastern hardwood forests communities cope with climate-an understanding paramount to developing future conservation efforts.

**24B Structure Motivated Mechanistic Modeling of Triphasic Force Dependent E-Selectin/Ligand Adhesion Behavior**

Hannah Goldberg and Aemilee Ziganti

Case Western Reserve University

*Michael Hinczewski Phd., Mentor*

Force-mediated leukocyte tethering to and rolling on vascular walls by adapting to changes in shear flow is facilitated by triphasic bond lifetime versus force behavior exhibited by E-selectin/ligand bonds. We created a mechanistic, network

analysis based model to describe this behavior which has been fitted to data from flow chamber experiments on E-selectin/ligand complex adhesion from Wayman et al.[1]. Best fit parameters have further been compared to estimates obtained from protein structural data of similar and near-identical complexes, and shown to agree within highly reasonable limits. With improvements in structural analysis and more research into the effects of mutations at the lectin/ligand interface, this modelling approach can shed great light onto the processes of healing and other biological functions that rely on a triphasic bond lifetime behavior.

## **25A Potential Food Waste Policies to Serve as Sustainable Reform for Food Insecurity in Cleveland - Cuyahoga County**

Rachael F Bucey Leopold  
Cleveland State University

*Colleen C Walsh, Mentor*

Food waste can be described as discarding food that is perfectly safe for human consumption. Effects of food waste include environmental, economic, health, and social factors. Ohioans currently rank 6th nationwide in food insecurity. Businesses and organizations in urban areas are notorious for excessive food waste. Food waste policies cultivated by committees such as the Cleveland-Cuyahoga County Food Policy Coalition can divert food from landfills to instead be donated, composted, or eaten by the original purchaser. This research endeavors to scrutinize food disposal practices in the Cleveland-Cuyahoga County area in order to propose policies that will serve as effective measures to achieve sustainable food waste reform. Systematic review of literature, analysis of notes from CCCFPC convenings, and quantitative and qualitative evaluation of a survey were used in this research.

## **26B The Reactivity and Clustering of Calcium Beta-Diketonate Complexes in the Gas-Phase**

Tayah Turocy  
Youngstown State University

*Brian D. Leskiw, Mentor*

The gas-phase ligand exchange reaction of calcium diisopropylacetylacetonate complexes with a series of metal  $\beta$ -diketonates was observed to occur within a triple quadrupole mass spectrometer following co-sublimation. By varying the identity of the ligand and metal center, the gas phase reactivity, as well as the corresponding fragmentation pattern of the resulting species, was investigated. These novel complexes also show the prevalence to form larger clusters through the addition of extra metal, as well as chelation of additional ligand. Further studies were conducted to test the cluster's recurrence with interchanged metal centers. Calcium clusters show promise as new materials with applications in thin film deposition and the formation of nanomaterials.

## **27A Concussions in Football Through the Years: Improving or Worsening?**

Francisco Castillo, Benjamin Huston  
Cuyahoga Community College

*Vanitha Parameswaran, Cathleen Rossman, Mentors*

Today concussions are a big topic in the world of football along with new equipment that will hopefully prevent it. In order to advance in the future, we must take in considering the now and the past. This project aims to find the difference in rate of concussions over three various age groups Youth (Flag – Middle School), Current (High School – College) and the Older Generations (30+), along with the reasoning behind said difference in order to better prevent concussions and future brain damage. The project delves into the advancements in technology and overall fitness of athletes which very well could correlate to the rate of concussions of each individual age group.

## **28B The Impact of TCM on IBD in Asia and Translation Beyond**

Julia Gaspare-Pruchnicki  
Case Western Reserve University

*Dr. Lihong Shi, Mentor*

Inflammatory Bowel Disease (IBD) is a categorization of a group of chronic diseases that affect the gastrointestinal tract. The two main diseases are ulcerative colitis (UC) and Crohn's disease (CD). The most common include abdominal pain, bloody diarrhea, fatigue, ulcers, and vomiting. The most common treatments for IBD in the U.S. are of biomedical nature. Doctors use treatments such as corticosteroids, thiopurines, and other immunomodulatory therapies. Alternative treatments for UC and Crohn's disease are not readily available to help patients, at least in the U.S. Other countries, especially Asian countries, have had noticeable success when using something other than biomedical treatments. This project explores some of the alternative treatments of IBD in the East Asian culture and evaluates the efficacy and transferability of Traditional Chinese Medicine on IBD treatment.

**29A Using in Silico Analysis of Transcription Factor Binding Sites and Relative Luciferase Activity to Understand CFTR Expressivity in CFTR DHS variants**

Wilmel Cosme

Case Western Reserve University

*Dr. Ann Harris, Dr. Jenny Kerschner, Mentor*

Cis-regulatory elements are undoubtedly strong influencers of gene transcription. As such, it is possible that single nucleotide polymorphisms (SNPs) in these non-coding regions can be disease causing. Here we attempt to identify how SNPs in CFTR regions Intron 11 DHS, an intestine specific enhancer, and -44kb DHS, an airway selective DHS, effect expression. DNA collection from eighty clinically diagnosed cystic fibrosis patients identified 5 variants in these regions which may be of interest to our understanding of disease. Since CFTR has tissue-specific enhancers it is possible to conduct comparative studies on these regions in different cell types. Primary techniques used during this project included in silico analysis of CFTR DHS regions, luciferase assays, and expression vector cloning.

**30B Natural Extraction of Metals by Trees rooted in Contaminated Soils. Phase I: Establishing Standards for Analyzing Tree Sap using XRF Spectroscopy**

Brandy Peprah, Salam Picard, Bryan Ortiz

Youngstown State University

*Dr. Alan Jacobs, Mentor*

We prepared standards that will be used to calibrate a portable x-ray fluorescence spectrometer. The p-XRF will be used in the field to identify toxic metals in trees rooted in contaminated soil around the Mahoning River near Youngstown, Ohio. The standards consist of 50-ml samples in two solvents: maple syrup and pine oil (simulating tree sap) that have been spiked with various known concentrations of a solution of metals. The samples were then analyzed for metals that have been found in the river banks using an inductively coupled plasma (ICP) and a benchtop XRF. Most of the metal conc. results were similar in both maple syrup and pine oil using the ICP and XRF. The solutions functions as standards for calibrating a p-XRF that will analyze the trees in contaminated soil around the Mahoning River. Tree species that absorb toxic metals can be used to remediate the contaminated soils.

**31A Purification of Water by Fatty Acid Linked UiO-66 through Hydrophobic Coating**

Dante DeChellis, Jordan Zackasee, Monther Nassar, Courtney Platt, and Bailey Varga

Youngstown State University

*Dr. Douglas Genna, Mentor*

The construction of three fatty acid-containing versions of the common metal-organic Framework (MOF) UiO-66 was performed via linker exchange between UiO-66 and each fatty acid: sebacic acid, nonanoic acid, and perfluorooctanoic acid. This functionalization was targeted due to its projected ability to form a hydrophobic layer on the outside, while still having pores that could allow for uptake and retention of water sensitive compounds. The purpose of this is to be able to use this framework for matters such as water filtration or to utilize the hydrophobic properties as a coating to resist water and store sensitive materials.

**32B Development and surface modification of iron oxide nanoparticles for plant uptake study via MPI relaxometer**

Beoline Uwampamo

Case Western Reserve University

*Anna Samia, Stella Ju, Mentors*

Superparamagnetic iron oxide nanoparticles (IONPs) with an average diameter of 17nm were synthesized through a thermal decomposition method using oleic acid as capping ligands. Several different surface coatings were used to modify and make the IONPS hydrophilic. The magnetic and stability of these different surface coatings were then compared to investigate the effectiveness of the modifications through powder x-ray diffractometry (PXRD) for phase identification, dynamic light scattering (DLS) for evaluation of the hydrodynamic radius of the modified IONPs, and transmission electron microscopy (TEM) for evaluating the morphology and size distribution of the synthesized nanoparticles. MPI relaxometer also used to evaluate the long-term stability and biocompatibility of the surface modified nanoparticles through the uptake of IONPS in living plants.

**33A Gold Organometallics in Optical Power Limiting Applications**

Branden Kraus, Maryann Veyon

Case Western Reserve University

The distinct relativistic and spin-orbit coupling properties of gold allow organo-gold complexes to function as reverse saturable absorbers more effectively than complexes of other heavy metals. Recent research has shown that gold(I),

gold (II), and gold(III) compounds that display nonlinear absorption of light can be synthesized. These compounds offer a promising new view of optical power limiting and have a broad range of applications including laser defense, microscopy, and bio-imaging.

### **34B The Physiology of Sloth Hindlimb Muscles**

Amanda Svenson, Abdel Ruhman Yusuf, Taylor Rogers, Lydia Johnson  
Youngstown State University

*Dr. Michael Butcher, Mentor*

Three-toed sloths (*B. variegatus*) have reduced muscle mass; however, they exhibit suspensory behaviors that require muscular strength and endurance. Previously, we revealed that sloths express only two myosin heavy chain (MHC) fibers in their forelimb muscles: slow MHC-1 and fast MHC-2A. We also found that regardless of MHC, both twitch fiber types mainly rely on anaerobic metabolism by high activity of the enzymes creatine kinase (CK) and lactate dehydrogenase (LDH). Here, we quantify the physiology of twelve hindlimb muscles and test the hypothesis that properties of the forelimbs are systemic and represent adaptations in sloths. Accounting for the differential roles of limb pairs during sloth locomotion, we predict the hindlimbs will have similar properties to the forelimbs, but with a broader distribution of slow-twitch fibers having greater aerobic activity for sustaining torque.

## **Engineering and Technology**

### **35A A preliminary behavioral study into the effects of heat responsive Microelectrodes**

Jennifer Paiz, Sarah Mortier  
Case Western Reserve University

Miro-electrodes play a prominent role in making up the future of brain computer interfaces. This study examines the affects of inflammation post electrode implantation on performance in behavioral tests.

### **36B Carbon Fiber Tie Rod Optimization**

Clay Hamilton  
Case Western Reserve University

*Owen Yang, Matthew Stewart, Mentors*

Case Western Reserve University's Baja SAE team designs and builds an off-road vehicle every year that is made to withstand the rough conditions of the nationwide competitions every year. CWRU's team placed 8th and 9th in two international competitions during the last year's season. In an effort to improve our rankings further, we are designing this year's car with optimization in mind. Some of the components we are focused on are the tie rods, which connect the steering rack of the vehicle to its wheels. In the past, ours were composed of a relatively heavy steel tube. This year, we intend to save weight by fabricating the tie rods from carbon fiber and aluminum. One of the challenges of using these two dissimilar materials is bonding them together while retaining the designed strength and durability of the component. In order to maximize the strength of the tie rods, multiple iterations of the design were tested in a tensile strength testing machine. The original single-piece steel tie rods were able to withstand 4500 lbs of tension. The first iterations of the two-piece carbon/aluminum rods only held 500 lbs, which would not supply sufficient strength to endure the harsh environment of the Baja competitions. After investigating, we found that the epoxy we had used was not thoroughly distributed between the aluminum and carbon fiber. In order to resolve this issue, we allowed for more space between the aluminum and carbon fiber so that the epoxy was able to bond the two together more efficiently. This next set of tie rods withstood 2500 lbs of tension while being roughly 1/3 the weight of the original steel tie rods.

### **37A Corrosion reduction using two coating methods on magnesium**

Rana Abu-Hashim, Amber Deming, & Malayja Jackson  
Youngstown State University

*Dr. Holly Martin, Mentor*

In an effort to lightweight vehicles, magnesium is a metal of interest due to its low density and high weight-to-strength ratio. It is easily corroded, though, so it cannot be used in exposed areas of vehicles, including most of the engine area. Polyetherimide (PEI), a hydrophobic polymer resistant to aqueous solutions and hydrocarbons, has been successfully

shown to delay the corrosion of magnesium, specifically AE44, which contains 4% aluminum and 4% rare earth elements. However, an uneven thickness using solution casting or a very thick shell using additive manufacturing greatly affected the delay of corrosion. In an effort to improve the corrosion resistance imparted by PEI, two different ways to deposit the polymer were investigated and the corrosion resistance in 3.5 wt% saltwater was determined.

### **38B Creating Topographic Maps through Field Surveying**

Justin Thomas

Case Western Reserve University

This project focused on making topographic maps based off of data that was acquired by surveying a certain portion of land. The surveying was done by using a total station, data collector and prism. The data collector was then downloaded onto a computer, where we were able to use AutoCad to create a topographic map based off of the data points. After creating the topographic map on AutoCad, we were able to print out the map and see the similarities from the actual site.

### **39A Design of Industrial Water and Wastewater Treatment Systems**

Michael Craver

Youngstown State University

*Dr. Tony Vercellino, Mentor*

The purpose of this project was to design a fully functional water supply system as well as a wastewater pretreatment system that would specialize in handling industrial waste. We were asked to come up with our own design of an existing facility in North Jackson, Ohio. This facility is to be used as both an office building and an industrial metal plating facility. The environmental portion of this project is mainly dealing with the water supply and wastewater treatments, but it also includes the development of a storm water management plan, safety planning and an environmental assessment of the site in pre-development, during construction and post construction. In the end the overall goal was to provide a representative design experience that focuses on professional practices while utilizing the various courses that were taken at Youngstown State.

### **40B Design of a Shorting Connector Assembly Machine**

Matthew Osiniak, John Pechatsko, Mark Fredrickson

Youngstown State University

*Dr. Jason Walker, Mentor*

A student design team worked with Delta Systems Inc. to redesign a machine to assemble a quarter-sized electrical connector. Poor efficiency and outdated components warranted the need for a new machine. The project included many engineering aspects including mechanical, industrial, and electrical design. Through collaboration between the student design team and the company sponsor, a solution was found. The design of a new machine has been completed and the machine is being constructed for factory use.

### **41A The Past, Present, and Future of Autonomous Vehicles**

Norman Barahona, EmilyAnn Moenich, Lindsey Shahan

Cleveland State University

*Nathan Spagnola, Mentor*

The idea of autonomous vehicles has become a part of driving history dating back to early as the 1920s. First created by Houdina Radio control as demonstration of the potential of radio technology, the idea has immensely expanded and now incorporates six different levels to autonomous driving. The science and mechanics of this technology include the incorporation of laser rangefinders, GPS/inertial navigation system, cameras, sonar, radar, and lidar. There are five primary components that shape how self-driving cars operate, and research on the subject is currently being investigated by companies such as Google, Tesla, and Honda. As more analysis is done, the inevitable question regarding the future comes into play. This research will highlight the potential benefits and costs that go into this endeavor.

### **42B Design and Analysis of a Supersonic Wind Tunnel Diffuser and Muffler**

Eric Haake, Michael Manginelli, Michael Ramunno

Youngstown State University

*Dr. Stefan Moldovan, Mentor*

The purpose of this project is to design and analyze an exhaust silencer system for Youngstown State University's blowdown supersonic wind tunnel so that the wind tunnel can be safely integrated into the Mechanical Engineering curriculum for future classes. This design project involves heavy usage of computational fluid dynamics (CFD) to perform

flow path analyses that allow the team to ensure test section stability as well as acceptable outflow conditions. The exhaust system must also attenuate harmful noise generated by the wind tunnel so that it may be operated safely. The performance of stress analyses on the design's structural members is an additional feature of the design that is of high importance to ensure the safety of the students and professors who will run the wind tunnel.

#### **43A Diffusion Performance of 3D Printed Kidney Filter**

Robert W. Dixon, Mason P. Shaulis, Derek G. Joy, Jose E. Cardenas

Youngstown State University

*Dr. Pedro Cortes, Mentor*

We will be 3D printing the internal structure of a kidney out of some water soluble material (yet to decide) and then coat it in a permeable membrane of our choosing. We will then dissolve the inside in water, and use the shaped membrane to simulate the structure of a kidney itself and run our filter tests on this to seek a more efficient and effective design to remove urea from an entering stream.

#### **44B Materialistic Efficiency of PLA in 3D Printing**

Sumaiya Ahmed, Jacob Martin, Owen McFetridge, Jacob Vitale

Cleveland State University

*Dr. Nolan Holland, Mentor*

Three-dimensional printing is the process of extruding a material layer by layer to produce a three-dimensional object. This technology has a variety of applications from creating lab equipment to houses. The goal of our research was to find the most efficient use of material in three-dimensional printing. To do so, the fill density of a rectangular beam was varied, then the spring constant of these beams was determined and compared to what should theoretically occur. This optimal percent fill would be the point in which the least amount of material would be used to maintain the greatest spring constant and would be the most efficient for industrial applications. A graph was created that plotted the determined spring constant versus the percent fill to find an optimal fill percentage. This would occur at the lowest percent fill where the change in the spring constant became very small.

#### **45A Exploration of the feasibility of Dalbavancin-filled cyclodextrin microparticles in PMMA bone cement for treatment of orthopedic infections**

Leandra Bowsman, Dylan Marques

Case Western Reserve University

*Horst von Recum, Mentor*

Vancomycin has been shown to effectively inhibit bacterial growth in PMMA samples in clinical settings. However, vancomycin is prone towards developing bacterial resistance and is not necessarily the most potent antibiotic to treat complex infections. Dalbavancin is a more potent variant of vancomycin and has the advantage of being less susceptible towards developing bacterial drug-resistance. Furthermore, the chemical structure (i.e. fatty acid hydrophobic tail) present on dalbavancin is more conducive towards incorporation into our drug delivery platform, compared to the hydrophilic structure of vancomycin. Therefore, this project will explore the molecular fit, delivery profile, and antimicrobial action of dalbavancin compared to vancomycin.

#### **46B Digital Conversion of a Pressure-Switching Data Acquisition System**

Kayla Fisher, Daniel Martin, Lauren Lottier

Youngstown State University

*Dr. Kevin Disotell, Mentor*

The Scanivalve Pressure Scanner, a fluid pressure measurement device, enables an array of ports sampled using a single, shared transducer. The scanner model at YSU requires a user to press a button to switch the port sampled by the transducer. To enable remote operation of the device and automated data acquisition (DAQ) for flow pressure measurements, digital controller logic converts analog switches to digital I/O with DAQ software. The push-button manifold was replaced by a National Instruments USB-6008 DAQ device for digital I/O. Software developed with MATLAB's DAQ Toolbox communicates between the USB and scanner. User-defined sampling parameters allow a user to select ports sampled, sampling rate, record length, and number of records. Deployment of digital controller logic enables automated DAQ routines to be programmed for wind tunnel experiments in YSU's Flow Physics Laboratory.

#### **47A Extreme Flow Analysis of the United States**

Cody Holland, Alexandra Eisenhart, Jacob Stellers, Jacob Crawford

Youngstown State University

*Dr. Sharma, Mentor*



Low flow of the stream is crucial for water resources management during low flow periods, whereas high flow estimation is essential for the prevention against the flooding during high flow periods. In this study, we analyzed the long term historical data from the Hydro Climatic Data Network from 1700 stations of the 21 regions across the entire 50 states of the United States. The tool developed by Environmental Protection Agency, DFLOW, was utilized to estimate 7Q10 low flows, whereas PeakFQ software was utilized to systematically estimate 100- year and 500-year floods. We found a general pattern when comparing the 7Q10 values to the 100-year and 500-year return period peak flow indicating higher 7Q10 values may correlate to 100-year and 500-year return period flows. The max 7Q10 value is 406.62 ft<sup>3</sup>/sec, corresponding to a 100-year and 500-year flow of 239200 ft<sup>3</sup>/sec and 285300 ft<sup>3</sup>/sec.

#### **48B Evaluation of 3D-Printed Lattice Structures for Energy Absorption**

Emili Bonanno, Trevor Leonard, McKenzie Scheckelhoff, Efrain Valez  
Youngstown State University

*Dr. Jason Walker, Mentor*

Using 3D-printed Onyx specimens of varying gyroidal porosities and grades, we tried to establish relationships between the distinguishing features and mechanical properties as well as resorption energies. Primarily focusing on conventional compression testing to achieve this, the data collected determined that adjusting the geometry, porosity, and material of the specimens can provide for great advantages with respect to mechanical properties, such as stiffness and toughness, and resorption rates. On a larger scale, these results also verify that the modification and reconstructive methods of these specimens through CAM and automated systems are superior to old methods and are useful in many industries, such as plastic surgery/tissue engineering, aviation and automotive.

#### **49A Hydrofracking in Ohio**

Alexander Duffy, Nathaniel Lauer  
Cleveland State University

*Dr. Lutful Khan, Mentor*

Hydraulic fracturing (fracking) is a method of gathering oil from the shale formations underground. The process works by drilling a mile underground into shale and injecting millions of gallons of water, mixed with sand and chemicals, at a very high pressure. While the water mixture is being injected, the shale breaks and releases the natural gases and oil. Fracking has both positive and negative effects for the United States, more specifically Ohio. On the positive side, it can be used to make the US less dependent on foreign oil and create jobs. However, since fracking and waste water removal began near Youngstown there was an increase in earthquake activity with approximately 130 seismic activities with magnitudes as high as 4.0. Fracking or the disposal of waste fluids may also cause pollution of groundwater. This poster will outline the risks and benefits fracking poses to Ohio.

#### **50B The Reduction of Motion Sickness in VR (Virtual Reality) Applications**

Alexander Thornton, Chase Petti, Andrew Leeseberg, Jalen McKinnie  
Cleveland State University

*Nicole Strah, Mentor*

With the recent advent of 3 DOF (degrees of freedom) and 6 DOF movement in Virtual Space VR devices and applications have become more immersive than ever before. With the ability to not only view one's environment, but also freely move around it. But with this increased freedom comes limitations, the chief among them the physical space that the user occupies limiting the user to a virtual space the size of the physical room. To combat this, many applications introduce a system of locomotion typically controlled through joysticks or touchpads, but this comes with many of its own drawbacks. The most troublesome being the introduction of simulation sickness, more commonly referred to as motion sickness. Which is a dissociation between visually perceived movement and vestibular system's sense of movement. We will be exploring the ways in which these applications cause this motion sickness.

#### **51A Identification of Dormant vs Aggressive Cancers via Ligand Specific Targeting**

Abdelrahman Rahmy, Aaron Yun, Abdallah Rahmy  
Case Western Reserve University

*Pubudu Peiris, Mentor*

The objective of this project is to identify dormancy even in the presence of an aggressive tumor model. A multi-tumor mouse model consisting of both an aggressive D2A1 mammary inoculation and a dormant D2OR mammary inoculation will be developed to fit these conditions. Nanochain technology can identify and locate these elusive dormant tumors through vascular targeting as opposed to passive targeting even within the presence of the aggressive tumor. The



effectiveness of the nanochain technology in detection of dormancy will be compared to the use of conventional iron oxide spheres in this model.

### **52B Impact Testing on 3D Printed Kevlar-Reinforced Onyx Specimens**

Mackenzie Scrocco, Logan Weinreber, Edward Ellks, Timothy Chamberlain  
Youngstown State University

*Dr. Brett Conner, Mentor*

Kevlar reinforced materials are commonly used in ballistics defense applications. The group utilizes 3D printing to reinforce nylon infused carbon fiber material with Kevlar to design specimens and perform various impact tests, such as Charpy impact testing and gas gun ballistic testing. The group hopes to use the data collected to better understand how various properties of these materials, when 3D printed, perform under impact.

### **53A Intuitive Reflow Oven**

Benjamin Wilson, Brian Zellers, Dillon Kennedy  
Youngstown State University

*Jalal Jalali, Mentor*

This project set out to refurbish an existing Reflow Oven that the Electrical Engineering Department at YSU had for future research and academic use by staff and students. Part of our design included using a raspberry pi 3 as the "brain" for the device to allow for PID and PWM for more accurate control of the device. Also for maintainability most of the replaced parts were chosen so that they could be easily replaced should something go awry.

### **54B Manufacturing Facility Design**

Matthew Manna, Danielle King, Matthew Mangapora, Courtney Budnik, Stephen Ersek  
Youngstown State University

*Hojjat Mehri, Mentor*

Facility design plays a key roll in the economics of a company. Proper designing and planning of a facility can have major effects on cost savings. An estimated 20%-50% of total costs in manufacturing are material handling related. With planning and analysis, bottlenecks, excessive idle times, and efficient employee/labor utilization can be determined and addressed accordingly. In order to create the most efficient facility, you must accommodate for current production, employees, machinery, and future production. Many procedures and methods have been developed in the past 100 years in order to create the best possible facility given the conditions and limitations. Methods to help complete the process include location analysis, forecasting, process flow charts, operation flow charts, depreciation calculations, and AutoCAD utilization for dimensioning. Proper planning can save thousands.

### **55A Mitigating Bed Fall Injuries in Retirement Homes by Lowering of Bed & Side-Cushion Attachments**

Justin McMahan, Ilana Roth, Gitanjali Kaw, Haosheng Li, Alexander Nesvisky  
Case Western Reserve University

*Brian Sanner, Dr. Colin Drummond, Dr. Matthew Williams, Mentors*

Injuries due to bed fall are common among retirement home residents and hospital patients. Bed rails are used in hospitals to reduce falls, however, Ohio law does not allow for restraining barriers in retirement or nursing home settings. This law was created due to feelings of loss of autonomy and increased isolation due to the restriction of free movement caused by bed rails. To work with this limitation, a side flap attachment to a bed that moves up and down was conceived. At its maximum height, the side flaps are flush against the side of the bed. As the height decreases, the side flaps flare out to the sides creating a decline from the mattress to the floor. In the event that a user would "fall" out of bed, they would merely "roll" instead, mitigating the chance for injury. A controller adjusts the bed, giving the user complete freedom over the height of the bed and the side flaps.

### **56B Optimization of Fabric Worm Robot**

Enrique Luevano, Aditya Malik  
Case Western Reserve University

*Dr. Kathryn A Daltorio, Mentor*

The Fabric Worm robot can potentially provide an unique application in search and rescue, exploration, pipe inspection and potentially medical. The current issue with the Fabric Worm robot is that the locomotion does not function properly. The Fabric Worm robot will need to be further studied and assessed to understand the opportunities for improvements and redesign. A main focus of this project is to help improve the design and help facilitate future research, by adjusting the rod stiffness to compensate being in an smaller robot. Several areas of alterations will be assessed such as adding additional grip, adding addition cables and modification to actuation movements.

**57A Physical and Digital Analysis of a Lulzbot Mini**

Sara Cole, Hugo Mendel, Kevin Yacucci  
Youngstown State University

*Dr. Eric MacDonald, Evan Harris, Mentors*

The usage of 3D printing is rapidly increasing in most industries, as companies are now able to rapidly prototype and iterate product designs. The accuracy and capabilities of 3D printers vary largely by printer models. Determining the limits of a 3D printers capabilities allow for more resilient designs. Locating these limits extends the use of 3D printing in manufacturing. To challenge the accuracy of the Lulzbot Mini repeated prints at the observed limits were conducted. After performing our experiment, the data collected pertaining to the limits were then compared to the factory specifications.

**58B Purcell's Scallop Theory**

Hayden Bartolovich, Zachary Opperman, Rachel Sutor, Joseph Wolf  
Cleveland State University

*Dr. Shawn Ryan, Mentor*

Purcell's Scallop Theorem is the movement of objects through fluids of various viscosities based on different motions. In our experiment, laundry detergent and water will be the viscous fluids used. Detergent represents the viscous fluid and water is the standard. An object with periodic motion will move forward in water and no net motion forward in more viscous fluid. In periodic motion, the forward and reverse movements cancel each other out in the detergent due to a lack of inertia. An object performing a corkscrew motion will move freely in any fluid. By using periodic and corkscrew motion mechanisms in water and detergent, the result of the theory will be observed. Mathematical calculations demonstrate how the periodic motion cancels and the corkscrew motion does not. This theory duplicates natural bacteria and the adjustment of their flagella to navigate forward in viscous fluids.

**59A Structural Design of Industrial and Office Building**

Jesse Saluga  
Youngstown State University

*Dr. Islam, Mentor*

The goal of this project was to earn realistic design experience that focuses on professional practice within the industry of Civil Engineering. This includes working in multidisciplinary teams in order to manage and complete the project on time. The task at hand was to complete all of the load calculations and structural member design necessary to construct an Industrial Office Building in North Jackson, OH. The structural members within the building include a steel truss roofing system, concrete masonry walls, columns with base plates, and a reinforced concrete slab on grade. All of these members must be able to withstand the necessary snow, wind, dead, and live loads specified within the National Building Code, Ohio Building Code, and ASCE 7-10.

**60B Recruitment Tools of the Future**

Morgan Weinreber, Victoria Woods, Ronald Yarwood  
Youngstown State University

*Snjezana Balaz, Mentor*

The Purpose of this project was to design and create a recruitment tool to be used by the Youngstown State STEM college. The tool had to be student designed, 3D printed, and incorporate STEM principles. At the average college recruitment fair, one can expect to find handouts such as pens, lanyards, notebooks, these tools are adequate but not interesting. The goal of this project was to fill this void by creating tool that promoted YSU while being engaging, one puzzle and one toy were created. The puzzle is a cage design with a free-floating triangle inside of it, the purpose is to remove the triangle from the cage by manipulating it a specific way. The toy is a top with a long stem, the top starts rotating on the rounded base and finishes spinning on the stem. Both tools can be produced for approximately 10 cents, this cost is inline with the cost of similar recruitment tools.

**61A The Unique Properties of the Geodesic Dome**

Verlaunte Hawkins, Cassandra Hyer, Timothy Szeltner  
Cleveland State University

*Michael Gallagher, Mentor*

Among structures, domes carry the distinction of containing a maximum amount of volume with the minimum amount of material required. Geodesic domes are a twentieth century development, in which the members of the thin shell forming the dome are equilateral triangles. This union of the sphere and the triangle produces numerous benefits with

regards to strength, durability, efficiency, and sustainability of the structure. However, the original desire for widespread residential, commercial, and industrial use was hindered by other practical and aesthetic considerations.

**62B Taylor Winfield Ergonomic Improvement**

Richard Ferry, Alexander Fitzgerald, Carmen Marinucci  
Youngstown State University

*Anthony Viviano, Mentor*

The purpose of this project was to redesign and ergonomically improve tooling adaptors used for mounting and dismounting components on and off of a train axle (i.e. gearbox and bearings). The adaptors were used with a horizontal wheelset press machine that press fits (interference) the components onto the axle with a high amount of compressive load. The main issues with the adaptors were the parts exceeding the OSHA weight standards and the handles not being operator friendly. The team was also tasked with creating a mechanism that corrects the wheel alignment as it is moved into position with the cylinder shaft. The current process created issues for the operator of the overhead crane because the wheel came in out of plane and did not slid onto the shaft easily. All new designs on the components and mechanism met the OSHA weight standards and industry factors of safety as well.

**63A The Analysis of Manufacturing Dimethyl Ether for Transportation**

Samuel Cappelli  
Youngstown State University

*Dr. Douglas Price, Mentor*

Dimethyl ether (DME) is considered to be a step towards near-zero particulate emission of motor vehicles when utilized as a transportation fuel. With several various means of production, many of which are sustainable, DME possesses key characteristics that lend itself to a preferable alternative to common fuels used. Consequently, this project aims to perform a production analysis of a plant producing high volumes of DME, and whether it is a viable substitute to gas or diesel. This is accomplished by the ground-up design of a functioning plant, with final recommendations made based on considerations surrounding overall costs, human and environmental safety, and technical/business risk analyses.

**64B Use of Computational Fluid Dynamics to Study Sinus Cavity Deformities**

Jennifer Markley and Nicole Elston  
Case Western Reserve University

*Kai Zhao, Mentor*

Use of Computational Fluid Dynamics to Study Sinus Cavity Deformities Empty Nose Syndrome (ENS) and Nasal Septal Perforation (NSP) are rare nasal abnormalities that affect the aerodynamics of air flow. Computational Fluid Dynamics (CFD) can help to treat both of these abnormalities, as they can be used to compare the aerodynamics of ENS or NSP patients' sinus cavities to that of healthy patients. CFD is a method of analysis that combines the areas of computer science, numerical analysis, and fluid dynamics. It is commonly used to measure the velocity and flow of particles through cells. This makes it a very useful tool to analyze the flow of particles within respiratory systems. Recent studies have used this technique to study both Empty Nose Syndrome and Nasal Septal Perforations.

**65A The Synthesis and Combustion of Biofuels**

Alexandria Prox, Christopher Churley  
Cleveland State University

*Vania De Paoli, Mentor*

Fossil Fuels are expensive and cause harm to the environment in many different ways. While using fossil fuels is very easy the demand is very high and the resources are going to become more limited as time goes on. Looking at the way the world is changing and how dependent the human race is on these resources. Research in Bio-fuels is the look into the future when looking for fuel and clean energy to replace fossil fuels. The project's focus was on three different sources that could be used in creating this energy. In order to see if the source was feasible for the uses the combustion rate needed to be tested as well. The ability of fossil fuels compared bio-fuels are the target point. The future will require a new fuel source and finding that source sooner then later will be beneficial.

**66B Vallourec Deox Nozzle**

Justin Stellmar  
Youngstown State University

*Stephan Moldovan, Mentor*

The Vallourec deox nozzle project is an optimization project. The deox process is used in the seamless tube process to inert the inside of a shell of steel, melt oxidized steel, and lubricate the shells interior before the shell is milled into a

finished pipe. The deox mixture is applied to a steel shell immediately after the shell is formed and still glowing hot. Optimization of the nozzle is achieved with additive manufacturing processes to create a nozzle geometry that evenly distributes the deox mixture across the inner shell surface. Verification of the nozzle design is verified with industrial testing as well as numerical analyses through FLUENT.

#### **67A Tri-C's Extreme Green Ecosystems Experience**

Steven Fairley

Cuyahoga Community College

*Dr. Bilal Bomani, Mentor*

I am researching a potential 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 were researched and implemented. I am utilizing two portable, self-sustaining renewable ecosystems containing three plant species (Lima camelina, Salicornia europea, and Salicornia subterminalis). I am also investigating a climatic adaption technique by salinizing each ecosystem from freshwater to beyond seawater levels and only use Poecilia species fish (Freshwater Mollies) as a natural fertilizer to provide essential nutrients for the plants. I am conducting a 10-week study with a goal of developing reliable, portable, self-sustainable, renewable ecosystems that can be implemented worldwide.

#### **68B What's in your Water?**

Claudia Bougebrayel, Luke Candow, Cassandra Dircks, and Tara Pena

Cleveland State University

*Fasong Yuan, Mentor*

On a daily basis, over 11 million people rely on Lake Erie as their main water source. As a result of Lake Erie's close proximity to various industrial cities, the most prevalent example being Cleveland, Ohio, the concentrations of various elements have subsequently increased. Upon analyzing data from both a geological science professor's previous research as well as various online sources, we hope to provide a correlation between the increasing concentration of the contaminants, specifically, Chromium, Aluminum, and Lead and their effect on water quality of Lake Erie.

#### **69A YSU Green Infrastructure Plan**

Joseph Agati, Daniel Bancroft, Austin Snovak

Youngstown State University

*Robert Korenic, Joseph Sanson, Mentors*

Our research group outlined a green infrastructure plan for priority areas throughout the Youngstown State University campus. Overland flow calculations were performed to evaluate the site in its current state and the site after it would be remodeled to improve rainwater flow. Environmental sustainability was kept in mind, through incorporating permeable pavement, rain gardens, and bioswales. The final priority of the project was to make the area more appealing to the campus community. Furthering this, by selecting priority areas campus-wide, a action plan was also completed to summarize the actions we would like to see done in each of the study areas.

#### **70B Demonstrations for Signals and Systems Coursework**

Rachel Boedicker

Case Western Reserve University

*David Kazdan, Mentor*

Demonstrations were prepared for the EECS 246 Signals and Systems course. The demonstrations made use of electromagnetic, acoustic, and physical phenomena to integrate engineering practice into a primarily mathematics driven course. The goal of the demonstrations was to showcase phase, frequency, signal modulation, and sampling using activities or techniques that apply mathematical coursework to the real world.

#### **107A Self-supporting Knee Brace**

Alexander Shimek

Case Western Reserve University

*Malcolm Cooke, Mentor*

Multiple sclerosis, muscular dystrophy, Parkinson's, and progressive muscle weakness are all characterized by an inability to carry a normal stride which subsequently results in frequent falls. Traditionally, knee braces are used to provide support to the knees to prevent this; however, this project aims to construct a more preventative knee brace with a locking mechanism. It will provide support when the user's knee fails and prevent him/her from falling while maintaining the profile and weight of a typical knee brace. The mechanism is weight actuated which will lock the brace in the upright position as long as there is weight on the leg. This allows for near full range motion in all other situations. This mechanism will be purely mechanical and is a reduced version of the technology used in a stance control knee-ankle-foot orthosis.

# Mathematics, Statistics, and Computer Science

## 71A Basic Simulation of HIV in Matlab

Tiffany Nguyen, Patrick Hogrell, Andrew Wiecek  
Case Western Reserve University

*Vira Chankong, Mentor*

In this case study I modeled the spread of HIV in a 100x100 pixel environment, where one pixel represents a single cell. The main part of the case study involved a 600 week simulation of HIV under different conditions of drug therapies. There were 9 different rank levels for the drugs effectiveness and 3 different conditions for the cells response to the drug. With this I simulated 12 weeks of HIV growth, 600 weeks of HIV growth, then each rank level of drug therapy over 600 weeks with a constant response rate, a decreasing discrete response, and an increasing linear response. The base of my Matlab code was based on a code given in class, which was then modified and expanded to simulate HIV.

## 72B Safety Simulation: The Gamification of Employee Training

Arik Stewart  
Case Western Reserve University

Every day, employees who work physically demanding jobs such as construction or field service often risk injuring themselves while using non-safe practices on the job. Companies should be using modern technology to minimize these risks employees face but still maximizing the experience in which hands-on training can only provide. A possible approach to solving this problem is through the gamification of field training by using simulations, or "video games", to practice tasks in a risk-free environment.

## 73A Astrocyte Image Segmentation

David Carlyn, Lana Frankle, Akhil Kumar Goud Koothal  
Kent State University

*Dr. Cheng Chang Lu, Dr. Robert Clements, Mentors*

Image segmentation is a complex area of work that, when perfected, could create a plethora of innovation and discoveries. Our current research focuses on using image segmentation to extract data of astrocyte cells, the most abundant glial cells found within the brain.

## 74B Actuarial Analysis of Expected Long Term Nursing Home Costs

Josephine Sabatino, Sarah Cook  
Kent State University

*Darci Kracht, Mentor*

We were asked by a local attorney to calculate future nursing home costs for people above the age 55. With the increasing rate of people entering nursing homes, and needing long term care, we projected the expected annual costs of private and semi private nursing home rooms over the next 25 years. We used Actuarial Mathematical principles to find the expected cost for different age groups ranging from 55-95+. Our findings concluded that it is important to save and invest your money effectively in order to prepare for future costs.

## 75A Communication Patterns Effect on Privacy

Kelsey Smith, Foster Capan  
Kent State University

*Maha Allouzi, Mentor*

We will be studying the effect of patterns in communication on privacy. Privacy is isolated information shared between two people. In the modern world, communication on social media, such as Facebook, Twitter, and Snapchat, is very important and private information can be hard to keep private and isolated from others. In this project, we are going to look at the shortest paths in communication and then propose an algorithm that will improve the privacy of network communication. We will look at minimizing the leakage of information between person A and person B.

## 76B Believe it or not: The Fibonacci Series

Natalie Alfano, Clare Dubecky, Amy Dittebrand, Charlie Jindra  
Kent State University

*Brian Cook, Mentor*

The Fibonacci sequence is a mathematical series in which each number is determined by the sum of the previous two numbers. It was invented by Leonardo Fibonacci and has been found to accurately predict growth in living things. From the Fibonacci sequence comes the Golden Ratio, which can be used to calculate any Fibonacci number. We will explore its use in mathematics, where the golden ratio is used to solve various enumeration problems, and in nature, where seemingly unpredictable growth of plants, foods, and even animal breeding, can be determined all by the same sequence of predictable numbers.

**77A Evaluating Computer Processing Efficiency Through Square Matrix Decryption**

Anthony Campagna, Hayden Ferencz, Shadi Zogheib  
Cleveland State University

*Yongjian Fu, Mentor*

In the modern technological age, the need to develop more efficient and robust cybersecurity methods remains a primary issue. At the same time, development of faster computational hardware - especially at the commercial level - can inadvertently render certain encryption practices obsolete, leaving one's personal information at risk. The purpose of this study is to observe the efficiency at which commercial PC systems could decode messages encrypted via a columnar transposition cipher. Messages are arranged in an  $m \times n$  matrix, where  $n$  is a defined keyword length and  $m$  is the number of rows needed to write out the message. Each matrix then has  $n!$  ways the columns can be permuted, creating the encryption. Decryption time was tested using messages across keywords between 2-12 characters. Findings support the hypothesis that more powerful processors decrease the overall decryption time.

**78B Blockchain Technology and How it will Revolutionize Our Digital World**

Hunter Samf, Mike Meaney, Anthony Ponzani  
Cleveland State University

*Dr. Pong P. Chu, Mentor*

Blockchain is revolutionizing the digital world by bringing a new perspective to security, efficiency, and stability of systems and data. Blockchain is a digitized, decentralized, immutable, public ledger in which digital events are approved and shared with all parties. It has almost infinite applications, and its concepts are transferable to a wide range of industries where security, scalability, and efficiency are critical. This project aims to provide an overview and explain the core concepts and principles behind it. We will identify its shortcomings and outline potential solutions. Further, the project explores the potential impact of the technology in different markets and its implementation in cutting-edge applications. Finally, we discuss the challenges with the widespread adoption of this disruptive and foundational technology that is set to revolutionize our digital world.

**79A Fee Inclusive Tuition**

Alexandra Ballow, Hannah Senediak, Mitchell Franko, Michael Kacir  
Youngstown State University

*Dr. Sturrus, Mentor*

Currently college tuition itself is frozen, but the college needs to keep up with the market, so to match inflation, colleges charge fees. Students know what their tuition itself will cost but with added fees ever growing and changing, students don't know how much they will actually owe. In an attempt to solve this problem, we looked at a way to consolidate college tuition and their fees. To do this we looked at the average fee cost per student per major and divided that total fee cost among the number of projected years that student will be in college. So, each major will have a different tuition price. To ensure our method works we created a hypothetical university with two colleges and seven majors. Once we had a mock university we were able to run different simulations and comparisons to see if charging tuition this way is better than the way universities have been charging tuition.

**80B Difference between profits**

Michael Mishak, CJ Roth  
Kent State University

*V. Renee Giermann, Mentor*

The project will go through the accounting and economic profit and how they differ. With this project we will be picking a small business and calculate the accounting and economic profit; in the end we will summarize with what calculation yields the most accurate 'profit' for the small business.

**81A Kent State Statistical Analysis of Nutrition Compared to Other Universities**

Max Lapolla  
Kent State University

Kent State offers a variety of different foods to satisfy everyone's nutritional needs from vegan to peanut-free options. However does Kent State have an overall nutritious meal and how does it compare to other universities ranging from public to private. This is what I am trying to discover in my statistical analysis of the nutrition at Kent State. This is found by finding a variety of meals and asking students what they eat for a given meal, and then averaging out the data to find what an average meal nutrition would be. Then I will go to a few other schools and find out they're average meals and compare. Along with this data I will construct a meal plan for a student to get the most out of their meals. This will bring a lot of insight into how nutritious the meals here are at Kent and to see if we really are getting the most out of the food offered.



**82B Exploring Generating Functions as Applied to Random Walks**

Hannah Tepley, Chris Thompson, Sarah Toth  
Cleveland State University

*Dr. Barbara Margolius, Mentor*

Generating functions provide convenient tools to understand the behavior of infinite sequences. A more specific form of these functions is a probability generating function, which can also be utilized to find the expected value of a discrete random variable. In our study, we used concepts from probability theory to explore Poisson probability generating functions and used them along with Poisson distributions to model a random walk in a plane. With the use of Euler's Formula, we were able to find where these functions converged, diverged, and the directions they moved with their real and imaginary components. This then leads us to more complex forms of functions and how they can then be translated into more complicated random walks. These random walks can be applied to real life with the study of population genetics, vision science, and the psychology of decision making.

**83A Mobile Service Robotics**

Honor Fournier, Zoey Pincelli, Jack Winterich, Alec Wiggins  
Cleveland State University

*Shiqi Zhang, Mentor*

Every day, technological advancements are being made that have the potential to help humans in their everyday lives. The capabilities of AI are limitless, with several different uses that this poster will highlight. One of the AI discussed in this poster is a combination robot and AI personal shopping assistant which will demonstrate machine learning and the growth of human-AI interaction. Another example of robotics presented will be STRANDS, a project dedicated to long-running autonomous robots that is aimed for increasing the scope of robotic security and surveillance as well as care and customer service. The AI and robotic system discussed and experimented with within the last article concerns a robotic system that can assist and become an integrated part of a building complex, which documents many experiments, most notably ones related to learning and verbal instruction.

**84B Generalized Fibonacci Sequences**

Lauren Smith, Emmett O'Flanagan  
Kent State University

We intend to explore into generalized Fibonacci sequences. We hope that by exploring this topic we can find a use for generalized Fibonacci sequences in the fields of mathematics.

**85A Modeling Temporal Variations in Escherichia coli at Villa Angela Beach in Cleveland, Ohio**

Alex Johnson, Sho Tanaka, Jemima Ukwela, Alexa Roberts  
Cleveland State University

*Dr. Barbara Margolius, Mentor*

The Northeast Ohio Regional Sewer District (NEORS) is a public utility district in Cuyahoga and Summit County. NEORS manages three wastewater treatment plants serving 62 communities, over one million residents, and 90 billion gallons of wastewater a year. This project looks to examine the beach closing model for Villa Angela Beach using the modeling software Virtual Beach. Variables chosen to examine in the model were wave height, flow from Euclid Creek, and lake turbidity. We found E. Coli has a different mechanism for growing in July and August than in the other months during the beach recreational season. Based on our results, we recommended the NEORS create and test multiple models during the season and sand sample more often.

**86B Mathematical Model of Wind Turbine Power Output**

Christine Campbell, Jake Derkacs  
Cleveland State University

*Dr. Shawn Ryan, Mentor*

The research done by Arantxa Tapia, Gerardo Tapia, J. Xabier Ostolaza, and Jos   Ram  n S  nchez, aims to represent a mathematical model of a wind turbine driven by a doubly fed induction machine and models a few examples of real-life performance of these machines. The model demonstrates the operating conditions of the machine both above and below the synchronous speed which provides the ideal power output. This modeling is possible via the use of a double-sided PMV converter, which connects the rotor to the power grid. This researcher utilized MATLAB, SIMULINK, and other machines to arrive at a model. The model of the wind generator is designed to show how a control strategy can be used to manipulate the power factor of the energy that the wind generator supplies.



**87A Modern Applications of Cryptography**

Jacob Haller, Maxwell Kotlan, Mira Shah  
Kent State University

Encryption is used to securely transmit sensitive data. The process has been around for thousands of years, and is now more widely used than ever. We will explain a brief history of encryption and cryptography, as well as modern applications, such as cryptocurrencies and the encryption of websites and emails.

**88B Predicting drop-out rates of students**

Garrett Anderson, Jeremy Sidoti, Christian Harwick, Karla McGinty  
Kent State University

*Darci Kracht, Mentor*

In order to help Kent State University retain more of their students, we set out to find the probability of students dropping out based on different characteristics. These characteristics include income, ethnicity, GPA, age, campus involvement, whether they were a first-generation college student and many others. We are using data previously collected from the Institutional Research Department at Kent State.

**89A Natural Language Based Neural Activity Classification Using Neural Network**

Anthony Hill, Firaus Odeh, James Hayes, Elizabeth Durflinger, Cameron Howard  
Youngstown State University

*Dr. Coskun Bayrak, Mentor*

Neural activity recording is the process of scanning individual neurons in the brain, and recording their activity in response to specific stimuli. The team has put together a language based neural activity study, where bilingual and monolingual test subjects are assessed with a 14 point brain scanning device that allows the team to monitor, and record, neural activity of each subject while being presented with language specific stimulus. This data is used to analyze differences in neuron activity between bilingual and monolingual subjects. The team expects to observe greater neural activity in bilingual subjects while assessing a visual stimulus.

**90B Queueing Theory Applied to Organ Transplant Waiting Lists**

Hannah Lipka, Kristen Reyes, Korin Vaughn  
Cleveland State University

*Barbara H Margolius Ph.D., Mentor*

Queueing theory is the mathematical study of waiting in lines, or queues. By taking a differential approach to model the wait time for an organ transplant, we can efficiently allocate organ donors to those who need them. The most involved case can be simplified, yet still effective. In this case, only O-blood type donors and O-blood type patients are being considered. Additionally, only the rate of donors available, the rate of death, and the rate of patients coming in are being modeled.

**91A Paint Cans**

Emily Herendeen and Joe Oglio  
Kent State University

For our project, we studied paint absorption and programming using Python. With some practice, we found an easier way to write our program. This program will calculate how many cans of paint one will need in order to paint a specified amount of rooms in their house. We kept in mind error measurements made by the home owner as well as excess paint being absorbed in the brush or left in the pan. Being as we are not professional programmers or painters, we hope this may inspire someone to take on this possible project or one similar to it and contribute to the Fourth Industrial Revolution.

**92B Re-inventing the Wheel: A Tangent Circle**

Leon Rockamore, Jr, Aaron Herrmann  
Cleveland State University

*Dr. Gupkin, Mentor*

The purpose of this project was to construct a formula to find the tangent circle between any given three points that lie on a curve. We did this by using basic geometric and algebraic principles, as opposed to more advanced math such as calculus, so it can be understood and applied from a different perspective. Using said principles, we were able to come up and experiment with a functioning formula. Through extensive experimentation of decreasing and increasing the distances between points, we discovered numerous different properties of tangent circles. Some of our results point towards complex geometry, which leads a connection between algebraic math and more advanced math such as other planes of graphing and complex geometry.

**93A Programmatic Entropy**

Evan Bause, Nick Pappas, Joshua Oberlin, Jared Anderson  
Kent State University

Pseudo random number generators find many applications in modern programming - however not all PRNGs operate on the same principles or algorithms, and thus may not be suited for all applications. This poster explores three of the most common PRNGs, their history, application, and inner workings.

**94B Remainder Math**

Nick Verbus  
Kent State University

An exploration of modular arithmetic and its various applications.

**95A A Connection Between Ford Circles and Continued Fractions**

Devin Boss  
Cleveland State University

*Dr. Steven Gubkin, Mentor*

This research investigates the connections between Ford Circles, Continued Fractions, and Fraction Mediants. Approximating irrational numbers is a longstanding pursuit of mathematics. Part of number theory deals with the approximation of Quadratic Surds, and it was through this lens that I was able to discover a connection between the popular way of approximating Quadratic Surds, Continued Fraction Expansion, and Fraction Mediants. It turns out that the action of taking a mediant between two fractions might be a connected to Continued Fractions.

**96B The Advantages of B-Spline Curves Compared to Bézier Curves in Computer Graphics**

Amanda Matson  
Kent State University

*Xiaoyu Zheng, Mentor*

A spline refers to a class of functions that are used in operations involving data interpolation and/or smoothing. Splines have several applications in curve fitting, 3D modeling, animation, and are widely used in industry. Two commonly used splines are the B-spline and Bézier. The purpose of our study is to compare these two spline functions mathematically and computationally. Overall, B-spline curves have a more intricate theory and call for more information (i.e., the degree of the curve and a knot vector) compared to Bézier curves. However, B-spline is a more advantageous choice for use in computer graphics. The significant properties of Bézier curves are satisfied by B-spline curves which also provide more control flexibility.

**97A Teaching Mathematics**

Claire Dillen, and Miranda Etgen  
Kent State University

*Dr. Joanne Caniglia, Mentor*

For our poster we are looking at different methods of teaching basic mathematics. We are taking different strategies that have been used in the past or present. Then we are analyzing each of these methods from an educators point of view. We want to look at the benefits of each strategy and then determine which one we would potentially use in our future classrooms.

**98B The Advantages of Modular Design in Software Engineering**

Jacob Brenkus, Alex Fausnaugh, Kayla Welton  
Cleveland State University

*David Aloj, Mentor*

The purpose of this research poster is to discuss the benefits of using a modular approach to software engineering. Modular software design is done by breaking the larger code into smaller sections, think modules, that hold specific functions. Modular design is shown to improve the design process by allowing better re-usability, workload handling, and easier debugging processes.

**99A Teaching Methods in Relation to Performance in a Classroom**

Katelyn Becker, Rebecca DeLozier, Ben Rife  
Kent State University

*Natasha Levinson, Mentor*

We are investigating the correlation between learning methods and overall grades/performance in the classroom. In order to research this, we are creating an anonymous survey for both instructors and students, asking about various teaching methods and performance in the classroom. These surveys will be distributed by the project participants. We

will then compile this information in order to see if there is a way to determine the most effective teaching method for a set of various learning method students, being the students that we are currently enrolled with. Afterwards, as future mathematics teachers, we will apply this learning method to mathematics courses to ensure the success of our students.

### **100B The Geometry of the Power Rule**

Jamie Rees, Emma Stec  
Kent State University

*Isaac DeFrain, Mentor*

Relationship between derivative power rule and product rule and geometry of cubes. Using examples with higher powers.

### **101A The Arithmetic Derivative**

Tyler Snyder, Tyler Vance, Donald McCrae  
Cleveland State University

*Steven Gubkin, Mentor*

The arithmetic derivative is a simple function defined using the unique prime factorization of integers and the product rule from calculus. This is quite deceiving, however, as the properties and behavior of the derivative are directly related to some of the oldest and most studied conjectures in elementary number theory. The arithmetic derivative operator is defined to be the unique map which sends every prime integer to 1 and which satisfies the "product rule" that for all  $a, b \in \mathbb{Z}$ ,  $(ab)' = a'b + ab'$ . For our research paper, we will use proof by induction on  $(nk)' = knk - 1n'$  to show that it holds true for all positive integers. We hope to familiarize the reader with the notation and properties of the arithmetic derivative.

### **102B The Stable Marriage Problem**

Brock Bavis, Brayton Rider  
Kent State University

*Jenya Soprunova, Mentor*

The stable marriage problem tries to solve stability between two different, but equally sized, sets of data. Stability in this case is defined by a match's members not being able to be better off than the current match. Each element in both sets have a ordered preference list for each element in the other set. The question of whether or not it is possible to create stable marriages between the two sets is answered by the Gale- Shapely algorithm. This algorithm iterates through the different preference lists until a match is found for all elements in the sets. By having one set propose to the other and the other chooses, over the course of the iterations, the algorithm guarantees that all elements within the sets will be matched and that all marriages will be stable.

### **103A The Math of Renaissance Art**

Erica Chambers, Alexa Fryberger  
Kent State University

*Joanne Caniglia, Mentor*

Our project, the Math of Renaissance Art, looks into how adding perspective, proportions, and other mathematical concepts into art shaped the creations of the Renaissance era. First, we give a basic interpretation of the art in the prior time period; then, we are going to discuss how the addition of math shaped the works of the Renaissance, in order to compare and contrast. Art within this time period reflected the change in the culture and society, as the people of the Renaissance were increasingly exploring and discovering math and science. This is evident through the use of techniques such as symmetry, geometrical figures, proportions, and perspective.

### **104B Youngstown Temperature Forecast**

David Gessler, Nicole Zimmerman  
Youngstown State University

*Dr. Thomas Wakefield, Dr. Moon Nguyen, Mentors*

The Actuaries Climate Index (ACI) has recorded weather patterns between the years 1961-2017, allowing people to access past climate changes in North America through multiple aspects. The ACI gave us the idea to create predictions for the weather in Youngstown over a 30- year period (1987-2017). We used regression to fit several different models to the data and determined the error between the values predicted and the actual values to ultimately predict the best value.

**105A The pro's and cons of digitizing admittance into social events**

Adam Tischler, Nick Potts, Luke Rinehart, Jamie Bowen

Kent State University

*Naser Madi, Mentor*

With the rise of technology and its presence ever increasing in our lives, parties and social events at universities nowadays have a lot more exposure, due to social media and texting. With this increase in attention and foot traffic, college parties now have higher risks and a high percentage of dangerous characteristics. We gathered data and assessed the risks of college parties with just person-to-person filtering at the door, compared to pre-party online ticketing using a mobile app. We then broke down risks into different characteristics to see what positively or negatively improved.

**106B To Plant or Not To Plant**

Vala Zeinali

Kent State University

*Mikhail Nesterenko, Mentor*

I am looking at observed germination rates of flowers, herbs, and vegetables and comparing them to the expected rates on the seed packet. I will be doing a Chi-Square test for homogeneity. I will be failing to reject or rejecting if the seed is worth planting again. The main purpose of this project is to maximize profit, optimize flat space, and eliminate bad seed packets by selecting the most viable packets. My project includes Statistics, Computer Science (coded a Chi-Square calculator), and Biology.

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