
ASU
undergraduate
RESEARCH
SYMPOSIUM
2021

Welcome to Angelo State University's 10th Annual Undergraduate Research Symposium
Monday, April 26, 2021
CJ Davidson Conference Room, Houston Harte University Center

Schedule of Events

Poster Session…….noon – 1:30 pm

The Undergraduate Research Symposium and Award Ceremony is coordinated by the Office of Research and Sponsored Projects.

Elizabeth Randell, Director of Student Research
Jan Heinen, Assistant Coordinator

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Following the Breadcrumbs:
Creating a Simplified Mathematical Model to Maximize Value Creation and Increase Resilience in the Agri-Food Supply Chain

Douglas Newcomer

Faculty Mentor: Dr. Andrew Tiger
Department: Management and Marketing

This research aims to explore the basic framework of Agri-Food Supply Chains (AFSCs) and the type of shocks caused by the COVID-19 pandemic, with the aim of exposing structural weaknesses and opportunities. Rooted in this academic understanding, a structural framework for a simple mathematical model that can be used to analyze various layers of AFSCs for a specific product or market of products in a given time frame is proposed to be used by organizations to facilitate capacity planning in a manner conducive to comprehensive supply chain management for AFSC products. Other considerations and limitations of the model are then discussed as potential avenues for firms to develop the model to their specific product or operational needs.

Pre-service Teachers' Perceptions Regarding the Impact of Virtual Learning on Students' Social and Emotional Development

Julian Huseman

Faculty Mentor: Dr. Leah Carruth
Department: Teacher Education

Schools play a big part in student social and emotional development. According to several studies, the success of students both while in school and as they mature is linked to strong social and emotional development. However, restrictions due to COVID-19 have led to drastic changes in all aspects of education including an increase in virtual learning in all levels of education. This switch to virtual learning greatly impacts students academically, but it also greatly affects the social and emotional development of students due in part to being isolated from their peers. The need for teachers to incorporate social emotional learning into their classroom will become even more important as virtual learning continues, but teachers may have difficulty teaching virtually while also maintaining social and emotional development. However, studies have not addressed how prepared pre-service teachers are to teach these skills, especially in an online environment, and they have not addressed the perceptions pre-service teachers have regarding the impact of virtual learning on student social and emotional development. This survey aimed to look at pre-service teachers' perceptions of social and emotional development and the impact of virtual learning while also looking at how they can continue to grow in their understanding of how to incorporate it into their future classrooms.

Pre-Service Teachers' Perceptions of Their Preparation Teaching English Learners

Caroline Huseman

Faculty Mentor: Dr. Leah Carruth
Department: Teacher Education

The number of English Language Learners in schools is multiplying every year, and special strategies are needed for teachers to effectively teach these learners. However, multiple studies show that many teachers cannot effectively teach this set of learners because they did not receive substantial instruction in their preparation programs about how to work with English Learners. Studies have also shown that when teachers receive an increased amount of professional development regarding best practices for working with English Language Learners, teachers better understood the strategies for working with these students, and they were more likely to incorporate them into their classrooms. As the number of English Language Learners increase each year, the need for teachers to be even more prepared to teach them will become more important and vital to the success of the classrooms. However, studies do not address how prepared pre-service teachers feel about working with English Language Learners and implementing the best practices in their classroom. This study aimed to look at pre-service teachers' perceptions of their preparedness for teaching English Language Learners and their knowledge of the best practices to use in teaching these students. This study was also used to discover if there is a correlation between how pre-service teachers have been prepared and their confidence levels on directly working with English Language Learners in the classroom as well as determining additional preparation pre-service teachers may need.

Comparison of Larson-Miller and Manson-Haferd Creep Rupture Model for Inconel 740

Logan Drake, Ismael Cecilio

Faculty Mentor: Dr. Mohammad Haque
Department: David L. Hirschfeld Department of Engineering

The Creep rupture is the failure of a material due to deformation over extended periods of time while operating at high temperatures [At least 40% of melting temperature] from a constant load. Stress rupture is the sudden failure of a material under stress. These two concepts tie together when analyzing the consistent long-term operations of high temperature machinery, such as power plant components. Due to the lack of longitudinal data available with regards to high temperature machinery operating for extensive periods of time, individuals and groups set out to create constitutive models that would estimate when failure “should” occur at a given load and operating temperature. The Larson-Miller (LM) technique is one of the first techniques used to extrapolate creep and stress rupture data, followed next by the Manson-Haferd (MH) technique. The MH technique was designed to eliminate the errors in the LM technique. The LM technique is calibrated for one parameter, which makes it easier to interpolate longitudinal data, but at the expense of accuracy at certain temperatures over longer periods of time (creep life). The MH technique utilizes two time – temperature parameters (TTP) to work with which allows the model to have a higher precision over a larger range, but at the expense of requiring more computational power. This paper will be comparing and analyzing both the MH and the LM techniques using the material Inconel 740 for temperature levels between 650-850 °C and stresses ranging from ~40- 700 MPa. After analysis, the MH technique is more flexible and accurate.

Attentional Focus of NCAA Division II Collegiate Basketball Players Performing Two Basketball Shots

Christina Hamilton

Faculty Mentor: Dr. Doris McCabe
Department: Kinesiology
Sponsorship: Undergraduate Research Faculty-Mentored Grant

An individual's ability to perform motor skills is influenced by many factors, including attentional focus. An individual's attention can be internally or externally focused. The purpose of this study was to determine if there was an association between attentional focus strategies used by NCAA Division II basketball athletes while performing an open skill and a closed skill. The two skills that were examined were a jump shot and a free throw. A jump shot is an open skill because it's performed while all of the players are able to move on the court and possibly intercept the shooter. A free throw is a closed skill because the conditions of a free throw, such as the player's distance from the hoop, stay the same every time. While performing a jump shot, the group of participants were equally split between using internal and external attentional cues. While performing a free throw, a little more than half of the participants focused on internal attentional cues compared to external attention. The Chi-Square test results showed that the asymptotic significance value was 0.525. This result signifies that the two attentional focus groups were not associated. So, NCAA Division II collegiate basketball players are not more likely to use external attentional focus strategies while performing a jump shot or a free throw. These results may have occurred because collegiate basketball players are extremely skilled in their movement patterns and can focus on other stimuli and basketball coaches could influence the focus strategy employed by the players.

Finding Variable Sources In Large Data Sets

Jackie Gray-Cherry

Faculty Mentor: Dr. Kenneth Carrell
Department: Physics and Geosciences
Sponsorship: Undergraduate Research Faculty-Mentored Grant

For years now astronomers have been collecting data using a combination of ground and space-based telescopes. We have so much information that it is impossible to sift through it all in a reasonable time frame. So, to counteract this we need to figure out ways to efficiently and quickly analyze these data sets to find meaningful results. One way we can do this is by crossmatching data sets with each other and looking for differences. This provides us with potentially interesting candidates for follow-up analysis. We used a crossmatched catalog with potentially variable sources flagged and examined their lightcurves from The Transiting Exoplanet Survey Satellite (TESS). After going through a magnitude limited sample, we found 3 binary sources that were already confirmed in the Set of Identifications, Measurements and Bibliography for Astronomical Data (SIMBAD) and 3 sources that are unknown.

Geographic Variation in Canyon Wren (*Catherpes mexicanus*) Song

Amber N. Norris

Faculty Mentor: Dr. Ben Skipper
Department: Biology

As young songbirds mature, they hear and learn the songs of the birds around them. Because of this, young birds are more likely to hear songs sung by birds that are nearby than those songs sung by birds that are farther away. This process can lead to the development of geographic dialects, very similar to the way human dialects and accents have evolved. These dialects have been found in several bird species, but it is uncertain how prevalent the occurrence is and how consistent the variation is across species. This research investigates the geographic variation in the songs of the Canyon Wren, a species of bird that inhabits a vast geographic area which ranges from central Mexico to southern British Colombia. Although Canyon Wrens have a song that is easily recognized, quantitative evaluation of the geographic variation is deficient. The quantitative song data (duration, number of notes, frequency etc.) will be drawn from song recordings of Canyon Wrens from online databases and will be measured through various computer analyses. Following these measurements, data will be statistically evaluated to assess the extent of the spatial autocorrelation.

Developing an Improved Teaching Tool for “Design of Experiments”

Aramis Ramirez

Faculty Mentor: Dr. Mohammad Haque
Department: David L. Hirschfeld Department of Engineering
Sponsorship: Undergraduate Research Faculty-Mentored Grant

Decision making during a design process is challenging as it depends on multiple variables. When an engineer designs a new product, they will need to test the design for specification, but testing every trial of the design would cost too much time and money for the company. In this study, we have designed and manufactured a teaching tool for hand-on Design of Experiment (DOE) learning module. The physical model consists of five interchangeable variables, where the students will drop a ball on the start of a track and try to find the perfect combination of variables to reach their goal at the end of the track. Through the experiment, the students will be introduced to Design of Experiment (DOE), which is an analytical approach to find a desired output of testing by altering the factors to find a cause and effect relationship. The design will allow the students to have a fun hands on experience, while utilizing the Taguchi method, which will allow for a significant reduction of testing needed to acquire the desired results, by giving optimal factors for the least amount of testing, so that all parameters are tested.

Social Isolation & Depressive Symptoms among College Students

James Harry

Faculty Mentor: Dr. Paige Trubenstein
Department: Psychology and Sociology
Sponsorship: Undergraduate Research Faculty-Mentored Grant

This exploratory study sought to better understand feelings of social isolation and depressive symptoms among college undergraduates in relation to the type of instruction students were receiving. Students self-selected into one of three categories indicating the primary type of instruction for the current semester with 10% of students being fully online, 16% of students being fully face-to-face, and 74% of students being in hybrid classes. The mean age of participants for this study was 19.44 (SD=1.68) years and the sample was 81.8% female. Overall, students reported having an average of 4.38 (SD=3.32) close friends with whom they feel at ease with, can talk to about private matters, and call for help. Additionally students reported talking to these friends about once per day on average. Similarly, students reported talking with their family about once per day on average. Mean level differences indicated that online only students felt less appraisal and tangible support than did face to face and hybrid students although this finding was not significant ($F(2,97)=1.71$, $p=0.19$; $F(2,97)=0.84$, $p=0.43$ respectively) . There were no differences in belonging support for any of the three instruction methods ($F(2,27)=0.64$, $p=0.53$). Although 38% of the sample reported moderate to severe depressive symptoms, there were no significant differences in depressive symptoms between any of the instruction styles ($F(2,97)=0.30$, $p=0.75$), nor were there differences in anxious arousal between any of the instruction styles ($F(2,97)=0.24$, $p=0.79$). Overall, instruction style did not appear to have significant influences on feelings of social isolation, depressive symptoms, or anxious arousal.

What Affects Perceptions of Sexual Harassment?

Lillie Krug, Ricardo Lara

Faculty Mentor: Dr. Cheryl Stenmark
Department: Psychology and Sociology
Sponsorship: Undergraduate Research Faculty-Mentored Grant

Introduction

This study examined perceptions of sexual harassment behaviors based on the gender of the perpetrator and the victim.

Male to female sexual harassment is the most common type of harassment. (Bendixen & Kennair, 2017). Men experience sexual harassment with the same frequency as women (Bendixen & Kennair, 2017), however, men are less likely to report sexual violation from women (Russell, Doan, & King, 2017). Reports of sexual harassment where males are the victim are likely underestimated.

Male to male sexual harassment can be due to threats to masculinity. It often "...represents a competition to gain status at work by proving masculinity" (Alonso, 2018). Females use same-sex harassment due to feelings of competition to gain status or to establish dominance (Alonso, 2018).

It is important to study the different types of sexual harassment because perceptions may vary depending on gender combinations.

Method

165 participants read 5 scenarios depicting various levels of sexual harassment. Participants randomly saw different combinations of genders for the perpetrator and the victim of the sexual harassment. Participants rated each scenario 7 dimensions.

Discussion

The results of this study suggest that people take a harsher view of a male perpetrator of sexual harassment, as evidenced by the findings that when the perpetrators were male, individuals experienced the most anger and when perpetrators were female, individuals were least likely to view the actions as sexual harassment, and had the least sympathy for the victims.

Screening of Genetic Markers to Distinguish Morphologically Similar Species of Cottontail Rabbit

Zoey Stormes

Faculty Mentor: Dr. Loren K Ammerman
Department: Biology
Sponsorship: Undergraduate Research Faculty-Mentored Grant; Tri-beta Research Grant

The Davis Mountain Cottontail, *Sylvilagus robustus*, and the Eastern Cottontail, *Sylvilagus floridanus*, are two morphologically similar but genetically distinct species of cottontail rabbit. Identification of a specimen as one species over the other is currently difficult due to the lack of a single genetic marker capable of conclusively separating the two species. This study aims to address this problem by investigating five nuclear genetic markers of interest (TG, THY, SPTBN1, PRKC1, and MGF) previously used to elucidate a phylogeny for the family Leporidae. This study utilizes both the species of interest as well as the Desert Cottontail, *Sylvilagus audubonii*, as an outgroup. Twelve *Sylvilagus robustus*, thirteen *Sylvilagus floridanus*, and ten *Sylvilagus audubonii* samples were obtained and DNA was extracted and amplified for the five markers of interest. Successfully sequenced DNA was aligned and processed using phylogenetic tree software, and the effectiveness of each gene was evaluated based on branch groupings and bootstrap values within the tree. So far, none of the five genes has shown promise in their ability to confirm a specimen as being *S. robustus* or *S. floridanus*.

Coxiella burnetii effector protein EmcB: the role of autoubiquitination in its suppression of innate immunity.

Marissa Brezgiel

Faculty Mentor: Dr. Emerson Crabill
Department: Biology
Sponsorship: Undergraduate Research Faculty-Mentored Grant

The type 1 interferon (IFN) pathway is an innate immune response that can be activated by the RIG-I receptor when it senses foreign RNA molecules. *Coxiella burnetii* is an intercellular bacterial pathogen known to infect mammalian cells and cause Q fever. This pathogen blocks the activation of the type 1 IFN pathway which is essential for its successful replication and infection. *C. burnetti* utilizes a Dot/Icm type IVB secretion system (T4SS) to release effector proteins in the host cytosol. These proteins include EmcA and EmcB which have been found to inhibit the RIG-I receptor of the type 1 IFN pathway. EmcB is a protein which itself is ubiquitinated and it serves to block the RIG-I receptor by de-ubiquitinating it, acting as a ubiquitin protease. This project looked to continue the study on the EmcB effector protein by determining if autoubiquitination of EmcB is necessary for its de-ubiquitinating activity of the RIG-I receptor. Ubiquitin is normally covalently attached to lysine residues of proteins. For this project, I made individual mutations to the lysine amino acid residues known to bind to ubiquitin, transforming them into arginine residues, and then tested for evidence of autoubiquitination and deubiquininase activity.

COVID's Effect on the US Stock Market

Justin Soldan

Faculty Mentor: Dr. Biqing Huang
Department: Accounting, Economics and Finance

The stock market has always been a tricky and complex system that is most noted when major spikes occur. It because of this reason, this study took to look into COVID-19's impact on the United States stock market. By using indexes and stocks in the oil and aircraft industry from January to October of 2020, an analysis was performed based on stock market values gathered from Yahoo Finance that was imputed and calculated in Excel. All of the data from 2020 was focused on a timeline manner to explain why and how these events had an impact on the market. Finally, the data previously mentioned was then compared to data from the non-pandemic year of 2019 and the Housing Crisis of 2008.

State Code of Professional Conduct Adoption Related to the Professional Accountant and Business Populations

Ryan Cook

Faculty Mentor: Dr. Russell Calk
Department: Accounting, Economics and Finance

Each state and territory of the United States provides a code of conduct for Certified Public Accountants (CPAs). Codes vary across jurisdictions/states. The purpose of this study is to investigate determinates of the differences. We hypothesize that there is a positive correlation between 1) the size of the business communities and the size of the accounting professional communities and between 2) professional communities and the complexity of their respective codes. Business Communities were approximated by the GDP of each jurisdiction. The complexity of each code was determined by using the Flesch Reading Ease and Flesch-Kincaid Grade Level tests. Results show that bigger business communities are correlated to bigger professional communities and bigger professional communities are correlated to more complex codes.

Development and Identification of Affibody Molecules that Target Crotalid Snake Venoms

Taylor Parmer, Lily Ellzey, Dhiraj Shrestha

Faculty Mentor: Dr. Edith Osborne
Department: Chemistry and Biochemistry
Sponsorship: Welch Foundation; Faculty Research Enhancement Program (FREP)

Affibodies are a type of small protein that can be designed to bind with high affinity to a researcher's protein of choice. They have been utilized in a variety of different applications, including therapeutics, in vivo imaging, and biotechnological applications. Affibody molecules that are specific to a protein target can be selected for using a library of affibody molecules displayed on phage. In this study, a library of affibody molecules displayed on M13 bacteriophage was used to probe affibody/snake venom interactions. This particular library was developed by New England Biolabs and was used to pan against Western diamond back rattlesnake (*Crotalus atrox*) and Western cottonmouth (*Agkistrodon piscivorus leucostoma*) venoms. By performing the panning procedure of the affibody phage display library against snake venom, we hope to determine which affibodies have an optimal affinity for the venoms. By identifying affibody molecules that have affinity for snake venom proteins, we hope to perform further protein/protein interaction studies that will contribute to the field of venom research.

Selection of Affibody Clones that Bind to the Human Signalling Protein WNT-7a

Lily Ellzey

Faculty Mentor: Dr. Edith Osborne
Department: Chemistry and Biochemistry
Sponsorship: Undergraduate Research Faculty-Mentored Grant; Welch Foundation

WNT-7a is a signalling protein found in humans that plays a vital role in embryonic development and is linked to oncogenesis in adults. Researchers are currently studying WNT-7a to determine how its role in cancers could be used to develop drugs and therapies to better treat and diagnose cancers where WNT-7a is involved. This proposed project hopes to develop an affibody that will bind to WNT-7a, enabling future researchers who study the protein to easily isolate the protein, aiding them in obtaining the protein and measuring *in vivo* levels of it. We will use an affibody phage display library and a panning selection experiment to identify possible affibodies. Then, we will assess the efficacy of these affibodies using an ELISA. Afterwards, we will express our affibody in *E. coli*.

Investigating a Granitic Pegmatite within the Llano Uplift and Examining the Secondary Uranium Minerals Formed from the Alteration of Uraninite

Emma Larue Fuentes

Faculty Mentor: Dr. Elizabeth Koeman-Shields
Department: Physics and Geosciences
Sponsorship: Undergraduate Research Faculty-Mentored Grant

At least three different pegmatites resulting from the Llano Uplift have formed in central Texas. The Badu Hill pegmatite located near Llano, Texas contains a rare-earth mineral, uraninite, whose secondary uranium minerals have a unique importance in studying. The main minerals uraninite produces are carnotite, tyuyamunite, and autunite. These uranyl minerals are important for understanding the stability, physical properties, and crystal structure of our pegmatite. It will also help us understand further mineral exploration, transportation processes and dissolution for the uraninite. In addition to the abundance of quartz, feldspar, pyrite, and mica minerals found in the research area, one definite sample of uraninite was found with possible secondary altered minerals on it (Micro-Raman spectroscopy testing currently being done). Other samples containing possible secondary alteration minerals were found on many of the samples containing pyrite and feldspar. This was indicated by the bright red and yellow colored powder located in the cleavage and/or fractures in the sample. The radioactivity readings of the samples in the quarry studied varied from 1.02 mR/hr to 12.84 mR/hr. Pending the laboratory data, the final results will yield data leading to a full composition, unit cell dimensions, and crystal structure that will result in the identification of our secondary alteration minerals found within the Badu Hill pegmatite. Since the site and the Badu Hill pegmatite have little information on them, this research will provide the fundamentals for future research projects.

The Ménagerie du Jardin des Plantes and the French Mentalité: How the French Mindset was Exhibited in France's Oldest Zoo

Rachel Beggs

Faculty Mentor: Dr. Elisabeth Muelsch
Department: English and Modern Languages
Sponsorship: Undergraduate Research Faculty-Mentored Grant

The Jardin des Plantes Ménagerie, a public zoo formed during the French Revolution, reflected French rationalist thought and policy through its display of new and foreign animals. Established in 1795 on the grounds of the Parisian botanical gardens that once belonged to King Louis XVI (guillotined in 1793), it not only reflected the power of the new state, it made the state's goals of scientific advancement relatable to the public. The best scholarly minds of the period conducted their research at the Ménagerie and thus contributed to the Ménagerie's reputation as a site of learning. Some of the more popular research projects linked to the Ménagerie were the attempts to acclimatize exotic species to the French environment. As a public, state-run site, the location also housed the living diplomatic gifts from foreign rulers and the animalian wartime spoils from Napoleonic conquests. This display of French power and scientific prowess was done in a way that inspired public imagination in art and culture through novel animals such as the giraffe. In later decades, however, the Ménagerie declined in prominence, particularly during the Prussian siege of Paris from 1870-1871, when many of the animals were killed to provide food to the people. Some of the decline, however, could also be attributed to the rise of other scientific zoos around Europe modeled after the success of the Jardin des Plantes Ménagerie.

Texas Poppy Mallow Genetic Study: Genetic Variation in the *ycf1* Gene in *Callirhoe scabriuscula*

Rachel Beggs, Alexandria Kemp

Faculty Mentor: Dr. Bonnie Amos
Department: Biology
Sponsorship: Undergraduate Research Faculty-Mentored Grant

The Texas Poppy Mallow, *Callirhoe scabriuscula*, is an endangered plant with scattered populations found in west Texas. While its conservation status is known, its genetic diversity is not. Without knowing the relatedness of these plant populations, it will be difficult to adequately protect or expand their reach or work to prevent their extinction. The goal of this research is to better understand the allele frequencies of *C. scabriuscula* gene *ycf1* in several west Texas populations. With frequency hopefully corresponding to plant relatedness, general conservation efforts can focus on more diverse populations and more protections can be given to less diverse populations. DNA was isolated from populations near the San Angelo area and the gene was replicated using PCR. The samples with viable results will then be sent to the A&M Corpus Christi labs for genetic analysis to reveal their allele frequencies.

On the Minimum Edge-Crossing Number of Specific Classes of Spine Drawings

Thi Thu Huong Vo

Faculty Mentor: Dr. Simon Pfeil
Department: Mathematics

Guy's conjecture states that the crossing number cr(K_n) of a complete graph K_n is exactly

$$\mathrm{cr}(Kn) := \frac{1}{4} \cdot \left\lfloor \frac{n}{2} \right\rfloor \cdot \left\lfloor \frac{n-1}{2} \right\rfloor \cdot \left\lfloor \frac{n-2}{2} \right\rfloor \cdot \left\lfloor \frac{n-3}{2} \right\rfloor$$

It has been shown that 2-page book drawings of complete graphs achieve this bound, but whether this is the minimum is not known. We study plane drawings with the goal of resolving this question with regards to novel embedding schemes. In particular, we introduce swirl drawings of complete graphs, and determine their crossing number. We also explore techniques to track and minimize cr(K_n) in general.

Stormwater Management ASU: Mapping and Analyzing Stormwater Flows on the Surface and in Sub-Surface

Cheyenne Hibbitts

Faculty Mentor: Mr. Stephen Shields
Department: Physics and Geosciences
Sponsorship: Undergraduate Research Faculty-Mentored Grant

Angelo State University (ASU) is located in a semi-arid climate, receiving on average (23”) per year of precipitation. The rainy season is short and intense, leaving most of campus and surrounding neighborhoods flooded. During intense rain events, ASU experiences severe flooding along high traffic areas such as roads, parking lots, and sidewalks. Furthermore, runoff from ASU heavily floods the roads that border the North and West side of campus. Thorough observations and analyses during rain events and subsequent mapping of the topography and water flow on the surface and in the sub-surface show where flooding is most significant on campus. Quantifying land use and applying “C” values to these units, and calculating the amount of discharge from precipitation gives a framework to implement improved stormwater management practices. The results show that surface runoff trends East to West, making the West end of campus more prone to flooding. Runoff from campus runs off-campus resulting in significant flooding on Avenue N and Jackson Street. Standing water beneath dumpsters, permanent rust stains, and oil slicks in parking lots show evidence of surface contamination into the runoff, reducing water quality. Improving ASU’s stormwater practices in these areas can change the amount of flooding that occurs significantly. The ASU campus is expanding and student enrollment has increased and continues to do so. It is important to be proactive with the best stormwater management techniques possible to ensure the well-being of the inhabitants of Angelo State University and the surrounding community.

Investigation of Protein Cbu513 from *Coxiella burnetii* and its Implications for the Induction of Host Autophagy

Calvin Benningfield

Faculty Mentor: Dr. Emerson Crabill
Department: Biology/Honors Program

Coxiella burnetii, an intracellular bacterial pathogen known to cause the zoonosis Q fever in humans, requires a type IV secretion system (T4SS) to deliver bacterial effector proteins to replicate inside an expanding *Coxiella*-containing vacuole (CCV) within host cells. A mutant lacking the effector protein Cbu513 did not have light chain 3 (LC3) present on its CCV, a known indicator of autophagy. This suggested that the protein plays a role in autophagosome and vacuole fusion. The focus of this study was to further characterize the molecular mechanism through which Cbu513 facilitates this fusion. Through bioinformatics, the protein was discovered to be a fructose-1,6-biphosphatase, a protein typically used for gluconeogenesis, but was found to be translocated into host cells via theT4SS of *Coxiella burnetii* during infection. This was further confirmed by our bioinformatics analysis which suggested a type IV secretion signal on the C-terminus of Cbu513. While in the host cell, Cbu513 would increase the cellular concentration of fructose-6-phosphate. Increased fructose has been shown to trigger mammalian target of rapamycin (mTOR) which leads to autophagy. It was for this reason that we set to express the Cbu513 protein in HELA cells to determine if autophagy had been upregulated.

Analyzing RR Lyrae Stars Using TESS Data

Garath Vetters, Andrew Tom, Faith Olsen, William Hennig

Faculty Mentor: Dr. Kenneth Carrell
Department: Physics and Geosciences
Sponsorship: Faculty Research Enhancement Program (FREP)

The Transiting Exoplanet Survey Satellite (TESS) has a primary mission of observing exoplanets. However, by precisely measuring the brightness of a large number of stars, it is an ideal tool to use in order to look for stellar variability. We have used TESS data and a program written in python to classify stars into three types of RR Lyrae variables: RRab, RRc, and RRd. Moreover, particular attention will be placed on looking for interesting phenomena only recently discovered by the latest generation of space telescopes.

Tuft Flow Visualization and Measurement

Brandon Shimp, Kristian Dehoyos, David Cobos

Faculty Mentor: Dr. Manuel Garcia
Department: David L. Hirschfeld Department of Engineering
Sponsorship: Faculty Research Enhancement Program (FREP)

Tuft flow visualization is a technique used for studying the dynamics of a fluid system. A tuft is a strip of yarn or string attached to an aircraft wing or a car surface. The purpose of this project is to develop a method to determine the velocity of a flow based on the deformation of the tufts. Initially, this was measured by analyzing monofilament deformation in the open channel flume. The experiment was prepared by manufacturing attachments that could be installed into the flume, upon which the monofilament tufts would be installed. Once arranged, the tufts deformation in a predetermined flow was visually captured for study. Calculating the deformation of the tuft was achieved using Computational Fluid Dynamics (CFD) and structural analysis simulations. The objective in running simulations was to match the results of the hands-on experimentation. Preliminary results show agreement with the current experimental model. Once a calibrated model is obtained, the velocity will be iteratively modified to match the tuft deformation.

Media and Perceptions

Grace Kerestly

Faculty Mentor: Dr. Teresa Hack
Department: Psychology and Sociology

Sponsorship: Undergraduate Research Faculty-Mentored Grant

Women make up a disproportionate portion of the audience for true crime media. This gender difference has been established; however, no research has invevstigated differences solely among women. I hypothesized that women who frequently consumed true crime would have a greater perceived likelihood of victimization, lower feeling of overall personal safety, and greater feelings of preparedness to avoid victimization compared to women who do not frequently consume true crime media. To test these predictions, participants were given a survey consisting of four parts: Consumption of True Crime Media, Perceived Likelihood of Victimization, Overall Feelings of Personal Safety, and Preparedness to Avoid Victimization. All survey questions were answered on a 5 point Likert Scale.

A tertiary split was performed on the data to determine those who are high and low in True Crime Consumption. I then conducted a multivariate analysis using True Crime Consumption (high, low) as the independent variable, and average scores for Perceived Likelihood of Victimization, Overall Feelings of Personal Safety, and Preparedness to Avoid Victimization as the dependent variables. This analysis found significant differences between the two groups; however, my specific hypotheses were not supported but opened up discussion on the topic.

Flight of Ballooning Spiders in Electric Fields

Eduardo Aguirre Serrata

Faculty Mentor: Dr. Michael Holcomb
Department: Physics and Geosciences
Sponsorship: Undergraduate Research Faculty-Mentored Grant

The process in which spiders lift off is called ballooning, and only a few select species possess this ability. The way these spiders navigate this process is not well understood. Early research pointed towards spiders using wind currents; however, most recent experiments have suggested that Gossamer (ballooning) spiders may be using the electrostatic field of Earth in order to lift off and stay afloat. This is supported by the presence of charge having been found on spider silk. Through some preparation and testing, a similar scenario was replicated in a lab environment by creating an electric field and using materials that resemble the chemical composition of spider silk. The response of these materials to the electric field, suggests that the proteins, or more specifically their constituent amino acids, play an important role in this behavior. With each amino acid tested separately, we were able to test for the specific amino acid that contains a charge, demonstrating whether ballooning spiders use the Earth's electric field to initiate their flight. Conversely, different voltages were also applied to the electric field in order to determine what the minimum field characteristics are necessary for lift off.

Should College Athletes Have the Opportunity to Get Paid?

Emily Keoughan, Gabriela Villagrand

Faculty Mentor: Dr. Adam Parker
Department: Kinesiology

Introduction:
Further compensation for college athletes is something that has been argued about for quite some time. Current NCAA rules prohibit payments beyond educational and athletic scholarships. Athletes are restricted to receive outside income. "The sale of television and radio rights to regular season games provided additional income to NCAA member schools. A successful college athletic program can also generate substantial indirect revenues"
(Goldman L. 1989). However, athletes cannot receive the money that their efforts have brought in. Should athletes have the opportunity to get paid? The overall goal of this study is to bring awareness of what athletes currently receive and to further understand what people think about this debate.

Volunteers willing to take the survey will be recruited from classes at ASU or recruited from ASU's Junell Center. Due to COVID-19 restrictions, students will be asked to answer questions using an online survey. Data will then be collected once we have the correct amount of responses. There will be no bodily fluids or tissues being removed for this study. Disadvantaged populations or populations who cannot legally give consent will not be used in this study.

References
Goldman, L. (1989). Sports and antitrust: Should college students be paid to play. Notre Dame L. Rev., 65, 206.

Methodology:
A.) We will get permission from professors and coaches to ask the students in the class or team to fill out a survey. Once permission has been granted, we will give the participants their consent form and access to the online questionnaire via email. The participants will then read the consent form and provide consent before completing the questionnaire. All participants will be students at ASU. We plan on recruiting 50 non-student athletes (ASU students who are not athletes) and 50 current student athletes. The overall goal will be about 100 participants. There will be no information collected that will allow participants to be identified. Data will be stored and sealed in a locked filing cabinet for at least 3 years.

B.) Participants will be asked to fill out a 5 minute online questionnaire to further understand the current opinions of people who think athletes should or should not receive further compensation on top of scholarship money. There will be around 15 questions asking for yes/no responses surrounding the current pay situation. All research data will be gathered from the surveys.

C.) The volunteers will be informed verbally and in writing via email about the research we are conducting. During their regularly scheduled class times or post practice. We will ask participants for their email addresses to send them the consent forms. After reading and providing consent they will then be given access to the online questionnaire and asked to fill out the questions. This will take no more than 5 minutes. The survey information will be stored appropriately.

D.) There will be no use of any special topics (deception, special populations, or invasive procedures) in this study.

Adenovirus Screening in Texas Bats

Katie Holland

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Sponsorship: Undergraduate Research Faculty-Mentored Grant; Beta Beta Beta Biological Honor Society Research Grant

Adenoviruses (AdVs) in the genus *Mastadenovirus* play an ecological role in causing respiratory, ocular, and gastrointestinal pathology in mammals. Bats have been noted as important reservoirs in the evolution of adenoviruses due to bats' atypical ability of harboring genetically diverse viruses within a single geographic location or host species. Research relating to the evolution, distribution, and diversity of adenoviruses can be beneficial for understanding epidemiological effects on bat ecology and conservation applications. Analyzing genetic diversity of viruses may also elucidate mechanics of inter- and intraspecies viral transmission in bats. We conducted RT-qPCR on 65 samples of *Myotis velifer* collected in 2019 and 2020 from Texas counties. For each sample, we completed two treatments to determine whether DNA extraction of intestinal tissue or DNA extraction of a phosphate buffered saline wash of intestinal tissue caused increased viral load detection via RT-qPCR. We added positive control AdV DNA to tissue prior to DNA extraction to determine the detection limits of the RT-qPCR assay. Based on these detection limits, all samples were negative for AdV DNA presence.

Deubiquitination Dynamics of the *Coxiella burnetii* Effector EmcB

Sharin Salam

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Department: Biology
Sponsorship: Undergraduate Research Faculty-Mentored Grant

Coxiella burnetii is an intracellular bacterial pathogen that causes the zoonosis Q-fever. A necessary component of its pathogenicity is a type IV secretion system that it uses to deliver bacterial effector proteins into host cells to create a favorable environment. EmcB is a *C. burnetii* effector that deubiquitinates RIG-I to block the type I interferon pathway. Deubiquitinases (DUBs) have catalytic cysteine residues necessary for their activity, and EmcB has a catalytic residue C156. During screening, the C156A and C246A mutants both yielded a high molecular weight band during DUB assays not seen with wild type EmcB, suggesting those mutants are poly-ubiquitinated. This project characterizes the nature and timing of EmcB deubiquitination in vitro using purified proteins by conducting a time course to see the kinetics of the accumulation of the high molecular weight band. Quick change PCR was used to generate a C156A/C246A double mutant to test for accumulation of the higher molecular weight band. Secondly, this research aimed to determine if an accumulation of higher molecular weight bands is specific to K63-linked ubiquitin chains by testing with K48 and M1 linkages and testing for the accumulation of a high molecular weight band when Lysine 63 was mutated from ubiquitin. The findings of this project will be presented although this research is currently ongoing.

Predicting the Spread of COVID-19 Pandemic Using Machine Learning Models on Twitter Data

Minh Huynh

Faculty Mentor: Dr. Erdoğan Doğdu
Department: Computer Science
Sponsorship: Undergraduate Research Faculty-Mentored Grant

Recent virus outbreaks such as COVID-19 has shown that information flow is very important in preventing and stopping these epidemics. Social media is an important source of information and its effectiveness has been shown in predicting different epidemics earlier. In this study we will analyze the first publicly available COVID-19 Twitter dataset released by researchers from the University of Southern California with over 50 million tweets collected from January to March of 2020. Our aim to show that the spread of a virus such as COVID-19 can be predicted with high accuracy using machine learning methods. We will specifically apply deep learning algorithms to train our learning model and compare against other baseline methods. For comparison we will use actual virus spread data from JHU and CDC.

The Precise Orbital Period of HAT-P-36 b

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Sponsorship: Undergraduate Research Faculty-Mentored Grant

Follow-up observations of confirmed exoplanets are essential to obtain more accurate measurements of a planet's period and transit midpoint. We observed the confirmed exoplanet HAT-P-36 b, first discovered by the Hungarian Automated Telescope Network (HATNet) Exoplanet Survey (Bakos et al. 2012). This planet can also be found in the Transiting Exoplanet Survey Satellite (TESS) database as TOI 1810.01. After processing the images obtained from our observing runs, we plotted their light curves to compare them with the data from HATNet, and the two-minute cadence and Full Frame Images (FFI) from TESS. Our resulting light curves match very closely the light curves we used as references. The data from HATNet was taken about ten years ago, the data from TESS was taken about one year ago, and our observations were made in March 2021. This means that the period and the transit midpoint of HAT-P-36 b have remained constant for over a decade. This type of science is helpful for planning spectroscopic follow-up observations and can be done by amateur astronomers using smaller aperture telescopes. This will save valuable time at bigger telescopes and will allow professional astronomers to more efficiently use their time.

The Accounting Faculty Shortage in Texas Public Universities

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The accounting faculty shortage is an issue that has become increasingly prominent in university classrooms and carries negative implications beyond the realm of academia. This research aims to address the causes behind the accounting faculty shortage and the implications it has on students who transition into accounting careers. Additionally, it seeks to propose possible solutions for universities to implement going forward. The faculty members of five different accounting departments in public Texas universities were analyzed for the sake of further investigating these implications. Data was then compiled concerning the ratio of PhD holding to non-PhD holding faculty members within these departments. Two themes found through the compilation of this data were then evaluated to propose solutions for universities to remedy this shortage of accounting faculty.

Keywords: accounting faculty, faculty shortage, accounting, university, staff

Stormwater Management ASU: Remediation Designs

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Sponsorship: Undergraduate Research Faculty-Mentored Grant

Current stormwater management practices on ASU's campus are sufficient for rains of low intensity and duration, but larger rain events overwhelm ASU's stormwater management system. Intense rain events lead to severe flooding in and around highly trafficked areas, making them inaccessible. Detailed observations of current stormwater management during rain events revealed areas prone to flooding. Maps of current stormwater flow were made showing the connection between surface and subsurface drainage. Data collected for the maps included field checks of all storm drain inlets and outlets, surface channels, retention basins, and other stormwater devices. The results show an East to West trend of surface flow, with the intermittent streets (Dena, Johnson, and Jackson) experiencing the worst flooding. Sediment buildup in parking lots, erosion in greenspaces, runoff contamination from dumpsters and parking lots, and damage to infrastructure occur because of inadequate stormwater management. So, flooding ultimately becomes inconvenient and hazardous to people and their property. Analyzing the data and ASU's 10-year master plan, five major areas of focus for remediation using low-impact development (LID) techniques emerged. The areas are classified and ranked based on the necessity of remediation and the level of disturbance to the land the remediation would cause. As campus and enrollment numbers continue to expand, preemptive measures taken in relation to stormwater management are extremely beneficial for the well-being of students and the accessibility of campus.

Variability in the Spectra of RU Psc

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RU Psc is an RR Lyrae variable star of type c. We obtained high-resolution spectra of this star in October 2020 using the Coude spectrograph on the 107" Smith telescope at McDonald Observatory. We fit absorption lines in the star's spectrum with a Graphical User Interface developed in python to examine how the lines change as a function of the stellar pulsation. These changes tell us how the outer layers of the star are physically changing.

Presence of Parasitic Roundworms, *Trichinella*, in Texas Skunks

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Trichinella is an important parasitic roundworm of humans that is present in domestic and wild animals. Research has shown the prevalence of *Trichinella* in some wildlife in Texas such as feral hogs and coyotes, but *Trichinella* also occurs in raccoons, opossums, foxes, and skunks. However, the research of *Trichinella* infection in these other species within Texas is sparse, specifically for skunks. Thus, the focus of this research is to determine the prevalence of *Trichinella* in skunks in Texas, with a focus on four counties: Tom Green, Franklin, Williamson, and Travis. Skunks used for this research were provided by the rabies testing lab of the Texas Department of State Health Services and were kept frozen. *Trichinella* larvae encyst in the muscle of an intermediate host and tongue tissue often has a high incidence of larvae. To detect *Trichinella* infection, the skunk tongues were removed, the muscle tissue homogenized, and then the tissues were artificially digested using a solution of hydrochloric acid and the enzyme pepsin. The digested tissue was filtered, separated via sedimentation, and then examined under a dissecting microscope to look for *Trichinella*. Eight tongues have been tested to date, with no *Trichinella* presence established. We have two possible explanations. First, our process of homogenization and digestion may have been incomplete, and we have not recognized samples that actually are positive for *Trichinella*. Second, our methodology may be sound, but our sample size has been insufficient to detect *Trichinella*. Additional animals are currently being tested.

Physiology and Food: Crises, Dietary Shifts, and Physical Health in Fourteenth-Century Europe

Margaret A. Dudley

Faculty Mentor: Dr. Sarah Lynch
Department: History
Sponsorship: Undergraduate Research Faculty-Mentored Grant

The first half of the fourteenth century completely altered Europe through a series of disasters, particularly the Great European Famine, the Great Bovine Pestilence, and the Black Death. These alterations included the daily diet and the physical health of the people of northern Europe. One disaster followed another in rapid succession, impacting the food supply and affecting northern European society to its core, quite literally to the very hearts of the survivors. With each new event, trends in eating habits shifted to accommodate the current circumstances. Famines, new food sources, and increased availability of food collided with medicine and magic cures to create new daily diets for the European people. Some of these newfound culinary trends persisted even after the circumstances in which they initially arose. Utilizing contemporary writings, archaeological evidence, and modern famine research, this paper examines these alterations in European diet and how they led to physiological outcomes in the survivors of the early fourteenth century disasters, some of which impacted people decades and even generations later.

Reclaiming Brine-Contaminated Soils by Applying Zeolites and Growing Halophyte Grasses

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Sponsorship: Shell Oil Co., ASU Gift Grant

As a result of oil and gas production, large areas in West Texas contaminated by brine water remain bare of foliage for decades. This project investigated growing halophyte grasses in brine contaminated clays amended with clinoptilolite zeolite (CZ) in a greenhouse setting to increase soil cation exchange capacity, moisture, soil permeability and reduce compaction. The objectives were (1) to determine the effects of CZ on the health and survival of plants, (2), to determine the fate of brine salts and metals in leachate, soil, and plant tissue in clay (Soil 1) amended with CZ at two levels (1% CZ in clay -Soil 2 and 10% CZ in clay- Soil 3). Alkali. Sacaton and Giant. Sacaton grass seedlings were measured weekly for survival and height while leachate was measured for mass, EC, pH and TDS following each irrigation. Leachate and plant tissue samples were sent to external laboratories and analyzed for salts (Na, Ca, Mg, K) and heavy metals (As and Sr). Survival remained above 50% for both species. Seedlings showed sizable growth after the 110-days. With the exception of Sr in A. Sacaton, all salt and metal concentrations in leachate increased with greater amounts of CZ in soil. This was the result of larger drainage in soils 2 and 3 compared to soil 1 indicating that CZ flushed ions to deeper soil layers which is desirable in contaminated soils. Results indicated that CZ mixed in soil absorbed and immobilized Sr, reducing their adverse effects to plants and the environment.

Special Cases of Barnette's Conjecture

Tyler Stokes, Jacob Whitaker

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Department: Mathematics

A graph is called Hamiltonian if there exists a cycle containing every vertex. Barnette's conjecture claims that every 3-connected cubic planar bipartite graph is Hamiltonian. Graphs satisfying the hypotheses of this conjecture are called Barnette graphs. We classify all Barnette graphs having maximum cycle length. Further, we devise several graph operations that generate infinite families of Barnette graphs, and prove that all such graphs are Hamiltonian. Finally, we use these operations to determine lower bounds on the number of Barnette graphs on a given number of vertices.

Searching for Long Period, Long Duration Events in the Fort Worth Basin

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Sponsorship: Undergraduate Research Faculty-Mentored Grant

With its abundant oil and gas deposits, the Fort Worth Basin is an active region for hydraulic fracturing, which can be associated with earthquake activity. Previous studies have determined that fracking can create Long Period, Long Duration (LPLD) events (as well as tectonic earthquakes). LPLD's are low frequency (10-80 Hz) earthquakes created by the resonating of fluids in subsurface cracks. The purpose of this study was to determine whether LPLD events were recorded within the Fort Worth Basin during the study period (2017-2020). This study utilized earthquake data from the TexNet Seismic Monitoring Program, from UT Austin's Bureau of Economic Geology, and the Incorporated Research Institutions for Seismology (IRIS). Data for 200 seismic events recorded at 40 TexNet seismic stations were retrieved from IRIS. The seismic events were analyzed using the Seismic Analysis Code. Each event was filtered to eliminated noise, passing frequencies from 10-100 Hz. Spectrograms were calculated to view the frequency content of the earthquakes. Of the 200 events analyzed, 90 fit the frequency range of LPLD events. The remaining 110 events were in the tectonic frequency range (2-10 Hz). The presence of tectonic events is not surprising, considering a fault system runs through the Fort Worth Basin. This study shows that LPLD events were present in the Fort Worth Basin during the study period and could be the result of water injection from fracking or other processes.

Political Polarization on Twitter

Zachary German

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Department: Computer Science
Sponsorship: Undergraduate Research Faculty-Mentored Grant

As social media continues to rise in relevancy to the political scene, Twitter has created a development API to be utilized by researchers around the world to analyze the information on their platform in great depth. Using this developer API, data is able to be collected using detailed specification. In the case of this research, collection was aimed at Tweets which were deemed by our algorithms to be political in nature with the goal of detecting and measuring political polarization on the Twitter platform. During the time period from August 20th, 2020 thru January 11th, 2021, more than 2.7 Terabytes of data was collected from the streaming Twitter API. Using this data, groups were identified using various correlating attributes such as retweets and hashtags. The communication between these groups was then measured and graphed along the timeline of the 2020 United States presidential election in an effort to visualize the effect of political polarization on Twitter. Consequently, there was a peak in polarization among users identified as conservative on the day following the election, accompanied by a spike in polarization from the users identified as liberal. However, this information only scratches the surface of what may be discovered using the activity of Twitter users, as the platform continues to grow and include more users around the globe.

Covid-19 Tweets and Politics

Duc Huy Nguyen

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Department: Computer Science

Understanding the features of public interest and how individuals are conscious of symptoms and their social media activity is an important requirement for adequate disaster response during adverse health incidents. During a pandemic such as COVID-19, this is much more important, as the primary responsibility for risk control is not concentrated into an organization but dispersed across society. In this analysis, we use Twitter data during the COVID-19 disease outbreak in a descriptive or predictive way by proposing a causal inference method to discover and measure causal associations between pandemic characteristics (e.g. amount of Covid-19 tweets or political dilemma) and Twitter activity as well as public perception in order to forecast how the pandemic spreads and implications on the election. Our findings demonstrate that the approach suggested can efficiently collect the information of the hygienics domain and decide whether the numbers can actually show how diseases impact society. In order to get completely informed in the future, we claim our study leads to the field of pathology by drawing an image demonstrating the transferability of the pandemic, the path it goes and how politics have been impacted.

Comparison of Motor Performance Between Passive and Active Interventions

Quang Vinh Nguyen

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Sponsorship: Undergraduate Research Faculty-Mentored Grant

Foam rolling and static stretching are passive interventions designed to improve flexibility and motor performance. Dynamic exercises (active modalities) may create an optimal environment for power production.
PURPOSE: to compare the acute efficacy of motor performance between passive and active warm-up protocols. METHODS: In a crossover study, ten active subjects (male=5, female=5) were randomly assigned to either passive or active warm-up intervention on the first session and switched to the other intervention on the second session. The passive intervention includes one set of foam rolling on the front of the hip for both legs in the prone position with 30 seconds per leg and one set of the Half-Kneeling Hip Flexor Stretch with 30 seconds per leg. The active intervention includes performing one set of the Bulgarian Split Squat for 15 repetitions and one set of the Kettlebell Swings for 15 repetitions. Each participant performed the prisoner squat jump for three repetitions to obtain the power output of each repetition to calculate the average.
RESULTS: The findings showed that both passive and active warm-ups can increase flexibility and peak velocity. Active intervention has a greater benefit on increasing flexibility but no better than passive intervention on enhancing peak velocity. There were no significant difference between the passive intervention and active intervention for peak power, peak force, and muscle activation.
CONCLUSION: The findings suggest that either active or passive intervention can be performed before exercise.

Intelligent IoT Network Security on Embedded Systems

Thai Ly

Faculty Mentor: Dr. Erdoğan Doğdu
Department: Computer Science

As the number of IoT devices grow significantly in the past few years, the enormous amount of IoT network traffic becomes more vulnerable to attacks and exploitations from various malwares. In this project, we investigate intelligent anomaly detection and network intrusion detection in IoT network traffic. We will examine the intelligent anomaly detection performance on devices: NVIDIA Jetson TX2 Development Kit, Intel Neural Compute Stick 2, NVIDIA Jetson Nano Developer Kit, and Raspberry Pi. For network attack detection and classification, we chose Gradient Boosting Trees algorithm from Keras and Tensorflow deep learning frameworks. We test and evaluate our system with the Aposemat IoT-23 dataset. Early results show promising performance.

Germination of Various Species of Family Proteaceae

Anne Crowley

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Department: Biology

The fynbos region of South Africa hosts some of the most unusual plant species in the world, many of which display special adaptations for survival. Some particularly notable adaptations are present in their unique seed germination requirements. The objective of this research was to examine the germination success rate of six key Proteaceae species (*Protea compacta, Protea eximia, Protea graudiceps, Protea obtusifolia, Leucospermum catherinae,* and *Leucadendron discolor*) native to this area through replication of their natural conditions to determine if germination success varied between the species. This research also studied the effect that two types of germination containers used had on the germination success in the species *Protea graudiceps*. All seeds were first pretreated with a 1% hydrogen peroxide solution to sterilize and loosen the seed coat. Then the seeds were soaked in native flora smoke extract, before being placed in closed containers for an experimental period of 50 days. A nightly cold stratification process was also used for the seeds, and they were checked for positive signs of radical formation on scheduled days. We conclude that the germination success rate of these species did vary in the lab conditions, and that the container used to germinate *Protea graudiceps* did impact the species germination.

Use of Halophytes Grown in Zeolite as Safe Disposal of Reverse-Osmosis Concentrate from Desalination Plants

Dhiraj Shrestha

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Sponsorship: Faculty Research Enhancement Program (FREP)

The common use of reverse-osmosis (RO) technology to remove salts from brackish water produces a highly concentrated brine that creates a disposal problem and an environmental threat. The project aimed to determine the most cost-effective soil-Clinoptilolite Zeolite (CZ) mixture ratio to reduce salt leaching when irrigating with a typical RO concentrate solution. Six major salt ions [Sodium Na^+, potassium (K^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), chloride (Cl^-), and sulfate (SO_4^{2-}] were identified in RO waste concentrate. Four series of soil-CZ mixtures (Soil 1-100% sand, Soil 2-100% CZ, Soil 3-80%:20%sand: CZ, and Soil 4-95%:5%sand: CZ) were treated with RO mock solutions at five different concentration levels (200%, 140%, 100%, 50%, and 10%) to determine salt adsorption rates by the soil-CZ mixtures. Laboratory batch sorption experiments were undertaken by mixing the four soil mixtures with the five mock solutions at different concentrations in 15 mL centrifuge tubes. The centrifuge tubes were agitated for 24-hours, centrifuged, and the supernatant analyzed with ion chromatography. Every treatment was replicated four times. Pure CZ consistently had the highest rate of adsorption for all ions except for Cl^-. Sodium adsorption in soils containing CZ (2, 3 and 4) was less than expected. Greater adsorption affinity for K^+ compared to Na^+ by CZ has been reported. Because of the strong interaction with K^+, the CZ used seems to be principally in the K^+ form making it unsuitable choice for the application proposed. A more suitable zeolite would be in which Ca^{2+} and Mg^{2+} ions predominate.

Probability of Energy State Transitions in Correspondence with the Zeeman and Stark Effect

Emily Maxey

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Sponsorship: Undergraduate Research Faculty-Mentored Grant

When elements are excited and then fall back to their ground states, they emit photons at specific wavelengths in a phenomenon known as optical line spectra. The energy of the released photons is completely determined by the first quantum number, n, which defines the atom's energy states. The energy state transitions correspond to a single spectral line. However, transitions also concern the angular momentum and its projection on the z-axis as well as the magnetic spin of the atom. The transitions concerning these 3 other quantum numbers must follow very specific transition rules. We set out to further understand the reasoning behind these rules through the Schrodinger equation and hydrogen wave functions, as well as start to understand the process behind calculating probabilities of specific transitions.

Stratigraphy and Correlation of Geologic Units in the Santana Caldera

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Sponsorship: Undergraduate Research Faculty-Mentored Grant

Near the town of Manuel Benavides, Chihuahua, Mexico, is the large Sierra Rica caldera complex. This complex lies within the Chihuahua trough, a northwest trending right-lateral pull-apart basin that formed in the early Cretaceous. In the late Cretaceous- early Tertiary the Chihuahua trough was inverted through Chihuahua tectonic belt/Laramide deformation. Rio Grande rift extension then began 40-20 Ma and is ongoing. The constituent calderas- the Santana and San Carlos, expose a composite section of Tertiary volcanic and Cretaceous sedimentary rocks over three kilometers thick. For the first time ever, detailed geologic mapping done at the 1:12,000 is used to construct geologic cross-sections of the subsurface elucidating fault patterns. Detailed rock descriptions gathered in the field and in the lab using hand samples and augmented with thin-section petrography and SEM analyses allow for assignments of Big Bend formation names and the construction of a preliminary correlation chart. An initial hydrologic study of the drainage basin in Sierra Azul, on the eastern edge of the Santana caldera margin, was performed to assess stream flow and water quality. Results show that groundwater flow is probably dictated by the confounding fault structures and that further mapping is needed and could help predict stream patterns.