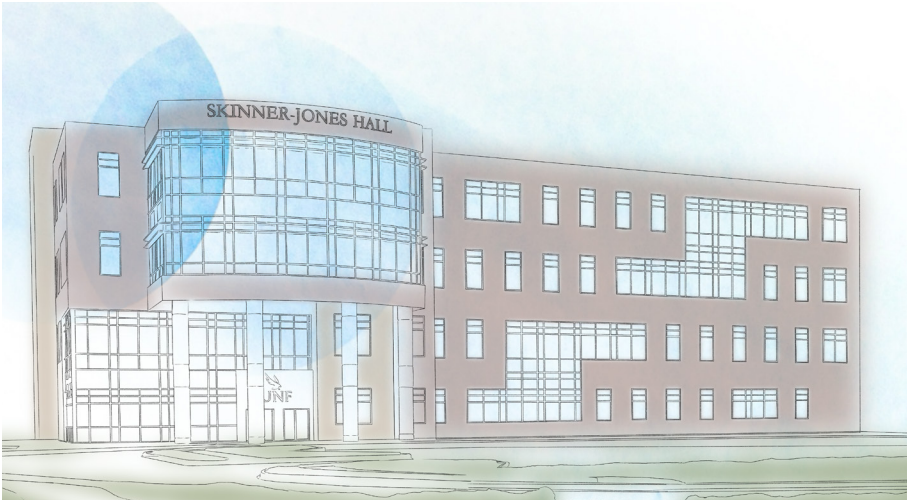
U-GLIDE

Program

Undergraduate-Graduate Learning, Inquiry and Distinctive Experimentation

2022

UNF
UNIVERSITY of NORTH FLORIDA



Welcome

The Undergraduate – Graduate Learning, Inquiry, and Distinctive Experimentation (U-GLIDE) Symposium is a new interdisciplinary conference at the University of North Florida (UNF) at which undergraduate and graduate students showcase their research and creative projects. The symposium will be held annually in fall semesters as a venue for students to present their research projects in poster format. We see U-GLIDE as a supportive environment in which students can share their work, which will be in various stages of development.

An historic first for UNF, U-GLIDE is organized and sponsored by the Office of Undergraduate Research with graduate projects sponsored by the Graduate School.

We gratefully acknowledge and thank those who contributed to the success of U-GLIDE 2022. Specifically, Kaitlyn Minnicks, the coordinator of the Office of Undergraduate Research, served as the lead organizer for the event, Kim Roberts, the Faculty Excellence and Academic Engagement office manager coordinated the refreshments, and Rebeca Mata, the designer for the Office of Undergraduate Research created this program and promotional materials for the event.

Welcome to U-GLIDE 2022!

Judith D. Ochrietor, Ph.D.

Director of the Office of Undergraduate Research
University of North Florida

Paige Lilley

Director of the Graduate School
University of North Florida

Presenting Schedule

10:15 a.m. - 11:00 a.m.

1 Emilie LaVoie-Ingram
Towards a Prototype Paleo-Detector for Supernova Neutrino and Dark Matter Detection

5 Albert Admasu
Magnetic Hyperthermia Therapy: Using Magnetized Nanoparticle Heaters to Kill Cancer Cells

9 Rebecca Robinson Rey
Projections for Rubin Observatory LSST Telescope's Detection of New Milky Way Satellite Dwarf Galaxies

13 Timothy Harris
Molecular Docking Analysis of SARS-CoV-2 Inhibitor N3 (6LU7) Against Selected Flavonoids and Vitamins

17 Natalie Clum, Dan'n Tima, Madeleine Powers, M. Ryan Nugent, Dr. Heather Truelove
Don't Tell Me What To Do: Reactance to Meat Reduction Messages

33 Nur Chodry
Jacksonville and Gentrification

21 Miguel Bolante, Diego Fontan-Ulibarri, Lovely Ramos, David Medis
Measurement of Ozone Profile using Ozone Sensors Payload on NASA High Altitude Balloon 2022 Flight

25 Rachel Lea, Lillian Seltenreich, Alexis Haag
Demographic Predictors of Mothers' Intent to Vaccinate their Children Against COVID-19

29 Natacha Tirado and Szymon Ciesielski
Role of Intramolecular Interaction in JDP Protein

35 Aaron Kaplan, Albin Mikhaylova, Adam Rosenblatt, M. Laura Habegger
The Effect of Drought on Alligator Eggshell Morphology

27 Karli Friedman
Examining Cortical Activation During A Self-Monitoring Task

11:15 a.m. - 12:00 p.m.

2 Shuala S. Martin
Using GIS to Gauge Response Readiness to Natural Disaster Fatalities in Asia, Part 1

6 Hannah Thomas
Looking for Biomarkers of Happiness Using fNIRS

14 Andreas Ink
Early Detection of Infectious Disease with Smartwatch Data

18 Alexander Bartkowiak
Effects of Ivermectin on Neuro-Transcriptional Profiles in Zebrafish

22 A. Evans
Investigating Electronic Properties of 2D Materials

26 Haley Peters
Reduced Dietary Isoleucine or Valine Increases Organismal Catabolism of Leucine in Adult Female Lubber Grasshoppers

30 Paige Courtier and Karin Gulick
The Benefits of RD Mentorship Program for Mentees Participating in the Dietetic Internship Match

34 Elise Ballash
Exploring Bacterial Genomes for Discovery of Novel Diketopiperazines

36 Lauren Whaley, Emily Norton, Victoria Corcino, Vanessa Jones, Kaisorn Chaichana, Alfredo Quiñones-Hinojosa, Hugo Guerrero-Cazares
Glioblastoma Cells Show Elevated Chitinase 3-like Protein 1 Gene Expression in Response to Human Cerebrospinal Fluid with Increased Migration and Epithelial-Mesenchymal Transition Related Activity

10 Vanessa Clarke, Dan Richard, Becca Berkey, Heather Burk
Why do Faculty Persist?: Designing a Survey to Assess Service-Learning and Community Engagement Motivations and Orientations

12:15 p.m. - 1:00 p.m.

3 Taylor Foster
Analyzing Nearshore Waves Using Drones Aerial Imaging and Computer Vision

11 Sara Buchanan
What Makes an International Student in the U.S. have Less Psychological Distress?: Secrets of Adjustment

15 Brandon Guerin
Cancer Mutations in Essential Human Co-Chaperone DNAJB1 Protein

19 Jacary Sapp
(La1-yEuy)1-xSrxMnO3 Thin Films grown as Random Alloys and Superlattices by MBE

23 Daniela Amalfi Ojeda and Paul Christenson
Unified Approach to Electricity and Magnetism

31 Brooklyn McDill
Using CRISPR Technology to Create NGLY-/- in human brain tissue cell lines

7 Sydney Pell, Rida Khan, Brandyn Figueroa
Significance of Danio Rerio Assays for Neurodevelopmental Research

1:15 p.m. - 2:00 p.m.

4 Nicholas Strasser
Dietary Protein Quality Does Not Alter P:C Intake Target in Grasshoppers

8 Magdalynne A. Alley
Northeastern Florida Indigenous Ceramic Chronology Revisited: A Bayesian Approach

12 James Taintor
Computational Methods for the Determination of Analytical Ground-State Solutions to the Heisenberg Hamiltonian

16 W. David Paredes Molina, Hemani Kaushal, Iman Vakilinia, Zornitza Prodanoff
Performance Evaluation of a UAV-Based ad-hoc Hybrid Wi-fi/LoRa Mesh Network Using a Particle Swarm Optimization technique

20 Nathan Bairen
Molecular Beam Epitaxial Growth of High-Quality LaVO3 and La1-xSrxVO3 Thin Films Using Low Oxygen Partial Pressures

24 Katie G. Peters and Doria F. Bowers
Utilizing Antibodies and Fluorescent Microscopy to Evaluate Sindbis Virus Infection in the Mosquito Aedes aegypti

28 Paul Christenson and Dalton Zona
Optimizing Superconducting YBa2Cu3O7-Î´ Thin Film Growth by MBE

32 Jeffrey Perera
Developing an Aptamer-mediated CRISPR Interference System in Primary Human T Cells

37 Patrick J. Keeney
Investigation of Magnetic-Exchange Pathways and Electronic Properties of Transition-Metal Doped 2D-TiS2

Towards a Prototype Paleo-Detector for Supernova Neutrino and Dark Matter Detection

Emilie LaVoie-Ingram

Using ancient minerals as paleo-detectors is a proposed experimental technique expected to transform supernova neutrino and dark matter detection. In this technique, minerals are processed and closely analyzed for nanometer scale damage track remnants from nuclear recoils caused by supernova neutrinos and possibly dark matter. These damage tracks present the opportunity to directly detect and characterize the core-collapse supernova rate of the Milky Way Galaxy as well as the presence of dark matter. Current literature presents theoretical estimates for these potential tracks, however, there is little research investigating the experimental feasibility of this technique. At the University of North Florida, we contribute to the field by searching for and analyzing these damage tracks in prototype detectors constructed from selected minerals, including: halite and Muscovite mica. This preliminary research will seek to characterize the applicable backgrounds in these prototype detectors. We will employ non-destructive techniques, including SEM, AFM, SAXS, and laser profilometry to identify and characterize damage tracks in the minerals. Chemical etching of the mineral surface enhances the detectability of these damage tracks at the expense of altering some of their geometrical attributes. We will measure two matched surfaces from a cleave (one etched and one unetched) to determine the effectiveness of the proposed techniques against the chemical etching standard. Our data will be compared to current theoretical predictions to pursue the practical implementation of paleo-detectors as local core-collapse supernova neutrino and dark matter detectors.

Mentors: Dr. Chris Kelso and Dr. Greg Wurtz

Magnetic Hyperthermia Therapy: Using Magnetized Nanoparticles Heaters to Kill Cancer Cells

Albert Admasu

In this study, we are examining the effect of various magnetic interactions on the ability for heat dissipation in magnetic nanoparticles. Our goal is to help gain a better understanding for the dispersion of thermal energy through the clusters as well as biological tissue. Through this analysis, we hope to determine way to optimize the heating effieciency and provide better avenues for cancer treatment.

Mentor: Dr. Jason Haraldsen

Projections for Rubin Observatory LSST Telescope's Detection of New Milky Way Satellite Dwarf Galaxies

Rebecca Robinson Rey

The annihilation of weakly interacting particles (WIMPs) produces energetic particles including gamma rays. Dwarf galaxies are a great target for indirect dark matter detection since they have high concentrations of dark matter and low astrophysical background. In this project we will predict the amount of satellite dwarf galaxies in our Milky Way that the Rubin Observatory Legacy Survey of Space and Time (LSST) telescope might detect for indirect dark matter detection. This will be achieved by modeling the telescope's survey using a Monte Carlo. To perform accurate modeling, we will first simulate the discoveries made by the Sloan Digital Sky Survey (SDSS), Dark Energy Survey (DES), and Pan-STARRS1 (PS1).

Mentor: Dr. Chris Kelso

Role of Intramolecular Interaction in JDP Protein

Natacha Tirado and Szymon Ciesielski

Molecular chaperones are group of proteins that assist in a variety of cellular processes utilizing their ability to recognize and bind unfolded polypeptide substrates. transfer across membranes and degradation. The Hsp70 chaperone is known to suppress the aggregation of unfolded proteins and promote their proper folding, disassemble multimeric protein complexes, and provide the driving force for the translocation of proteins across organelle membrane. The Hsp70 functional specificity is driven by interaction with their obligatory partners and co-chaperones J-Domain Proteins (JDPs). Based on differences in domain architectures JDPs are divided into classes A and B represented in yeast S. cerevisiae by Ydj1 and Sis1 proteins, respectively. Sis1 (class B) is essential for yeast cell viability, and even increased amount of Ydj1 (class A) cannot compensate for this unknown Sis1 function.. However, previous studies have shown thatYdj1 with a G70N mutation can compensate for the lack of Sis1 and restores viability of cells lacking Sis1. Additional NMR studies suggested a potential new interaction between Sis1 and Ydj1 G70N variant and Hsp70. This interaction observed between yeast proteins could provide a more general explanation as to why class B and not class A JDPs are essential. The goal of this project is to assess the possibility of similar interaction existing between human DNAJB1 and Hsp70 using NMR.

Mentor: Dr. Szymon Ciesielski

Effects of Ivermectin on Neuro-Transcriptional Profiles in Zebrafish

Alexander Bartkowiak

Ivermectin is a common anti-parasitic drug prescribed for use in humans. Although ivermectin's proposed site of action in the brain is the GABA receptor, not much else is known about its neuroactivity. Zebrafish provide an intact vertebrate model for testing the neuroactivity of systemically administered compounds. We used genetically engineered NeuroD-GFP zebrafish that have a widespread expression of Green Fluorescent Protein in their neurons to isolate neuronal and non-neuronal cell populations with and without exposure to ivermectin via flow cytometry. We then performed bulk-RNA sequencing to determine the expression profiles of each population. Downregulation in the GABAergic synapse pathway was found validating the methods used. Additionally, upregulation in the cytokine-cytokine receptor interactions pathway was found suggesting that ivermectin elicits an innate immune response which requires further investigation. Future work will include an expanded analysis of the GABA pathway.

Mentor: Dr. Marie Mooney

Investigating Electronic Properties of 2D Materials

A. Evans

Here, we work with two types of characterization techniques, Scanning Tunneling Microscopy (STM) and X-Ray Photoelectron Spectroscopy (XPS), to investigate the properties of 2D materials. Transition Metal Dichalcogenides (TMDCs) are a class of 2D materials which have the chemical formula MX2, where M is a transition metal atom and X is a chalcogen atom. We can use STM to explore the electronic properties of our material, as well as achieve atomic resolution images to help us understand the structure of our material. XPS tells us about the chemical composition and how these elements are bonded in the material. We can use these techniques together to understand the overall lattice structure of our material. In a previous project, we used these characterization techniques to explore phase changes in TMDCs when exposed to excess metal. The use of STM with XPS can help us determine where the excess M positions itself in the lattice. In our next project we will be working with doping and magnetic characterization of TMDCs.

Mentor: Dr. Paula Coelho

Why do Faculty Persist?: Designing a Survey to Assess Service-Learning and Community Engagement Motivations and Orientations

Vanessa Clarke, Dan Richard, Becca Berkey, and Heather Burk

Service learning and community engagement (S-LCE) is a form of pedagogy that pairs classroom instruction with students engaging in service in the community. Previous research has demonstrated primary motivations (student learning and community impact) and orientations (disciplinary knowledge and training and social change) towards S-LCE from faculty who have worked in the field. The current project will develop a survey that can be administered to faculty participating in S-LCE in order to discover the motivations of their work, using the past findings as guidelines. Researchers coded and rephrased statements from interviews of 29 faculty who engage students in S-LCE work at two institutions of higher education. Two independent coders identified statements to be included in the survey. The survey will comprise statements from interviews of faculty members that detail their anecdotal experiences with S-LCE and are coded to identify motivations and orientations as well as typical challenges and support experienced at institutions of higher education. Once the survey is constructed, it will be administered to faculty at different institutions to validate the survey instrument.

Mentor: Dr. Dan Richard

Investigation of magnetic-exchange pathways and electronic properties of transition-metal doped 2D-TiS2

Patrick J. Keeney

2D materials have been of increasing interest since the development of graphene in 2004. They offer promising applications, especially in the fields of sustainability and nanotechnology. In addition, transition-metal dichalcogenides (TMDC's) are a popular group of compounds due to their abundance and interesting properties. In this study, we use Density Functional Theory (DFT) to predict the magnetic and electrical properties of 2D Titanium Disulfide (TiS2), a common TMDC, as a function of transition-metal dopants and separation between the dopants. Vanadium, chromium, and manganese are the dopants of interest due to how they ad magnetism to an otherwise non-magnetic TIS2 mother compound.

Mentors: Dr. Jason T. Haraldsen and Dr. Paula M. Coelho

Measurement of Ozone Profile using Ozone Sensors Payload on NASA High Altitude Balloon 2022 Flight

Miguel Bolante, Diego Fontan-Ulibarri, Lovely Ramos, and David Medis

University of North Florida (UNF) team successfully launched ozone sensors payloads in the stratosphere by NASA high altitude 2022 balloon flight. The objectives of flight were to measure good ozone profile in the stratosphere and bad ozone in the troposphere. Ozone sensor payload on NASA balloon flight consisted of three different types of gas sensor arrays, made of nanocrystalline oxide semiconductor thin films. Each gas sensor array has eight thin film gas sensors. In addition, the payload has one-pressure sensors, three temperature sensors, one GPS and microcontroller circuit board. The payload met the specified design criteria of NASA. The payload integrated on the balloon platform for power and communications. The payload successfully cleared the thermal vacuum testing and all other requirements of NASA at the NASA- Columbia Scientific Balloon Facility (CSBF) in Palestine, TX from July 25th to 29th, 2022 and certified for the High-altitude balloon flight 2022. The high-altitude balloon successfully launched into the stratosphere at an altitude of 38 km from the NASA-Columbia Scientific Balloon Facility, Fort Sumner, NM on September 8, 2022, at 13:25 UTC. On September 9, 2022, at 09:46 UTC, the flight was terminated, and then, impacted on ground of Arizona. The total balloon flight time was about 17 hours and 59 minutes. After termination of balloon flight, the payload got direct impact on ground. The payload recovered in the good condition. The data analysis confirmed that all sensors were successfully measured the ozone gas profile in Stratosphere. The maximum value of good ozone in Stratosphere during float was observed at about 7.8 ppm, which is less than last year. After applying cold temperature and pressure values, the bad ozone value in Troposphere around altitude of 15000 m was about 1.0 to 1.6 ppm, which is higher than last year. Ground ozone has lots of interferences of reducing gases but estimated observed value was about 160 to 200 ppb.

Mentor: Dr. Nirmal Patel

Unified Approach to Electricity and Magnetism

Daniela Amalfi Ojeda and Paul Christenson

The conventional approach of Physics II – electricity and magnetism – is based on sequentially presenting the concepts related to electricity, then magnetism, and finally the connected concepts and applications that link electricity and magnetism. A major drawback of this method is the tremendous amount of time spent on electricity before introducing magnetic fields, which leaves the student very little time, during a one-semester-long course to see, to make connections and to understand the unified nature of electricity and magnetism. Since the end of the 19th century, it has been well understood that electricity and magnetism are two aspects of the same phenomenon that we call electromagnetism. In this spirit, we discuss the unified approach to Physics II – an approach that truly embraces the interwoven nature of electricity and magnetism, treating them side-by-side from the outset. This approach not only enables the student to draw parallels, but it also exposes the student to the contrasting aspects of electricity and magnetism providing the student a firm intuitive grasp of this unified phenomenon, electromagnetism.

Mentor: Dr. Maitri Warusawithana

Molecular Docking Analysis of SARS-CoV-2 Inhibitor N3 (6LU7) Against Selected Flavonoids and Vitamins

Timothy Harris

The disease known as COVID-19 (SARS-CoV-2) became a pandemic since its outbreak. In addition to vaccines, combination of antiretroviral agents, chloroquine derivatives, and vitamins are being used to treat SARS-CoV-2. We performed molecular docking analysis of SARS-CoV-2 inhibitor N3 (6LU7) using a series of flavonoid derivatives and vitamins. The X-ray crystallographic 3D structures of COVID-19 main protease in complex with an inhibitor N3 (PDB code: 6LU7, resolution 2.16A0 complexed with a selective substance) were downloaded from the online Protein Data Bank. The structure of the ligands and protein were constructed using ChemDrawUltra 8.0. The docking process, interactions, and binding of ligands were visualized using software Molegro virtual dockings. The physicochemical and toxicity characteristics of tested flavonoid derivatives and vitamins were determined using Swiss-ADME and pkCSM online software. We found that mole docking scores are between -64.42 and –172.00 Kcal/mol. H-bonding and steric

interactions were compared with other flavonoid derivatives. The ADMET parameters suggest that compounds 4, 68, 90, 92, and 94 have higher GI rate. Our results also indicate that compound 78 is more potent and has higher skin permeation than other flavonoid derivatives. The study further shows that the compounds 5, 28, 74, 78, and folic acid fit well in the active site of COVID-19 inhibitor N3 and interact with the residues in the active site, which are essential for their biological activity. Therefore, these compounds can be a COVID-19 inhibitor N3 and might be used treatment of COVID-19 infection.

Mentor: Dr. Bujjibabu Chidipi

Using GIS to Gauge Response Readiness to Natural Disaster Fatalities in Asia, Part 1

Shuala S. Martin

The International Committee of the Red Cross (ICRC) is a neutral, impartial, independent, humanitarian organization providing protection and assistance to victims of armed conflicts and other disaster situations. The ICRC assists authorities and other local actors to protect the dead following disaster situations by promoting their recovery, analysis, identification, return to loved ones, and the final disposition of their remains. Covering approximately 30% of the world's landmass and home to 60% of the global population, Asia experienced over 2,800 natural disasters in the last 30 years, accounting for roughly one-third of natural disasters worldwide and over half of the global death toll. Utilizing ArcGIS Pro software, Part 1 of this project seeks to create a geodatabase, conduct spatial analysis, and map country susceptibility to natural disaster fatalities. This is compared with response readiness of the ICRC and local actors to manage the dead following natural disasters. Susceptibility is determined based on average annual deaths per total population and total landmass. A response readiness model provides a total score based on 11 variables collected from the ICRC. Susceptibility analysis shows that South Asia and the Philippines are particularly prone to natural disaster fatalities, while the response readiness model reveals a disparity between susceptibility and readiness for some Asian countries but not others.

Mentor: Dr. Christopher Baynard

Demographic Predictors of Mothers' Intent to Vaccinate their Children Against COVID-19

Rachel Lea, Lillian Seltenreich, and Alexis Haag

The present study aimed to examine whether a mother's intention to vaccinate their child or children is associated with their annual income, parental age, or educational status. Female participants (N=298) from the United States were recruited through an online survey system called Prolific and were monitored over two years to complete four self-report surveys. Participants were asked to provide demographic information including their age, gender, race, income, education level, relationship status, number of their children and age of their children. Additionally, between September through December of 2021, participants were asked to complete a COVID-19 questionnaire that investigated their intentions to vaccinate themselves and their children and their perceived levels of safety in regard to government mandates. We found that mothers with higher educational level and older age were more likely to vaccinate their child. Furthermore, we found that income was not significantly associated with mother's intentions to vaccinate their child. The present study did not have a large variation in race or gender; therefore, future research should focus on how race and gender predict mothers' intentions to vaccinate their child.

Mentor: Dr. Jody Nicholson

Don't Tell Me What To Do: Reactance to Meat Reduction Messages

Natalie Clum, Dan'n Tima, Madeleine Powers, M. Ryan Nugent, and Dr. Heather Truelove

Strong messaging can have an undesired effect on individuals leading to feelings of threat and anger causing them to behave counter to the message's intention, a process known as reactance. While some studies have found that men produced higher reactance scores than women, some have reported no significant differences, especially in response to pro-environmental messages. The present study further investigated the relationship between gender and reactance. 241 participants (49% female) were randomly assigned to see either an assertive message reading "Stopping Climate Change: Everyone must eat less meat!" or a nonassertive message reading "Stopping Climate Change: Everyone could eat less meat." Participants were then asked about their intentions to comply with the meat-reduction messaging and their feelings of reactance (mean of anger scale and counterarguing scale) and perceived threat to freedom (PTTF). We ran ANOVAs with message type, gender, and their

interaction predicting PTTF, Reactance, and Compliance Intentions Score. The interaction between message and gender was significant for all outcomes. Men responded with more reactance (p = .002) and more PTTF (p < .001) and complied less (p = .001) to messages that were assertive vs. nonassertive. Women showed no difference in outcomes based on message type. Our study revealed that assertive messages related to the environment led to more reactance from men but limited-to-no reactance from women. Environmental messaging should avoid assertive word choices to prevent the unintended consequences of reactance, especially among men.

Mentor: Dr. Heather Truelove

The Effect of Drought on Alligator Eggshell Morphology

Aaron Kaplan, Albin Mikhaylova, Adam Rosenblatt, and M. Laura Habegger

The eggshell is one of the most crucial adaptations that has enabled vertebrate's transition to land. Among the different components and materials that make up this structure there is a network of pores that facilitate the exchange of vital resources between the developing embryo and the external environment. The size, number and distribution of these pores are variable and dynamic, as they are partially shaped by microbes; environmental changes could also affect these pores leading to embryo mortality. Although eggshell research is abundant, most work has been centered on birds compared to other vertebrates, and even less is known on the effect environmental changes (i.e., climate change) may have on eggshell morphology and embryo survival. Therefore, the goal of this research is to determine if changes in nest humidity may impact eggshell morphology in the American alligator (Alligator mississipienssies). Alligator eggs collected in the wild were incubated in the lab at different humidities and eggshell pore morphology was characterized with advanced microscopy techniques. Pore numbers, size, and distribution, among other variables, were assessed along the eggshells of over 200 eggs. Patterns in pore distribution and size will be analyzed in the context of embryo viability to correlate any possible findings. Our results will serve as the foundation for future work focusing on how climate change may affect alligator's embryo viability.

Mentors: Dr. Albina Mikhaylova, Dr. Adam Rosenblatt, and Dr. M. Laura Habegger

The Benefits of RD Mentorship Program for Mentees Participating in the Dietetic Internship Match

Paige Courtier and Karin Gulick

Research outcome: The purpose of this research was to observe the benefits of a mentorship program on mentees applying to a dietetic internship (DI) and a deeper look into the characteristics attributed to success such as the development of strong professional, interpersonal, research, education, counseling, and marketing skills. Methods: The RD Mentorship Program was a national, project-based mentoring program that virtually matched dietetics students with registered dietitians (RDs) based on their professional interests. Out of the larger cohort, the data analyzed included those who completed the post-survey (mentees =114; mentors=139). Matched partnerships met at least once per month (virtually or face-to-face) from September 2021 to April 2022. Analysis: Descriptive statistics were completed to analyze the data. Results: Out of all the mentees in the RD Mentorship, 50% (n=57%) participated in the 2021-2022 DI match. Mentees reported the RD Mentorship program made them more competitive applicants for the DI match (96%). Qualitative feedback collected revealed this was due to gaining experience in the dietetics field and also having a mentor to provide feedback on personal statements. Successful outcomes of matching to a DI program included matching in the first round (81%) and second round (9%). Over one-third (37%) of mentees received a letter of recommendation from their mentor. A majority (73%) of mentors were described to have provided guidance for the DI match to the mentee. Nearly one-quarter of mentees applied to a distance DI program and 60% were able to secure at least one preceptor via the RD Mentorship Program. Conclusions: These findings indicated that the mentorship between a nutrition student and an RD in a mentoring program was greatly beneficial to their success in matching to a DI. Students reported that their work with their mentor made them more competitive applicants for the DI through their gained experience in the dietetics field, feedback received by their mentor regarding their personal statements, the guidance received by their mentor on matching to a DI, and obtaining a letter of recommendation from their mentor. Further research should continue to analyze the benefits of the RD Mentorship program, or similar mentoring programs, on a student's success in matching to a DI. Learning

Outcome: The benefits of mentorship on professional and skill development. Learning Codes: 1010 Career planning, 6080 mentorship.

Mentor: Dr. Kristen Hicks-Roof

Analyzing Nearshore Waves Using Drones Aerial Imaging and Computer Vision

Taylor Foster

Increasing accessibility to small Unmanned Aerial Vehicles (UAVs), such as drones, has made it possible to capture high quality video footage in previously hard to reach or otherwise challenging conditions. For this analysis, a DJI Phantom 4 multi-rotor drone was placed above the surf zone to capture the video data which is the basis of this research. Additionally, computer vision libraries such as OpenCV have made it increasingly easier to analyze and extract data from images. This can be used to study a variety of nearshore phenomena. For example, analyzing near shore breaking waves and tracking plumes from natural and manufactured sources. The nearshore phenomena this research focused on was surfers and the overall surfability of the location analyzed. Surfability is defined as the proportion of waves in which a surfer can stay ahead of the breaking point before the wave crashes. Using Python and open-source libraries such as OpenCV, you can outline 2D contours and track objects such as waves and surfers. With this data, you can calculate important variables such as peel angles and distance surfed. An important technique used in this analysis is filtering noise from the images being studied. Once the noise is filtered from the image, the object being researched can be tracked and analyzed clearly without extraneous data. This makes it possible to analyze and record a variety of phenomena with efficiency. Once the various data points are collected, a statical distribution can be compiled and a single numerical output can be achieved. The purpose of this statistical analysis is to demonstrate how computer vision could be used to quantify the conditions of nearshore phenomenon— effectively determining the surfability in the footage captured by UAVs.

Mentor: Dr. William Dally

Looking for Biomarkers of Happiness Using fNIRS

Hannah Thomas

Previous research using functional near-infrared spectroscopy (fNIRS), a non-invasive brain imaging technique, has shown that depression is correlated with reduced activity in the left prefrontal cortex when completing a verbal fluency task (VFT). Successful treatment of depressive symptoms is associated with increased activity in the left prefrontal cortex and better performance on a VFT. These studies have examined depression levels, but little research has utilized fNIRS to measure happiness. fNIRS uses two different wavelengths of near-infrared light to quantify concentrations of oxygenated hemoglobin, a direct measure of cortical activity. We aim to identify biomarkers for happiness by focusing on three of its major components: optimism, agency, and social connectedness. Participants complete scales that measure these constructs to determine happiness levels, then neural responses in the prefrontal cortex are recorded as they complete a VFT that consists of four blocks. The baseline is a basic VFT where participants come up with as many words as they can that start with a specific letter. The next three blocks ask participants to list as many words as they can think of when it comes to situations that center around optimism, agency, or social connectedness. We expect that happier individuals will have more activity in the left prefrontal cortex and better performance on the VFT compared to those who are less happy. We also expect to find the brain regions associated with optimism, agency, and social connectedness individually.

Mentors: Dr. Tracy Alloway and Dr. Katherine Hooper

Early Detection of Infectious Disease with Smartwatch Data

Andreas Ink

Vito is an app and future research study with the goals of reducing the spread of COVID-19 via physiological-derived alerts, encouraging trust in a community via ambitious privacy standards and community involvement, and increasing app usage with greater convenience via a more efficient on-device algorithm that utilizes smartwatch data to detect COVID-19 in real-time. Vito is heavily based on a study conducted by Stanford University and the algorithm created from the study, NightSignal~\cite{NightSignal}. NightSignal has a 78\% accuracy when predicting COVID-19 with heart rate data while asleep. Further, the study determined that

COVID-19 stress-related alerts occurred for a mean of 4.9 days, compared to 1.9 days for non-COVID stress alerts. The study also details how to improve future algorithms' accuracy, primarily by adding additional physiological-based data. Notably, some of NightSignal alerts were associated with vaccination. A newer study with an algorithm, CovidDeep~\cite{coviddeep}, utilizes neural networks and novel data points such as blood oxygen, and respiration rate. The accuracy of this model is 98\%, which is significantly higher than NightSignal's 78\%.

Mentor: Dr. Indika Kahanda

Jacksonville and Gentrification

Nur Chodry

This project focuses on Jacksonville's demographics and issues with gentrification, looking at the city through an educational lens. Three schools in Jacksonville—Stanton, Paxon, and Douglas Anderson, were three historically black k-12 schools before being converted into magnet schools in the 1980's, when Duval County gained national attention and went through a second desegregation wave. Out of all the historically black schools in Jacksonville, these three are the only public schools left standing and are now all at a 60% white enrollment rate, despite being situated in areas that don't reflect those demographics. By interviewing alumni, DCPS administrators, current students, staff, and experts on the education system, we wanted to compile interviews on how and why this transition occurred. Geospatial technology was used to visualize the gradual change in demographic makeup, but the project was made with the intention of archiving certain perspectives that might not already be widely available in our community, and compiling them into a podcast format. A lot of the material in the podcast contextualizes what students, educators, and the county as a whole might take at face value. A lot of the issues talked about in the podcast have reverberating effects on how DCPS is structured now and the issues within schools.

Mentor: Dr. Laura Heffernan

Glioblastoma Cells Show Elevated Chitinase 3-Like Protein 1 Gene Expression in Response To Human Cerebrospinal Fluid With Increased Migration and Epithelial-Mesenchymal Transition Related Activity

Lauren A. Whaley, Emily Norton, Victoria Corcino, Vanessa Jones, Kaisorn Chaichana, Alfredo Quiñones-Hinojosa, and Hugo Guerrero-Cazares,

Glioblastoma (GBM) is the most common and malignant primary brain tumor in adults. GBM tumors proximal to the lateral ventricles have a worse prognosis with multifocality, recurrence, and lower overall survival. Studies suggest this increased aggressiveness is attributed to cerebrospinal fluid (CSF), as we have previously observed transcriptomic changes in GBM cells upon CSF exposure. GlioVis database reveals chitinase 3-like protein 1 (CHI3L1), a glycoprotein secreted by immune and cancer cells, is associated with poor prognosis and co-expressed with pro-inflammatory and tissue remodeling genes. We suggest exposure to CSF elevates CHI3L1 expression, consequently impacting malignancy-associated gene expression in patient-derived GBM lines. We first evaluated if patient CSF influences the expression of CHI3L1. GBM cells were treated with artificial CSF, non-cancer CSF, or cancer CSF for 72 hours. qPCR revealed significant increases in CHI3L1 ($p < 0.0001$), SPP1, and CD44 expression in cancer CSF groups compared to artificial CSF. CHI3L1 expression at the protein level is also increased by cancer CSF when profiled using Western Blot. Additionally, ELISA results indicated significantly higher levels of CHI3L1 in CSF samples obtained from patients with high-grade tumors compared to non-cancer samples. Next, we assessed if exogenous CHI3L1 stimulates GBM malignancy at the cellular level. An effective concentration of recombinant human CHI3L1 was determined through Alamar Blue assay, showing 500 ng/ml CHI3L1 increases viability in primary patient cell lines compared to non-treated media. Recombinant CHI3L1 also increases cell migration in Transwell assay. qPCR revealed Vimentin ($p < 0.001$) and Twist ($p < 0.0001$) expression significantly increases while E-cadherin ($p < 0.001$) significantly decreases in CHI3L1-treated groups, consistent with EMT and migratory activity. Ultimately, this study shows CHI3L1 is a CSF-induced factor in GBM and could be a therapeutic target as it enhances tumor malignancy by increasing proliferation, migration, and malignancy-promoting gene expression.

Mentor: Dr. Hugo Guerrero-Cazares

Using CRISPR Technology to Create NGLY-/- in Human Brain Tissue Cell Lines

Brooklyn McDill

The NGLY-1 gene is responsible for producing the enzyme N-glycanase 1, which deglycosylates (removes N-glycans) from misfolded proteins by cleaving between the proximal asparagine residue of the protein and the N-acetylglucosamide (Suzuki et al., 2015). These misfolded proteins are then sent to the proteasome to be degraded. Therefore, deficiency of the NGLY-1 gene leads to the accumulation of misfolded proteins within the cell. Typical phenotypes of NGLY-1 deficiency include motor deficits, liver dysfunction, and neurological symptoms as a result. We can study these effects in animal models (mice and zebrafish). In mouse models, homozygous knockouts of the NGLY-1 gene have been shown to be lethal. Transcriptomic data of mouse MEF cells have revealed the downregulation of Wnt signaling pathways as well (Batten, 2022). However, zebrafish knockout models show minimal phenotype expression, yet metabolon data does suggest an increase in cholesterol synthesis (Phillipe & Mooney, unpublished). Both models are imperfect: the mouse data is from cortical tissue only and the zebrafish data is from whole heads (including eyes). We know little about how NGLY-1 deficiency affects human brain cells and tissues. To study the effects of NGLY-1 in human cells, Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology will be utilized to engineer NGLY-1 knock-outs in the human U87 (glioblastoma) and SY5Y (neuroblastoma) cell lines. CRISPR is a family of DNA sequences found in the genomes of prokaryotic organisms. The CRISPR system involves guide RNA (gRNA) and Cas-9 protein (Giuliano et al., 2019). The designed gRNA recognizes the target sequence in the gene of interest (NGLY-1) through complementary base pairing. The Cas-9 nuclease then makes double-stranded breaks at the recognition site. The cut is repaired, often imperfectly, with non-homologous end joining. Imperfect repairs create loss-of-function genetics models. Introducing NGLY1 deficiency in human brain tissue cell lines will allow us to observe critical transcriptional pathways underlying the neurodevelopmental deficits in the relevant human tissues. We expect to see the same dysregulation (Wnt, cholesterol synthesis) in NGLY-1 deficient human brain tissue cell lines, perhaps in separate cell types. If we can verify these pathways are being downregulated in human cells,

we can use drugs and enzyme supplements to target these pathways. Wnt agonists and drugs that promote cholesterol synthesis may be possible treatments for this congenital disease. We would need to test this hypothesis once the NGLY-1 KO cell lines are created. Once these cell lines are designed, future work includes whole transcriptome analysis with RNA-Seq.

Mentor: Dr. Marie Mooney

Reduced Dietary Isoleucine or Valine Increases Organismal Catabolism of Leucine in Adult Female Lubber Grasshoppers

Haley Peters

The prevention of aging and age-related disease is of main interest in the biomedical research industry. Through this interest, dietary modifications have been studied extensively where protein restriction has been shown to be the most effective in prevention of age-related disease (Mirzaei et al. 2014). Dietary protein restriction is achieved through restriction of one or more amino acids where restriction of specific amino acids such as isoleucine and valine in mice has been shown to have various favorable metabolic effects (Yu et al. 2021). These effects are shown, but the biological pathways by which these benefits are modulated are not well defined. In studying such pathways, three main functions of amino acids are considered: protein synthesis, storage, and catabolism. Catabolism refers to the breakdown of amino acids and is likely to occur when organisms are consuming amino acid compositions beyond what is required for protein synthesis (Elango et al. 2008). Restriction of specific amino acids in a diet causes ideal conditions for catabolism, and here the amino acids, isoleucine, leucine, and valine, were restricted independently and bolus leucine catabolism was tracked in female adult lubber grasshoppers. In terms of leucine catabolism, the isoleucine and valine restricted groups were significantly different from the low leucine group, suggesting the animals on low isoleucine and low valine diets were prone to leucine catabolism. These results suggest the metabolic benefits of isoleucine and valine restriction may be connected to amino acid catabolism, and further studies will focus on clarifying this correlation.

Mentor: Dr. John Hatle

Significance of Danio rerio Assays for Neurodevelopmental Research

Sydney Pell, Rida Khan, and Brandyn Figueroa

Congenital disorders of glycosylation are extremely rare and are the result of a defect in an enzyme to build a lipid donor or modify the glycan chain. They can disrupt the functions of many organs and tissues and cause severe symptoms like epilepsy, intellectual disability, myopathy, neuropathy, and stroke-like symptoms. The disorder is present from birth and causes notable defects in neurodevelopment. Zebrafish have become a novel model organism and are valuable because of their homology with other vertebrates and mammals, the ability to observe developmental stages, and the ability to identify mutants with altered phenotypes. They have also been used to study color discrimination, learning and memory, locomotion and exploratory behavior, and place preference. This study aims to distinguish between the intellectual and motor disabilities of different Zebrafish genetic models. A swim test, endurance test, latent learning maze, associative learning, and conditioned place preference tests will all be used to identify this difference and the different phenotypes. We expect to find a correlation between intellectual ability and genomic mutations as well as an increase in latency and errors during the T-Maze for the experimental fish. We also expect an increase in latency and a decrease in time in the reward chamber and the tunnel open to them during training. We expect to be able to distinguish between the motor and intellectual deficits of the genetic models. In the future, we want to collect data to ascertain the phenotypes for zebrafish genetic models and understand how to differentiate between motor and intellectual disabilities when running locomotor assays. Ascertain the mutationâ€™s effect on different learning strategies and run genetic testing on genes of interest (NGLY1, ALG1, DPAGT1, ELG1, and DHDDs).

Mentor: Dr. Marie Mooney

What Makes an International Student in the U.S. have Less Psychological Distress?: Secrets of Adjustment

Sara Buchanan

This study aims to identify which acculturation factors lead to better adjustment among international college students attending American universities. International students experience unique stressors, as well as bring with them their own culture of origin identity, language, and competence when acculturating. To get a comprehensive picture, we collected survey data on demographics, acculturation, stress, anxiety, depression, and symptomatology from N= 146 college students (n = 51 international students; n = 95 U.S. citizens) from three universities in the southeastern United States. For international students, increased acculturation to the U.S. (English proficiency and culture competence) is related to decreased symptomatology and anxiety. Additionally, international students' competencies in culture of origin are significantly associated with competencies in U.S. acculturation. Regression analyses indicated that among international students, higher U.S. acculturation and lower stress, significantly predicted less anxiety; lower stress significantly predicted less symptomatology. Implications for higher education and future research are discussed.

Mentor: Dr. Tes Tuason

Cancer Mutations in Essential Human Co-Chaperone DNA-JB1 Protein

Brandon Guerin

DNAJB1 is an essential co-chaperone protein found in humans. Chaperone protein networks carry out vital cellular functions and are often recruited by cancer to combat increased proteotoxic stress. The purpose of this research to understand is how DNAJB1 is mutated in cancer patients and what effect these mutations may have on its function. Mutations were selected from three major databases based on functional and structural criteria together with residue conversations across sequences of 15 DNAJB1 homologs form different species. After selecting three main DNAJB1 candidate mutations, a proper system for protein expression and purification needed to be tested. E. coli was used as a host and expression vector resulting in production of protein of interest fused with a cleavable His-SUMO tag on its N-terminus. To test this expression system, yeast homolog of DNAJB1 (Sis1) was used as a positive control. Preliminary results indicate a successful induction and testing expression and production of human DNAJB1 and its mutated variants

using same expression system will follow. Upon successful purification of DNAJB1 variants, chaperone function will be tested using in vitro methods as well as testing their biological activity in vivo using S. cerevisiae as a model organism.

Mentor: Dr. Szymon Ciesielski

Examining Cortical Activation During A Self-Monitoring Task

Karli Friedman

In social psychology, self-monitoring refers to the way in which individuals regulate the manner in which they present themselves to others. High self-monitors are those who are driven to fit in, and strategically adapt their presentation of self to cultivate a specific image of themselves. Low self-monitors are driven more by their personal values and are less likely to adjust their behaviors situationally. One component of self-monitoring is emotional regulation, where high self-monitors are more adept at regulating the presentation of their emotions, (e.g. concealing and faking them), than low self-monitors. We used functional near-infrared spectroscopy (fNIRS) to study how brain activation differs in high and low self-monitors in a self-monitoring task. fNIRS uses two wavelengths of near-infrared light to measure cortical activity by detecting levels of oxygenated hemoglobin. Participants were asked to fill out a self-monitoring questionnaire to determine whether they are high or low self-monitors. Then, while monitoring neural activity with fNIRS, participants viewed a series of positive, neutral, and negative images while completing one of three self-monitoring tasks: inhibiting facial expressions, producing a facial expression consistent with the emotion elicited by the image, and producing an expression inconsistent with the emotion elicited by the image. High self-monitors, being more skilled at emotional regulation, are expected to have an easier time inhibiting facial expressions and producing inconsistent facial expressions in comparison to low self-monitors. We hope to determine the regions of the brain involved with self-monitoring, and to detect any differences between high and low self-monitors while performing this self-monitoring task.

Mentor: Dr. Katherine Hooper

(La1-yEuy)1-xSrxMnO3 Thin Films grown as Random Alloys and Superlattices by MBE

Jacary Sapp

Using molecular beam epitaxy (MBE), we grow single-crystalline thin films of mixed-valent manganites. Specifically, we study (La1-yEuy)1-xSrxMnO3 thin films where x is set to 1/3 and the europium substitution for lanthanum, y, is changed from 0 to ½. The starting compound with no europium (y=0), La1-xSrxMnO3, is well studied and it is understood that lanthanum and strontium are mostly ionic in the crystal forming La3+ and Sr2+ ions. At x=1/3 this material is well known for its colossal magnetoresistive properties and its highly spin-polarized ferromagnetic ground state. The addition of europium into this crystal can impact its electronic properties in three respects. The valence state of europium, which is not known can influence the doping. The ionic radii of europium can trigger additional lattice distortions that couple to the electronic structure. The f-electrons in europium can influence the spin state of the hybridized t2g and eg electrons that mediate the double exchange interaction and the resulting ferromagnetic metallic ground state. Here we study this influence of adding europium in both random alloy samples and ordered superlattice thin films. Specifically, we carry out a comparison of the electronic properties due to the addition of europium, y=0 vs y=1/2 as well as between the random vs ordered arrangement of europium in the lattice. In both comparisons, we find the influence of europium leads to distinct changes in the electronic properties.

Mentor: Dr. Maitri Warusawithana

Dietary Protein Quality Does Not Alter P:C Intake Target in Grasshoppers

Nicholas Strasser

Adequate consumption of essential amino acids (EAAs) is needed to facilitate development and reproduction. However, overconsumption of some (e.g., BCAAs) can spur disease, while low protein consumption can extend lifespan. When offered multiple foods, most animals self-select their dietary protein:carbohydrate (P:C), called intake target. We sought to elucidate the effect of dietary protein quality on intake targets of female grasshoppers. We predicted that consuming a low-quality diet will shift intake targets to a higher P:C ratio, to acquire sufficient EAAs. Here, each individual was offered both a high- and a low-protein version of one of four artificial diets (a high-quality diet; a low-quality diet; a diet

known to positively P:C [positive control]; a negative control). Each grasshopper was tested on all diets, and sequences were randomized. Intake targets for each diet group were: high-quality 0.42±0.04, low-quality 0.42±0.04, positive control 2.15±0.14, and negative control 0.76±0.10. High- and low-quality diets were not significantly different (t-test; P=0.44). In contrast, consumption of the positive control diet increased intake target (ANOVA; P<0.0001), showing these grasshoppers can alter intake target. Low-quality diets may not lead grasshoppers to increased protein feeding. Animals that consume lower quality protein may experience impaired reproduction. In future work, we seek to bridge the gap between the preference to feed on higher quality diet and the lack of altered feeding behavior on a lower quality diet.

Mentor: Dr. John Hatle

Optimizing Superconducting YBa2Cu3O7-Î´ Thin Film Growth by MBE

Paul Christenson and Dalton Zona

We investigated the effect of stoichiometry, substrate temperature, and layer-stacking order on the critical temperature of superconducting YBCO thin films. The films we studied were grown using ultra-high vacuum (UHV) molecular beam epitaxy (MBE) with distilled ozone as the source of oxygen on (001) oriented lanthanum aluminate (LAO) substrates. To probe the effect of stoichiometry, the films were grown with varying yttrium, barium, and copper stoichiometry by ±7%. We also explored different substrate temperatures to promote the growth of c-axis YBCO thin films (c-axis oriented along the film out-of-plane direction). In situ reflection high-energy electron diffraction (RHEED) imaging was used to monitor the film surface during growth. RHEED provided real-time feedback on second-phase nucleation due to off stoichiometry. Following each growth, we made resistance measurements as a function of temperature using a four-point geometry; these measurements allowed us to determine the superconducting critical temperature. We find that a substrate temperature between 630°C and 680°C in an ozone partial pressure of 2×10^(-6) torr is ideal for the growth of c-axis YBCO thin films and that an anneal of around 5 minutes after each unit cell (specifically after the Cu-O_2 layer) helps with the crystalline quality of the sample.

Mentor: Dr. Maitri Warusawithana

Northeastern Florida Indigenous Ceramic Chronology Revisited: A Bayesian Approach

Magdalynne A. Alley

In the field of archaeology, radiocarbon (C14) dating is vital to understanding chronologies of past cultures. Using this method, approximate dates are calculated, typically with a range of 60-120 years. These large date ranges become more complex as the number of samples increase, making interpretations of chronologies difficult at large scales with large numbers of C14 dates. To remedy this problem, Bayesian statistics are used to combine chronologies with radiocarbon dates to construct models of potential timelines. With Bayesian modeling, I am able to condense dozens of radiocarbon dates into a single probability date range, refining the extant understanding of northeastern Florida ceramic chronologies. My study focuses on three Indigenous ceramic phases in northeastern Florida, spanning from 900 to 1600 CE, which have previously been subject to radiocarbon dating. I use Bayesian modeling to refine these dates and compare my results to the existing Indigenous chronology of the region. My results show the significance Bayesian statistics has to refining our current understandings of ceramic chronologies in the area. Through this project, I have gained greater insight into start and end dates of ceramic transitions, which have yielded even larger interpretations of Indigenous cultures, settlement patterns, and the transference of ceramic traditions.

Mentor: Dr. Keith Ashley

Molecular Beam Epitaxial Growth of High-Quality LaVO3 and La1-xSrxVO3 Thin Films Using Low Oxygen Partial Pressures

Nathan Bairen

Using molecular beam epitaxy (MBE), we grew thin films of Sr-doped LaVO3 (La1-xSrxVO3 or LSVO) with doping concentrations of x = 0, 0.1, and 0.2. Due to the many oxidation states of vanadium, confining vanadium to a 3+ oxidation state in order to synthesize LaVO3 in a perovskite crystal structure is challenging. Our research resulted in optimized growth parameters for LaVO3 that produced RHEED diffraction patterns indicative of higher quality perovskite crystals than previous attempts. We found that oxygen partial pressures of 5E-7 torr resulted in films which showed features in their RHEED images indicative of defects, presumably due to higher vanadium oxidation states. Oxygen partial pressures of 5E-8 torr, however, resulted in perovskite LaVO3 crystals that showed interesting electronic transport behaviors.

Mentor: Dr. Maitri Warusawithana

Performance Evaluation of a UAV-based ad-hoc Hybrid Wi-fi/LoRa Mesh Network Using a Particle Swarm Optimization Technique

W. David Paredes Molina, Hemani Kaushal, Iman Vakilinia, and Zornitza Prodanoff

Flying Ad-Hoc Networks (FANETs) have become a hot topic among researchers because of the availability of Unmanned Aerial Vehicles (UAVs) and the electronic components required to control and connect them. Applications such as 3D mapping, construction inspection, oil exploration, agricultural monitoring, or emergency response operations, could benefit from using a swarm of UAVs instead of a single UAV, by forming an ad hoc network for communication and coordination. The objective of this research work is to dynamically maximize WiFi coverage to ground nodes inside a predefined area, using a Particle Swarm Optimization (PSO) technique to properly place UAV-mounted access points. Communication between UAVs is conducted using Long Range (LoRa) technology to maximize air-to-air range while maintaining network connectivity of UAVs to the ground nodes through the WiFi access links. The ad-hoc UAVs will act as relays that collect the data generated by ground nodes and forward it to a distant base station using LoRa links. An impractical number of UAVs would be required to achieve a complete coverage of the entire area in which the ground nodes are located. Therefore, a Particle Swarm Optimization (PSO) technique is proposed to find the optimal positioning of the UAVs, to maximize both Air-to-Air range and Air-to-Ground coverage, while minimizing movement and network downtime. A simulation scenario has been implemented in MATLAB using its UAV and Wireless Local Area Network (WLAN) toolboxes to find the optimal number of UAVs and the positions of the UAVs that maximize coverage of the ground nodes.

Mentors: Dr. Hemani Kaushal, Dr. Iman Vakilinia, and Dr. Zornitza Prodanoff

Utilizing Antibodies and Fluorescent Microscopy to Evaluate Sindbis Virus Infection in the Mosquito Aedes aegypti

Katie G. Peters and Doria F. Bowers

Prior to transmission by mosquito, Sindbis virus (SINV) must first infect the mosquitoâ€™s midgut. Due to the small size of viruses, visualization of viral infection can present a hurdle in research. As an alternative to the traditional method of electron microscopy to image viruses, immunohistochemistry can be utilized to locate viral infections and produce images using a confocal microscope. SINV-TaV-eGFP produces green fluorescent protein upon replication. While this can be viewed without any staining, it provides a limited perspective of the arbovirus infection, only indicating where the virus was, not necessarily where it currently is. Utilizing fluorescent antibody staining, a more complete story can be told. A polyclonal primary antibody against SINV and a secondary antibody conjugated with the fluorochrome TX-Red was employed to stain viral proteins in dissected midguts of Aedes aegypti. The colocalization of GFP and TX-Red results in yellow when images are merged. It is shown by the results that TX-Red generally has a larger spread than GFP, indicating that there is virus present, but that the reporter gene for GFP has not yet been expressed. The concentration of TX-Red around the edges of the foci could also be viral proteins that are moving toward the membrane of the cell before they egress for cell-to-cell spread. In conclusion, while GFP by itself can allow us to locate an infection, it is the combination with immunolabeling that allows for a more precise view of the infection. This detailed view can be used in future studies to better understand the characteristics, spread, and persistence of SINV in mosquitoes.

Mentor: Dr. Doria Bowers

Developing an Aptamer-mediated CRISPR interference System in Primary Human T cells

Jeffrey Perera

CRISPR interference (CRISPRi) is an emerging tool in primary human T cells (PHTs) to repress genetic expression at the transcriptional level and study gene function. The original CRISPRi system consists of a dead Cas9 endonuclease (dCas9) fused to a transcriptional domain KrÃ¼ppel-associated box (KRAB) repressor, which when directed to a geneâ€™s transcriptional start site (TSS) or enhancers by a single guide RNA (sgRNA) can interfere with transcriptionâ€“However, this system (dCas9-KRAB) frequently suffers from incomplete knockdown. In literature, we learned of a more efficient CRISPRi system upon fusing a bipartite repressor, KRAB-

MeCP2, to dCas9 and that dCas9-KRAB-MeCP2 caused greater repression with sgRNAs targeting enhancers. However, these modifications were completed in immortal cell lines and have not yet been accomplished in PHTs. Since dCas9-KRAB-MeCP2 is too large of a construct to be efficiently packaged in lentiviral vectors for delivery to PHTs, we split the delivery into 2 components: 1) dCas9, and 2) PP7 coat protein (PCP)-KRAB-MeCP2. PCP binds with high affinity to modified sgRNAs containing a PP7 aptamer. To test our hypothesis, we cloned constructs for 3 experimental groups: 1) dCas9-KRAB, 2) dCas9 + PCP-KRAB, and 3) dCas9 + PCP-KRAB-MeCP2 targeting genes ICOS and CD28. We lentivirally infected the constructs into PHTs and stained them with antibodies recognizing CD28 and ICOS to measure their surface expression by flow cytometry. To quantify protein surface expression, the Median Fluorescence Intensity (MFI) of ICOS and CD28 in PHTs was analyzed. MFI analysis revealed increased knockdown effects by dCas9 + PCP-KRAB-MeCP2 when compared to the other CRISPRi systems.

Mentors: Dr. Zachary Steinhart and Dr. Alexander Marson

Exploring Bacterial Genomes for Discovery of Novel Diketopiperazines

Elise Ballash

Actinomycetes bacteria excel at producing small molecules that are important in drug discovery. Some natural products contain diketopiperazine (DKP) groups. DKPs are structurally diverse molecules that have a variety of biological functions. The formation of DKP scaffolds are catalyzed by cyclodipeptide synthases (CDPS) which form an amide bond between two aminoacyl tRNAs (aa-tRNAs). For this research, the expression of three cryptic gene clusters from Actinomycetes resulted in production of DKPs. LC-MS and HPLC data indicate that the gene clusters' CDPS catalyze the formation of cyclo(L-Trp-L-Trp) and/or cyclo(L-Trp-L-Phe) as the DKP scaffold. These precursors are further modified into the final decorated DKP.

Mentor: Dr. Amy Lane

Computational Methods for the Determination of Analytical Ground-State Solutions to the Heisenberg Hamiltonian

James Taintor

Using a combination of computational methods and a Heisenberg Hamiltonian, we can rapidly iterate through different lattice configurations to build phase diagrams and simulate spin waves. One of the major obstacles to performing detailed analytical calculations for spin waves is the tedious and laborious setup for different lattice configurations. Changing a singular parameter or making a small mistake could drastically alter the results for the entire configuration. The program being developed aims to solve these significant issues by streamlining the entire process. This python library, in the final stages of development, allows a researcher to visually create a sub-lattice with interactions and rapidly simulate those configurations. This program has already saved time and resources to produce simulations for sub-lattices such as the Lieb Lattice, square lattices, chains, and many more. In the past version of the program, we have be able to extract the frequencies and phases diagrams for any valid configuration. This information has been crucial in creating a more holistic understanding of different lattices. Currently, we are working on finding the intensity of each of the waves produced in order to experimentally verify our theoretical results. We hope that, by making the whole process more efficient, other researchers will greatly benefit from this program.

Mentor: Dr. Jason Haraldsen