The 2024

SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM

at Washington State University

SUMMERRESEARCH.WSU.EDU

Summer Undergraduate Research Symposium 2024

Friday, August 2, 2024
8:00 a.m. – 1:00 p.m.
CUE Atrium and CUE 203

Symposium Schedule

8:00 a.m. – 9:00 a.m. CUE Atrium
Check-in and poster set-up

9:00 a.m. – 10:00 a.m. CUE 203
Welcome and keynote speaker
Keynote: Scott Beckman

10:00 a.m. – 1:00 p.m. CUE Atrium
Students are at their posters, available to discuss their research and to answer questions

1:00 p.m. CUE Atrium
End of the Symposium - put posters away and say farewell

WASHINGTON STATE UNIVERSITY
Office of Undergraduate Research

Summer Research Symposium 2024

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Poster 1

Mapping Physical Risk and Social Vulnerability to Hydrologic Hazards in the Intermountain West

Undergraduate Researcher: Jozi Renken, *University of North Carolina Asheville*

Co-Authors: Julie Padowski

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

The increasing prevalence of hydrologic hazards as the climate changes creates a pressing need to identify and assess which areas and communities will be most at risk if these hazards do occur. While there has been research into what areas will be most at risk for specific hazards (e.g., floods, droughts, or wildfires) there is limited research that looks at multiple hazards together along with social vulnerability and environmental justice impacts. I focused this work in the Intermountain West, which represents an interconnected regional system that faces a similar set of water-related challenges. For this project, I used QGIS to explore data from FEMAs National Risk Index and the EPA's Environmental Justice Screening and Mapping Tool. Using these datasets, I identified where drought, wildfire, flooding, landslides, and heatwaves are likely to coincide and which communities in this region will most likely experience the highest risk from these hazards. I also identified the areas that are at higher risk in multiple categories and the most at risk counties in each state using Excel to analyze the numerical data. I did this by normalizing the data and finding the counties in the top twenty percent for each variable. Some variables are related to social and economic data such as the percent of residents who are low income, younger than 5, or older than 64. Other variables are related to the hazards themselves like the number of instances of a certain event taking place, the total expected annual loss due to said events, and the area exposed to the hazard. Results show that California is the most vulnerable to physical hazards overall while Wyoming is the least, and in terms of environmental justice and social vulnerability California is also at higher risk compared to other states being looked at along with Nevada.

Poster 2

Communication in Policing: How Language Barriers Impact Police Interactions

Undergraduate Researcher: Arisa Morales, *University of Texas at El Paso*

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

Communication plays an essential role in police interactions. With effective communication, police officers can be more productive when gathering information, building trust, and resolving conflicts on the scene. However, language barriers can be difficult to overcome in communication. Given the already stressful nature of the job, failure to properly understand others may further escalate a situation or have escalation occur at a quicker rate. This study aims to analyze police interactions by comparing the differences in escalation between interactions with a language barrier and without a language barrier as well as interactions when a person of interest has a non-native accent and does not have a non-native accent. Data was collected through police body camera footage from a mid-sized police agency located in the Pacific Northwest, and a random sample of over 100 videos of police interactions consisting of mainly welfare checks. The level of a language barrier and accent, the substantial presence of communication being done in a language other than English, the person of interest's fluency in English, and the officer's fluency in another language, if applicable, were all recorded when collecting data. This study hopes to bring to light the struggles of communication and the potential outcomes of poor communication. The findings of the study will be discussed during the presentation.

Poster 3

Shock Response of Barium Fluoride (BaF2) in Planar Impact Experiments: Hugoniot States under High Dynamic Compression

Undergraduate Researcher: Luke Hunter, *Purdue University*

Co-Authors: Matthew Shapiro, James Hawreliak, Brian Jensen

Summer Research Program: Summer Undergraduate Research Experience (SURE) (Brian Jensen)

Abstract

Barium fluoride is a transparent solid whose shock response has only been studied up to 4GPa. In this work we will study the shock response of [100]-oriented single crystals of barium fluoride (BaF_2) up to a pressure of ~46 GPa. We conducted plate impact experiments using a powder gun to propel a single crystalline copper (Cu) projectile with a thickness of 1 mm into a 1 mm thick barium fluoride target backed by a 3 mm thick [100] lithium fluoride (LiF) optical window, all with diameters of 25 mm, at velocities up to 2.81 km/s. The impact interface and the BaF2/LiF interface velocities were measured using a 4-point Velocity Interferometer System for Any Reflector (VISAR). The wave profiles at the impact surface in a plate impact experiment are used to determine the Hugoniot states as well as the optical properties in barium fluoride under extreme conditions to tests its functionality as an optical window for other high pressure shock physics experiments. In this poster we present the Hugoniot states determined from our experiments.

Poster 4

An Analysis of Older Adults with Memory Complaints Usage of Health Features in a Newly Developed Electronic Memory Application

Undergraduate Researcher: Kendra Wales, *Grove City College*

Co-Authors: Samina Rahman, Maureen Schmitter-Edgecombe

Summer Research Program: Gerontechnology (Diane Cook and Maureen Schmitter-Edgecombe)

Abstract

Objective: Health applications can assist older adults with memory complaints in tracking their health information, thus increasing level of independence. Health features were added to an Electronic Memory and Management Aid (EMMA) application through iterative participatory design. Based on this work, we hypothesized that medication and physical exercise tracking would be the most used health features, while cognitive and well-being exercises and emotion ratings would be the least used.

Participants and Methods: Participants were 49 older adults (age: M = 70.29, SD = 9.3; education: M = 15.29, SD = 2.35; 71.43% female) with memory complaints who completed an adaptive web-based training program to learn to use EMMA followed by three months of monitored use. To understand strengths and barriers to health feature use, qualitative interviews were conducted with 14 participants, transcribed verbatim, and themes identified.

Results: For the first month post-training, medical information (39%), medications (29%), and weight tracking (20%) were the most used health features. In the second and third months, medications (31/29%), medical information (24/26%), and physical exercise (20/22%) were most used. Across months, the features of cognitive and well-being exercises (8-16%), and health and emotion ratings (4-8%) were used least. Themes for use of EMMA health features included simplicity in keeping records in one place and ability to track in extensive detail, while non-use themes included having established tracking systems already in place.

Conclusions: Based on our preliminary work, the most and least used health features of EMMA were as predicted. The barriers to EMMA health feature use were consistent with prior research on older adult's experience in adapting to new technology. To improve older adults' technology use, further research on barriers between seniors and health applications would be beneficial.

Poster 5

Real Space Josephson Effect in a BEC

Undergraduate Researcher: Kathryn Gabriel, *Kutztown University of Pennsylvania*

Co-Authors: Colby Schimelfenig, Jacob Pierson, Michael Forbes, Peter Engels

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

The Josephson effect describes the current between two superconductors or superfluids separated by a penetrable barrier. Here, we combine theory and experiment to form a more complete picture of the Josephson effect in real space with Bose-Einstein condensates (BECs). Our initial simulations demonstrated the AC Josephson effect for systems in a harmonic trap penetrated by a barrier. These simulations also indicated the generation of an abundance of solitons. We experimentally recreated the AC Josephson effect simulations in real space by penetrating the BEC with a laser and shifting the trap to induce dynamics. We then observed the motion of the BEC for several hundred milliseconds. The experimental setup produced Josephson oscillations similar to the theoretical results, however they are on a longer time scale, because the theoretical systems are scaled down in size to accommodate run time. The solitons present in the simulation also can be found in the experimental results. We conclude that theoretical predictions for the Josephson effect are in good agreement with the experimental data. With broad applications from SQUIDS for quantum sensing to building blocks for quantum computers, Josephson effects play an important role for modern quantum technologies. Our studies using BECs provide a new viewpoint on this intriguingly rich area of physics.

Poster 6

Conversion of (4s)-limonene Synthase to Produce 1,8-cineole by Active Site Residue Mutations

Undergraduate Researcher: Connor Laureano, *Whitworth University*

Co-Authors: Mark Willis, Narayanan Srividya, Iris Lange, B. Markus Lange

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

Monoterpene synthases bring about the first committed step in monoterpene biosynthesis. This class of secondary metabolites displays a great degree of structural diversity. Structural variability is dependent upon carbocation formation with the removal of pyrophosphate from its substrate, geranyl diphosphate (GPP). Recombinantly produced wild-type (4S)-limonene synthase (LMNS) produces ~ 97% (-)-limonene in assays with GPP. However, through active site manipulation, the enzyme is notable in its ability to synthesize multiple products from GPP. This capability occurs via alterations to the enzyme active site which subsequently influences both carbocation formation and the resulting variety of terpene products, including stereoisomers.

In the present work, we are in the process of performing comparisons between LMNS and 1,8-cineole synthases from mint and other plant species. Sequence conservation patterns and protein structural modeling are used to guide the choice of mutations that alter product formation.

Mutagenesis is accomplished via PCR, recombinant protein production in *E. coli*, protein purification, and enzyme assays with GPP as substrate. Product specificity is characterized using Gas Chromatography (GC). The variants studied display drastically less (-)-limonene, whereas product formation of 1,8-cineole, α-pinene, β-pinene, sabinene, myrcene, α-terpineol, and β-phellandrene increase. The degree to which each terpene is produced differs by variant. At the end of the study, we will be able to determine the number of mutations required for the conversion of LMNS to produce 1,8-cineole as its primary output.

Poster 7

Investigation of a Candidate Potato Resistance Gene Against the Root-knot Nematode Meloidogyne chitwoodi race 1

Undergraduate Researcher: Ibrahim Waheed, *Vassar College*

Co-Authors: Marcella Teixeira, Sapinder Bali, Cynthia Gleason

Summer Research Program: NSF Plant Genome (Laura Bartley)

Abstract

The Columbia Root Knot Nematode, *Meloidogyne chitwoodi* (CRKN), is one of the most severe pathogens to commercial potatoes in the Pacific Northwest. Without natural resistances, farmers must turn to expensive and harmful pesticides to reduce damage caused by CRKNs. This project is aimed at characterizing a candidate resistance gene, *RPM1-like*, introgressed from the wild potato species *Solanum bulbocastanum* (SB22) into the breeding line PA99N82-4 (N82-4). We have previously narrowed down the region transferred from SB22 and identified the *RPM1-like* gene. To investigate if this is the gene conferring resistance to CRKNs, we silenced it in the resistant N82-4 and over-expressed it in a susceptible cultivar, Desiree. If this *RPM1-like* gene confers resistance against nematodes, silencing it in N82-4 will reduce the observed resistance. On the other hand, expressing the *RPM1-like* gene in the susceptible plant will make it resistant against CRKNs. Both experiments were performed using the hairy root protocol, which takes advantage of *Rhizobium rhizogenes'* ability to transform plant roots with our constructs of interest. The generated root lines will be used for future screening with CRKNs. If our hypothesis is confirmed, this will be the first resistance gene against CRKNs ever cloned from a potato.

Poster 8

Results from Multiple Methods of Correlating Pennycress Microbiome to Plant Growth and Yield

Undergraduate Researcher: Sarah Lanphear, *Lycoming College*

Co-Authors: Andrew Spishakoff, Anna Kyslynska, Augusta Finzel, Tarah Sullivan

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

Soil microorganisms play a major role in plant health. Better understanding of the beneficial and inhibitory interactions can lead to improved yields and soil conditions. Pennycress (*Thlaspi arvense*) is an emerging biofuel crop that could be incorporated into existing rotations as a winter cover, thus decreasing competition of land use between food and fuel while benefiting the soil. In this study, we analyzed amplicons produced from rhizosphere samples acquired in Maycomb, Il to look for correlations between fungal and bacterial diversity and pennycress yield and coverage. Analyzing amplicon data in QIIME2, we compared fungal and bacteria rRNA gene sequences with the UNITE and Silva databases, respectively. We also did culturing trials from pennycress rhizosphere samples to look for organisms with plant-growth-promoting properties. For the bacteria, plants with excellent coverage had significantly lower alpha and beta diversity than those classified as fair or poor. However, this correlation was only present between fungal beta diversity and coverage. Higher bacterial and fungal alpha diversity were both significantly correlated to lower yield. We found one fungal and two bacterial genera to be enriched in plots with lower coverage. The *Sistotrema* fungal genus was enriched in our pennycress samples, which was unexpected since it has been associated with greater stress tolerance in blueberries. Our identified bacterial genera, *Thermobacillus* and *Planifilum* are commonly associated with compost, whose may indicate a lack of clearing from the previous crop residue at the site. Our culturing revealed some species that have growth-promoting traits, highlighting the importance of using multiple techniques to better understand the soil microbiome. Future research could include further DNA analysis and culturing of the fungal and bacterial genera associated with lower plant success and genome analysis of the cultured organisms who had growth-promoting traits.

Poster 9

Identification of Low Phytic Acid Mutants in Durum Wheat (Triticum turgidum L.) Using A Reverse Genetics Approach

Undergraduate Researcher: Isabela de La Combe, *Washington State University*

Co-Authors: Emily Klarkquist, Aichatou Waziri, Niharika N. Chandrakanth

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

Phytic acid (InsP6) content in plants has been observed to reduce the mineral bioavailability of cations such as iron (Fe) and zinc (Zn) due to the formation of insoluble salt known as phytate. InsP6 is a large molecule with six negatively charged phosphate groups. The insoluble phytate-mineral complex is not readily absorbed by the body, leading to an increased risk of developing a mineral deficiency in individuals who consume a low-quality diet. This study focused on identifying low phytic acid (lpa) mutants in Durum wheat (Triticum turgidum L.) TILLING population to improve mineral bioavailability. FASTA sequences of rice genes associated with the lpa phenotype were used for BLAST searches to identify corresponding genes in wheat, resulting in 101 high-confidence putative mutants based on specific genetic changes. The mutants' seeds were harvested from unreplicated headrows along with BC2F4 near-isogenic lines (NILs) previously selected for the lpa trait were grown in a randomized controlled block design (n=3) at UC-Davis in 2022. The 101 putative lpa mutants were screened for high inorganic phosphate (HIP) using a colorimetric method (n=3). The HIP assay is often used as a rapid preliminary screening to identify lpa mutants, as a reduction in phytic acid usually corresponds to an increase in inorganic P when total phosphorus remains constant. From this assay, mutant T-2711 indicated a similar phenotype to the lpa barley mutants included in the assay and reflected an earlier greenhouse HIP screening of the same mutants. The previously developed BC2F4 NILs, with one pair containing the T-2711 mutation, were screened for total P determination, HIP, protein, seed size, and ash content. Identifying a lpa durum wheat mutant will support breeding efforts to improve nutritional quality by enhancing mineral bioavailability without negatively impacting the overall phosphorus content of the seed.

Poster 10

Elucidating the Tolerance Mechanisms of Pennycress to Metal lactates Compared to Arabidopsis and Canola

Undergraduate Researcher: Emrik Gollnick, *University of California, Davis*

Co-Authors: Ekom Idio, Karen A. Sanguinet

Summer Research Program: NSF Plant Genome (Laura Bartley)

Abstract

Pennycress (Thlaspi arvense L.) has promise as a low maintenance cover crop that provides significant ecosystem services and is potentially a metal hyperaccumulator, though its response to metal-related stress is not well understood. Metal lactates have recently emerged as alternative organic biostimulants that are sustainable and potentially optimal for crop growth; however, high concentrations can lead to metal toxicity. The main objective of this research was to determine optimal versus toxic concentrations of metal lactates for enhanced growth in three Brassica species: canola (Brassica napus), Arabidopsis (Arabidopsis thaliana), and pennycress. The goal of this experiment was to determine if pennycress is capable of tolerating higher concentrations of metal lactates compared to the other Brassica species, which are non-hyperaccumulators. The three species were individually plated onto media with different concentrations (1 µm, 10 µm, and 100 µm) of five metals—Co, Cu, Mn, Ni, and Zn, as well as a combination of all five—and root growth was measured. These growth assays showed that pennycress is able to tolerate higher concentrations of metal lactate compared to the other two species, with the exception of Cu and Co. There is evidence that pennycress is a metal hyperaccumulator, which further supports the claim that it can be used as a sustainable cover crop with minimal input.

Poster 11

Salt Stressing Nicotiana benthamiana Reveals Key Sieve Element Protein Function

Undergraduate Researcher: Austin Cloke, *Gonzaga University*

Co-Authors: Viktoriya Vasina, Michael Knoblauch

Summer Research Program: NSF Plant Genome (Laura Bartley)

Abstract

All sugars from photosynthesis are transported throughout plants via sieve elements in the phloem. While sieve elements are highly important for the growth and development of plants, they are one of the most understudied cell types across the field of plant biology because they have a reduced endomembrane system and no nucleus. Considering the lack of organelles and a nucleus, RNA sequencing to reach conclusions about genetic mechanisms in the cell is not feasible. A newly developed method of isolating sieve elements allowed for proteomics analysis, in which a new protein (Nb-SEP1) was found. The function of this protein was unknown until stress studies revealed it may be involved in salt tolerance. Over the course of this experiment, we investigated 3 developed lines of *Nicotiana benthamiana*; a wild type, a CRISPR knock-out line, and a reporter that overexpresses this protein. Preliminary data from plants watered with 200 mM concentrated salt or no salt revealed the CRISPR line was more salt sensitive than the wild-type. In addition, the root growth was measured from the same lines but on agar plates containing different concentrations of salt; 0 mM, 25 mM, 50 mM, 75 mM, 100 mM. The roots were measured every day and there was a statistically significant difference in germination time and root growth, revealing a strong deficit with the CRISPR knockout line under higher levels of salt stress. The results indicate that the protein is related to salt-tolerance in the sieve elements in plants. Nb-SEP1 is highly valuable in its relationship to salt stress due to the inevitable nature of climate change and larger salt concentrations in soil. If the protein can be over-expressed in crops, this will largely benefit salt dense areas as it will create plants with higher tolerances.

Poster 12

Examining the Effects of Genotype and Dormancy Loss on Alpha-amylase Expression During Wheat Grain Germination

Undergraduate Researcher: Hannah Brown, *Gonzaga University*

Co-Authors: Scott Carle, Abigail Holtz, Camille M. Steber

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

Wheat seeding growth requires energy provided by the enzyme alpha-amylase digesting starch chains within the endosperm of the grain during germination. However, rain before harvest can cause the grain to germinate on the mother plant resulting in elevated grain alpha-amylase before noticeable germination. While alpha-amylase is necessary for plant growth, premature starch digestion causes a decrease in flour quality resulting in cakes that fall and sticky bread and noodles. Much of the wheat grown in the inland Pacific Northwest is exported to Asia where the flour is used to bake specialty cakes requiring excellent quality. Currently, the industry standard used to detect high levels of alpha-amylase is the Hagberg-Perten falling numbers method which assesses the gelling capacity of flour by measuring the amount of time it takes for a weight to fall through a gravy. Growers receive a significant dockage on their payment for wheat with a low falling number (FN). Thus, we need wheat varieties less prone to low FN when rain occurs before harvest. While alpha-amylase is usually considered to be expressed after germination has occurred, previous work has shown that alpha-amylase levels are not always rigidly correlated with visible germination. Wheat varieties that express alpha-amylase later during germination may result in higher FN when it rains, without causing poor seedling growth. When this study measured alpha-amylase expression during germination time course experiments, varietal differences in the timing of alpha-amylase expression were observed. It is still unclear whether or not these differences are independent of seed dormancy. Moreover, the effect of different amounts of the dormancy-breaking treatment cold imbibition on alpha-amylase levels were examined. The results from this study will be used to identify traits and varieties of wheat that are less susceptible to end-quality problems and therefore reduce financial risk for growers.

Poster 13

Decreased Leaf Chlorophyll, Lateral Roots, and Biomass in Sudan Grass (Sorghum vulgare) when Colonized by Arbuscular Mycorrhizal Fungi and Fertilized

Undergraduate Researcher: Lucia Tilson, *Washington State University*

Co-Authors: Jeremy Jewell, Mahmoud Gargouri, Laura Bartley

Summer Research Program: NSF Plant Genome (Laura Bartley)

Abstract

Most terrestrial plants associate with soil fungi to regulate nutrient and carbon cycling. In one such association, called arbuscular mycorrhiza (AM), a fungus colonizes the cortical cells of roots and differentiates its hyphae into intracellular arbuscles and vesicles. Previous research has identified a relationship between nutrient availability and AM establishment, suggesting that lower nutrition may encourage endomycorrhiza-plant associations. In this experiment, Sudan grass (*Sorghum vulgare*) seeds received water fertilizer, fungal inoculant, both, or neither of these treatments. We used annual Sudan grass to model perennial switchgrass (*Panicum virgatum*), a highly productive biofuel crop. There was higher aboveground biomass, lateral root development, and leaf chlorophyll concentration in fertilized Sudan grass than in inoculated groups, suggesting that fungal inoculation negatively affected the seedlings. Fungi can direct nutrient supplies away from plants, but with further research to optimize the role of colonization in plant growth, fungi may direct nutrients toward plants later in their life cycle. Beneficial mycorrhizal fungi could improve the health and yields of Sorghum-related biofuel crops and serve as alternatives to ecologically harmful fertilizers.

Poster 14

Discerning Wheat Vascular Bundle Morphotypes to Advance Crop Resiliency in a Changing Climate

Undergraduate Researcher: Sophie LeBard, *Washington State University*

Co-Authors: Andrei Smertenko, Glenn Turner, Matt Cochran

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

Crop resiliency is crucial in the face of climate change and environmental stress on crop plants. Vascular bundles house the xylem and phloem cells which are necessary for water and nutrient movement along with the overall structure of the plant. The morphology of vascular bundles may determine the plants ability to withstand abiotic factors. The purpose of this experiment was to identify different morphotypes of vascular bundles based on the variation of size, structure, and arrangement within the plant. This experiment observed vascular bundle morphology in spring wheat landraces (*Triticum aestivum L*.) to identify how morphology may range between different genotypes. Utilizing various genotypes created a larger range of morphology to observe. This experiment looked at 31 different wheat landraces all planted on the same date and grown in a climate-controlled greenhouse where they were watered and monitored daily. When a landrace reached anthesis (when pollen was visible on the anthers), spikes were cut; measurements of height and number of internodes were collected. Dates of anthesis were also noted by how many days the plant took to reach anthesis based on planting date. In the lab, each stem was sectioned at the third internode from the bottom and a hand microtome was used to make cross-sections of the wheat stem. These cross-sections were dyed using Toluidine blue which stains the vascular tissues for easy observation. The stained sections were observed using a dissection microscope to identify and photograph the vascular bundles. In looking at the different landraces, varying sizes of vascular bundles were detected along with variations of xylem and phloem cells. The future of this experiment would be measuring the vascular bundles to find increased differences in size and what this might mean in the face of crop resiliency.

Poster 15

Overexpression of Osat9 Gene Increases Enzymatic Glucose Release in Rice Leaves

Undergraduate Researcher: Julia Johnson, *College of Wooster*

Co-Authors: Cheng Cheng, Niharika Nonavinakere Chandrakanth

Summer Research Program: NSF Plant Genome (Laura Bartley)

Abstract

As the ubiquitous use of fossil fuels continues to exacerbate global warming and affect our climate in unprecedented ways, new, carbon-neutral energy sources become an increasingly attractive alternative. To that end, breaking down plant biomass for use as biofuel has been proposed as an eco-friendly energy source. However, this method is currently very expensive and impractical for mainstream use; therefore, creating and utilizing biomass with more accessible sugars can economize biofuel production.

Characterizing the effects of *Ubi:OsAT9* transgenic lines in leaf and leaf-sheath tissues led to the hypothesis that these overexpressed lines would release less enzymatic glucose when compared to their wild-type counterparts, due to more robust cell walls decreasing glucose accessibility for enzymes. This is because the *AT9* gene is hypothesized to be a feruloyl-arabinoxylan transferase (FAT), which are known to facilitate the attachment of ferulic acid to cell walls, promoting crosslinking and enhanced wall strength.

Contrary to the hypothesis, the findings of biomass deconstruction in leaf samples show that overexpression of *OsAT9* resulted in increased enzymatic glucose release. However, the measurement of the amount of glucose in cellulose and other sugar monosaccharides in hemicellulose revealed no significant difference between the wild type and overexpressed *AT9* samples.

Further research is needed to understand the underlying reasons for the unexpected phenotype observed in the leaf samples. Ultimately, this study offers a promising avenue to enhance biofuel production through decreased cell wall strength and thus, increased enzymatic glucose release. This can contribute significantly to mitigating fossil fuel dependence and combating climate change.

Poster 16

Development of high throughput analysis of oil and protein in Brassicaceae for the advancement of plant breeding

Undergraduate Researcher: Abraham Baker, *Eastern Washington University*

Co-Authors: Matthew G. Garneau, Philip D. Bates

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

Oil seed crops, such as members of the *Brassicaceae* family, are among the most agronomically important agricultural products through their production of oil and protein which can be used for feedstuff, mechanical lubricants, and animal feed. Because of this important economic potential, developing high throughput methods for analyzing oil and protein content in a variety of oil seed producing species is essential for the breeding and engineering of these crops. Part of this project focused on developing effective and efficient protocols for high throughput oil and protein analysis in the model species *Arabadopsis thaliana*, and the agricultural crops *Thlaspi avernse* (pennycress), *Camelina sativa* (camelina), and *Brassica napus* (canola). High throughput oil analysis protocols were developed using Sodium Methoxide or methanol/sulfuric acid of ground and whole seeds, and then compared to the standardized lipid extraction and oil analysis procedures. These oil analysis methods are now being used to describe changes in oil and protein accumulation in the seeds of *Arabidopsis* lines overexpressing BADC2, which is a known regulator of fatty acid synthesis that may have important effects on both lipid and protein accumulation in seeds.

Poster 17

Testing of gene control elements for improved bioenergy crop sustainability

Undergraduate Researcher: Riley Evergreen, *Washington State University*

Co-Authors: Jeremy Jewell, Demeke Bayable, Laura Bartley

Summer Research Program: NSF Plant Genome (Laura Bartley)

Abstract

Switchgrass (*Panicum virgatum*) is a bioenergy crop, which could help replace traditional fossil fuels. This project is developing genetic tools to alter plant characteristics to support optimization of above and switchgrass tissues separately. As an example, lignin is a phenolic polymer produced by plants to increase both the structural and chemical resilience of cells. However, it can inhibit the conversion of plant shoots into fuel. Suberin is another polymer that acts to insulate plant cells from stresses and may promote soil carbon accumulation. An ideal crop would have decreased lignin in above-ground tissue and increased suberin in below-ground tissues. This project seeks to isolate root- and stem- specific promotors to direct the expression of genes in those tissues while minimizing alterations to the opposing tissues' gene expression. Public gene expression data was scanned and revealed genes with high expression in one tissue and low expression in the other, named p5, p6, p7, p1KG for root and p3NG, p7NG for shoot. We inserted the putative tissue-specific promoter sequences into a dual luciferase reporter plasmid and transfected the plasmids into cells extracted from roots or shoots from the model grass, rice (*Oryza sativa*). Thus far, all three root-specific promoters tested gave consistently higher expression in root cells compared to shoot cells. In the future, our project will develop transgenic switchgrass using these promotors to test if they work *in vivo*. These root- and shoot-specific promoters may be useful for altering tissue composition and controlling genes for other traits in an organ-specific manner, such as improving soil carbon sequestration while minimizing alterations to aboveground tissues and increasing biofuel yields.

Poster 18

Discerning Wheat Vascular Bundle Morphotypes to Advance Crop Resiliency in a Changing Climate

Undergraduate Researcher: Jakiyah Johnson, *Washington State University*

Co-Authors: Andrei Smertenko, Glenn Turner, Matt Cochran

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

Vascular bundles are an array of tissues within a plant that aid in structure, water, and sugar movement throughout the plant. Vascular bundles are made up of xylem, phloem, parenchyma cells, and the bundle sheath, which were the parts observed within the experiment. Vascular bundle size and strength can vary between plants due to many environmental factors, including drought and heat stress. The purpose of this experiment was to utilize the data found in order to visualize how certain locations and conditions of wheat can affect yield. This experiment's goal was to discern the differences in vascular bundles between various wheat genotypes. 31 total landraces of wheat were grown in a climate-controlled greenhouse with two plants per pot. Each pot had the same type and amount of soil, and were all located in the same area of the greenhouse. As the wheat began to come into anthesis, samples were taken into the lab and the dates of sampling were recorded, as well as length in centimeters and how many internodes the samples had. The samples were cut into 1-2 cm pieces from their third internode from the bottom of the stem, which sat in a fixative for preservation. When ready, we sliced cross sections using a hand microtome in order to observe the vascular bundles (and components of them) under a dissection microscope. The microscopic slices were stained with a Toluidine blue stain which aided in observation of the vascular bundles under the microscope. Photographs were taken of each sample to record the vascular bundle size differences and compare them against one another. In future studies and experiments, the bundles and its parts in the photographs should be measured in terms of length, width, and area to come to further conclusions on how environmental stresses can impact different wheat genotypes.

Poster 19

Overexpressing Osat9 Reduces Enzymatic Digestibility in Rice Straw

Undergraduate Researcher: Ellen Heyns, *University at Albany, SUNY*

Co-Authors: Niharika Nonavinakere Chandrakanth

Summer Research Program: NSF Plant Genome (Laura Bartley)

Abstract

Burning fossil fuels is responsible for trapping heat in Earth's atmosphere and heavily contributes to climate change. Biofuel is a renewable fuel made from biomass that is an environmentally friendly alternative. Enzymes deconstruct cell wall components into monosaccharides which are then converted into biofuels. Ferulic acid in grasses makes the cell wall stronger, impeding enzyme access to sugars. A subclade of the so-called BAHD gene in grasses functions to manipulate the ferulic acid content in the cell walls. This project aims to understand the function of the BAHD, OsAT9, by overexpressing the gene and analyzing its effects. In stem and straw biomass, it is hypothesized that transgenic samples will have decreased glucose levels compared to wild type after enzymatic deconstruction. Cellulose and monosaccharide analysis were run as follow-up investigatory experiments. Enzymatic deconstruction experiments showed that in straw tissue there was a significant decrease in glucose released in the transgenic compared to the wild type. Stem tissues had a similar trend but there was no significant difference. In the glucose released from cellulose, there was no significant difference but a trend that more glucose was released from the mutant samples. With the acid hydrolysis followed by hemicellulose sugar analysis there was no significant difference between the transgenic and wildtype lines, however, in both straw and stem tissues a common trend was more monosaccharide content in the wildtype than the transgenic samples. Understanding the mechanism of feruloylation in grasses will provide valuable information about the synthesis of plant cell walls to improve biorefining and ferulic acid applications. Replacing fossil fuels with renewable alternatives, like biofuels, is an important part of climate conversion and will greatly improve the condition of Earth's atmosphere.

Poster 20

Unraveling Yield Disparities: A Comprehensive Analysis of Yield Parameters in Crop Varieties

Undergraduate Researchers: Matthew Cochran, *Whitworth University*

Kajsa Winther, *Gonzaga University*

Co-Authors: Andrei Smertenko, Taras Nazarov, Glenn Turner, Jakiyah Johnson, Sophia Lebard

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

As climate change becomes a growing concern, there is uncertainty on how it may impact our agricultural systems and farms, as plants experience stress during periods of heat and drought. This stress can bring about negative consequences for a plant, and potentially reduce yield and impact availability to food systems. In this study, we attempt to investigate if there is any correlation between different phenotypes and overall yield of different varieties of wheat. We looked at weight per seed, total seed count and weight and yield per spike as well as seed morphology, which includes length, width and area measurements. Additionally, due to an increase of harmful reactive oxygen species (ROS) in heat and drought stressed plants, we also looked at peroxisomal abundance, due to their function as an ROS detoxifier. 30 different land races, or natural varieties of wheat with greatly varying genotypes and adaptations to different environments and climates, were selected for overall yield. These land races were then planted in plots in Lind and Othello, Washington. Once mature, the plants were harvested and weighed for total yield and individual spikes taken for further analysis using the parameters listed previously. Initial analysis of total yield correlation for all land races at both locations showed no significant results, however, by analyzing the top and bottom 5 performing varieties in Lind, there was a significant relationship between total yield and seed width. When looking over the top and bottom 10 land races, it was also apparent that most of the top yielding varieties were on the bottom 50% of peroxisomal abundance values. These results could suggest that starch availability is important for development and ultimately yield and that low peroxisome values indicate a plant is less stressed, maintaining a healthy ROS homeostasis and therefore allowing it to produce more effectively.

Poster 21

Salmonella and the Microbiome: How Metabolism plays a role in competition

Undergraduate Researcher: Samira Diaz De Leon, *Washington State University*

Co-Authors: Arden Baylink, Siena Glenn

Summer Research Program: Baylink Laboratory (Arden Baylink)

Abstract

Salmonella enterica causes 1.35 million infections in the United States each year. While most *Salmonella* infections are mild and self-resolving including symptoms like diarrhea and abdominal pain, a concerning 10-20% succumb to severe outcomes, including inflammation and gastrointestinal bleeding (GI). This project focuses on how *Salmonella's* growth is affected when competing against a diverse microbiota with different metabolisms. Examining the growth dynamics of a GI microbial community we isolated a series of diverse species that are members of the swine microbiome and grew them in the presence of an *S. enterica*. The 11 species I work with were isolated under hypoxic (1% oxygen) and normoxic conditions (20% oxygen). These 11 isolates make up what I termed a nanobiome, aiming to represent a portion of what the microbiome is like *in vitro*. Species isolated under hypoxic conditions are presumed anaerobe while species grown in normoxic conditions are presumed aerobic. I aimed to replicate the intestinal environment by culturing cells in fecal-enriched media and maintaining 37° C in a hypoxic atmosphere. Growth over 18 hours was tracked using absorbance and fluorescence to quantify the effects of the nanobiomes and invaders. A thorough analysis of cell growth was averaged theoretically and graphed to distinguish the activity of *S. enterica* competing with the microbiome. As a result, we discovered that the microbiome significantly reduces S. enterica, inhibiting it from out-competing the native microbes. Overall, these experiments give us an insight into the pathogen's colonization and assist in understanding the importance the microbiome plays in preventing infection.

Poster 22

Shock Response of Barium Fluoride (BaF2) in Planar Impact Experiments: Optical Properties Under Extreme Compression

Undergraduate Researcher: Matthew Shapiro, *University of Florida*

Co-Authors: Luke Hunter, James Hawreliak, Brian Jensen

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

The shock response of barium fluoride (BaF_2) has been determined at low pressures (<4 GPa). This project seeks to characterize the optical properties of BaF_2 under extreme conditions. Planar shock wave experiments were conducted on the Institute for Shock Physics powder gun using copper impactors up to velocities of 2.81 km/s. The target is comprised of a 1 mm-thick BaF_2 single crystal oriented in the [100] direction bonded to a ~3 mm-thick single crystal lithium fluoride (LiF) window, both 25 mm in diameter. Initial experiments indicate that the BaF_2 remains transparent under pressures of up to approximately 46 GPa under shock loading. Varying the impactor velocity in other experiments permits characterization of the material under extreme pressure and an understanding of the pressure-density, pressure-particle velocity, and pressure-refractive index relations. Rigorous study of these qualities will enable BaF_2 to be used as a window in future shock experiments, especially those involving high-density targets and/or greater pressure.

Poster 23

Navigating Uncertainty: Understanding Police Interactions and Scene Complexity Through Body-Worn Cameras

Undergraduate Researcher: Ethan Frisius, *University of Idaho*

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

Police interactions are dynamic in nature, both between and within situations, leading to significant uncertainty with how they unfold. Such is compounded by scene complexity as it increases the cognitive load of needing to be aware of developing situations and to ensure the safety of all those involved, consequently affecting officer decision-making. Though scene management is a foundational police training principle, there is limited discussion of it within literature and how these elements affect how a scene unfolds. This study looks at this gap, predominately focusing on welfare checks due to the established cognitive load. Using over 100 unredacted police body-worn camera videos from a mid-sized department, scene complexity was analyzed with a dual lens — law enforcement dynamics and external factors, such as bystanders and other first responders. Findings demonstrate how scenes vary and can influence officer decision-making, highlighting the cognitive load of scene complexity and that police-community interactions consider factors external to the immediate situation.

Poster 24

Analyzing the Effectiveness of Bio-Based Oils in Enhancing Dimensional Stability in Wood Fiber Composites

Undergraduate Researcher: Sofia Flores, *Harvey Mudd College*

Co-Authors: Avishek Chanda, Vikram Yadama

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

Wood has been widely used in various applications in the built environment. The demand for wood and wood-based composites has significantly increased with the recent need for carbon sequestration and environmentally friendly alternative materials. Although it has excellent strength-to-weight and stiffness-to-weight ratios, versatility, applicability, and machinability, one of the crucial issues with wood is its inherent hydrophilic nature, which results in low dimensional stability and low mechanical performance after exposure to moisture. Dimensional stability is necessary because of the increased demand for wood-based structures, which has led to a growing number of studies on different treatment procedures. The goal is to enable the use of wood and other natural fiber-based materials in internal and external applications of the built environment. Oil tempering, a traditional method for conditioning wooden structures, improves dimensional stability, increases life, and reduces moisture affinity. The current research aims to explore oil tempering on lab-produced wood strand composites by applying ideal oils to enhance dimensional stability. Although synthetic oils have shown promise, the aim is to achieve superior hydrophobicity using bio-based oils, thereby promoting the biodegradability and recyclability of the products. Through a detailed comparison of nine different bio-based oils effectively used to enhance the dimensional stability of wood and other lignocellulosic materials and a comprehensive ranking system, three top candidates were selected for testing. The candidates used for wood strands and strand-based composites were linseed, tung, and pyrolysis oil. The oils were maintained at the following temperatures for the treatment: ambient temperature, 80 °C, and 180 °C. Tempering times of 1, 5, 30, and 60 mins were required for each temperature. Therefore, for efficient analysis, StatEase®, a statistical tool, was deployed to develop the design of the experiment, in which the responses were plotted to understand the ideal oil, tempering time, and temperature. The reactions included oil uptake, water absorption, volumetric swelling, moisture exclusion efficiencies, and contact angle. The anticipation is that the oil uptake and contact angle in pyrolysis and linseed oil will be higher than in tung oil. In comprehending the effectiveness of the hydrophobicity of these bio-based oils, industries that focus on wood-based products can use this technique efficiently to make them dimensionally stable.

Poster 25

The Impact of Health Literacy and Health Communication Format on Health Information Navigation Performance Among Older Adults

Undergraduate Researcher: Yarithzi Ortiz, *Washington State University*

Co-Authors: Carolyn Pagan, Matteya Proctor, Maureen Schmitter-Edgecombe

Summer Research Program: Gerontechnology (Diane Cook and Maureen Schmitter-Edgecombe)

Abstract

Objective: Prior studies have found lower health literacy (HL) is associated with poorer internet health search behaviors among older adults. We examined how HL may interact with different formats of health communication (web-based and pamphlet-based) to influence performance on a Health Search Task (HST). We hypothesized that those with lower HL may be disproportionally negatively impacted by the web-based version compared to the pamphlet-based version.

Participants/Methods: Participants included 57 community-dwelling older adults (age: M = 70.79, SD = 8.61; 68.4% female; education: M = 15.72, SD = 2.32; global cognition > 26). Participants completed both web-based and pamphlet-based versions of the HST (counterbalanced for order and migraine versus diabetes form), a naturalistic measure of health navigation ability, and the Newest Vital Sign, a HL measure. Participants were matched on age, education, and gender (2:1 ratio), resulting in 38 participants categorized as having high HL and 19 as having low HL.

Results: A two (high/low HL) by two (pamphlet/web-based task) mixed factorial ANOVA revealed a significant main effect of HST form type, $F(1, 55) = 33.08$, effect size = .38, and HL level, $F(1, 55) = 6.71$, effect size = .11, on HST performance, but no significant interaction, $F(1, 55) = 0.14$, effect size < .01.

Conclusion: Findings suggest that while both groups performed more poorly on the web version of the HST and those with low HL performed more poorly on both HST tasks, there was no disproportionate deficit because of the more challenging web-based format. This suggests that web-based tasks do not widen the performance gap between participants with different HL levels. Future research can investigate how different formats of health-related tasks and HL levels may influence performance utilizing a more representative sample, aiding in development of more effective strategies for improving internet health information accessibility for older adults.

Poster 26

Performance, Crystallinity and Charge Lifetime in a Scalable Organic Solar Cell

Undergraduate Researcher: Sydney Pfleiger, *Linfield University*

Co-Authors: Atiq U. Rahman, Tanner M. Melody, Acacia Patterson, Brian A. Collins

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

Organic solar cells (OSCs) are an emerging form of solar energy which can generate high performance, low-cost solar cells compared to traditional technology. However, the large-scale production of OSCs is limited by traditional spin coating techniques which can't be scaled up. A scalable deposition method is roll to roll manufacturing. Here we study the performance, charge carrier lifetime and morphology of an analogue of roll to roll (blade coating) to determine the morphological characteristics which result in superior performance. The same performance can be achieved with blade coating compared to spin coating while the crystallinity is different. Transient photovoltage measurements will determine the impact of crystallinity on charge lifetime. Understanding and controlling the interplay of these factors will improve OSC technology to ultimately replace traditional solar energy.

Poster 27

Altered Minds, Altered Outcomes: Cognitive Impairment and the Dynamics of Police Escalation

Undergraduate Researcher: Sydney Pasciuto-Wood, *University of Oregon*

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

In the 1960s, increased costs for mental health care and advancements in medical care led to state hospitals being shut down and the deinstitutionalization of people with mental illnesses, leading to increased instability and a higher chance of encounters with police. In fact, 7-10% of police interactions involve those suspected of experiencing mental health issues. Preliminary evidence shows that police arrest people with mental illnesses more frequently than those without mental illness and those contacts are increasingly associated with non-criminal contacts (e.g., welfare checks and crisis contacts). Notably, there is a general lack of understanding of how police navigate those interactions and how to best support someone actively in crisis. This study aims to determine if the presence of a mental health crisis plays a role in verbal and physical escalation in law enforcement interactions. Data was collected from a random sample of over 100 unredacted police body-worn camera footage of welfare checks and suicide contacts from a medium-sized police agency in the Pacific Northwest. Using systematic social event modeling, this data was coded to examine observational cues associated with cognitive impairment, in addition to examining escalation by officers and citizens. These incidents were examined to determine to what extent cognitive impairment and escalation influence an interaction's result. Results suggest a myriad of different approaches taken by officers, including individual-level differences. The information learned through this study bridges a significant gap in the literature and for training the next generation of law enforcement.

Poster 28

Measuring the Impact of Temperature on Cognition Using Ecological Momentary Assessment

Undergraduate Researcher: Isabella Santiago, *Washington State University*

Co-Authors: Kimberly Meidenbauer, Maureen Schmitter-Edgecombe, Diane Cook

Summer Research Program: Gerontechnology (Diane Cook and Maureen Schmitter-Edgecombe)

Abstract

Ecological momentary assessment (EMA) is used to collect multiple data points over periods of time in participants' natural environments (Shiffman et al., 2008). Assessments highlight the participant's current mental states, allowing for a more accurate measurement of cognition, which is useful for assessing older adults' daily cognition. EMA methods can be used to measure cognition as a function of external environmental factors, such as temperature and thermal comfort. An n-back (NB) task has been adapted to fit onto a smartwatch, enabling the use of EMA to collect information on young adults' cognition across domains, including attention, memory, and executive functioning (Schmitter-Edgecombe et al.). Previous research has established that there is a known link between hot temperatures and impaired cognition (Luo et al., 2023;). Here, we test the association between reported thermal comfort, distracting temperatures, and NB performance in individuals' daily lives. NB performance was defined as 1) the number of correct responses on the task and 2) the number of trials attempted. In our analysis, we found that thermal comfort is related to both correct responses and the number of trials attempted by participants - as thermal comfort decreases, cognitive performance worsens. Additionally, temperature was one of the environmental distractors significantly predicting less accurate NB performance. Since we found these effects in a young adult population, we plan to examine this effect in older adults who have less effective thermoregulation and experience more thermal discomfort, and thus may be more affected by temperature. We suggest ways that results and methodologies used can inform the cognitive assessment of older adults and be used in the design and implementation of public health announcements and interventions.

Poster 29

Development of a Novel Four-Actuator Spin-Coating Device and Its Application in Studying the Optical Kerr Effect in PMMA Thin Films

Undergraduate Researcher: Mitchell Gale, *University of Delaware*

Co-Authors: Mark Kuzyk, Garrett Compton

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

In this study, we present the design and implementation of an innovative four-actuator spin-coating device equipped with precision-controlled syringes and an 8000 rpm rotor for uniform polymer film deposition. The system features integrated annealing and cooling functionalities using nickel-chromium wire radiation heating and a fan-assisted cooling mechanism, respectively. This advanced setup ensures high-quality, homogeneous thin films essential for various optical experiments.

We employed this spin-coating device to fabricate polymethyl methacrylate (PMMA) thin films for investigating the Optical Kerr Effect (OKE). The experiment involved using 450 nm semiconductor lasers as the pump and HeNe lasers as the probe. We focused on measuring the output intensities at the end of the film to demonstrate the Kerr effect in the polymer substrate.

Our experimental setup aims to observe the polarization rotation induced by the Kerr effect and measure the cross-phase modulation (XPM) coefficient. Our results demonstrated significant transient changes in the refractive index, confirming the Kerr effect in the spin-coated PMMA films. The high precision and reproducibility of our spin-coating device contributed to the reliability of the optical measurements. This work highlights the potential of our engineered spin-coating system for producing high-quality polymer films and its application in advanced optical studies, paving the way for future research in nonlinear optics and material science.

Poster 30

Effects of Electrode Size on Electrochemically Active Biofilm Response in Soil

Undergraduate Researcher: Dylan Peach, *University of Nevada, Reno*

Co-Authors: Christina Webster, Samuel Transtrum, Haluk Beyenal

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

Millions of microorganisms live in the soil and are crucial for energy transfer between living and non-living entities via nutrient cycling. The activity of the microorganisms in the soil can be monitored by looking at the current produced by electrochemically active bacteria (EAB) donating and accepting electrons. The EAB in the soil come together to form an electrochemically active biofilm (ECAB). The ECAB can attach to electrodes placed in soil and the ECAB transfers electrons to and from the electrodes during respiration. Three-electrode systems were placed into saturated soil reactors to be used as a proxy to quantify the health of finely sieved healthy soil, unhealthy soil, and store-bought soil. This study aims to determine if the size of the electrodes affects the time it takes for the ECAB to initially colonize the electrode and the time it takes to reach the peak amount of current that can be produced. It is hypothesized that there are no significant differences in response time from the ECAB that is dependent on the electrode sizes; therefore, electrodes with a smaller surface area can be used to have the same efficiency as a system with a large surface area for detecting ECAB in soil.

Poster 31

Intelligent Segmentation and Classification of Object Usage in Smart Environments Using MetaWear Sensors

Undergraduate Researcher: Wenjie Wang, *Washington State University*

Co-Authors: Regan Jenkins, Diane Cook

Summer Research Program: Gerontechnology (Diane Cook and Maureen Schmitter-Edgecombe)

Abstract

This research project focuses on the development and refinement of an Item Sensor system using MetaWear sensors to monitor and categorize object usage in smart home environments. The project involves several stages, including data collection, feature extraction, and supervised learning for classifying object usage as functional or non-functional. Initial efforts included the acquisition of raw data from participants, followed by data segmentation to define discrete usage periods, or "bouts." Features such as segment length, time of day, and object type were extracted to characterize each segment. The project addressed challenges such as differentiating between moving and still states of sensors and filtering erroneous sensor data. Feature engineering incorporated day-of-week encoding and mapping object identifiers to general object types to improve model generalization. A decision tree model was initially used to derive interpretable rules, with plans to explore more complex classifiers like random forests. Experiments aimed to maximize the number of labeled training examples and participants to ensure robust performance across varied object types. Performance metrics, including accuracy and F1 score, were generated to evaluate the classifiers. The project's findings contribute to the broader field of smart home automation by enhancing the understanding of object interaction patterns and improving the accuracy of activity recognition systems.

Poster 32

The First Impression: How Appearance Influences Police Interactions

Undergraduate Researcher: Alexandria Ray, *North Carolina Agricultural & Technical State University*

Co-Authors: David Alan Makin, Christina Shellabarger

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

Appearance plays a critical role in shaping perceptions and behaviors. Appearance is among the primary attributes informing our perceptual shorthand for how we think and feel about those attributes and, thus potentially, how we make decisions and treat those associated with those attributes. In policing, this body of research examines the influence of appearance on officer-level decision-making and its association with bias resulting from stereotypes and prejudices. However, within this research, there is a critical gap in that few studies examine the initial point of contact –how an officer interacts in the first few moments. This research investigates the influence of general appearance on the actions and behaviors of police officers. Using a random sample of 100 unredacted body-worn camera videos recorded by a mid-sized police agency in the Pacific Northwest, coders rated a series of scales on police professionalism, respect, fairness, dignity, and antagonism. Appearance is operationalized based on existing schema for safe and threatening attire, with results documenting if and how appearance influences officer professionalism. This study highlights the importance of police recognition in how biases resulting from citizen appearance may influence decision-making and communication.

Poster 33

Degenerate Biphoton Waveforms in the Heisenberg Langevin Picture

Undergraduate Researcher: Elinor Kay, *Smith College*

Co-Authors: Yefeng Mei, Fangyu Shang, Scott Hillen

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

Entangled photon pairs, known as biphotons, have a wide range of applications including quantum information processing, quantum sensing, and quantum communication. Narrowband biphotons with long coherence times are preferable for long-distance quantum communication and effective interactions with atomic systems. In this work, I first theoretically investigate the coherence time of biphotons protected by space-time symmetry using the Heisenberg-Langevin theory. In the case of nondegenerate biphoton generation, the coherence time is shortened due to absorption loss and dephasing. However, in the degenerate case, where each photon propagates in opposite directions with the same group velocity and absorption coefficient, the coherence time is protected by symmetry. When analyzing biphoton generation, there are two formalisms: the Interaction picture, which uses perturbation theory to study the impact of the interaction Hamiltonian on the system, and the Heisenberg-Langevin picture, which involves solving the coupled differential equations for field annihilation and creation operators. Current literature extensively covers nondegenerate biphoton generation using both the Interaction and Heisenberg-Langevin pictures. However, the generation of degenerate biphotons has only been studied using the Interaction picture. Here, we employ the Heisenberg-Langevin theory to examine the waveform of degenerate biphotons, where the Langevin noise preserves the commutation relationship between generated Stokes and anti-Stokes photons even in the presence of complex linear and nonlinear gain and loss. To experimentally validate our theory, we are preparing a cold atom system in a magneto-optical trap for biphoton generation via the four-wave mixing process. Cold atoms provide an ideal platform for studying narrowband biphoton generation due to their negligible Doppler broadening, long ground-state coherence time, and large optical depth. I have studied the theory of magneto-optical traps and developed various frequency locking schemes for external-cavity diode lasers. We will keep working on the ultrahigh vacuum system and eventually obtain the cold atoms.

Poster 34

Examining Consistency of Machine Learning Methods for Predicting Cognition using N-back Measures

Undergraduate Researcher: Jaehong Lee, *Washington State University*

Co-Authors: Shenghai Dai

Summer Research Program: Gerontechnology (Diane Cook and Maureen Schmitter-Edgecombe)

Abstract

Objective: Nowadays cognitive decline associated with aging has emerged as one of the growing public health concerns. It's imperative to find predictors that are associated with the onset of cognitive impairment. Machine learning algorithms are gaining attention for predicting cognitive functioning. While many studies have endorsed the accuracy of machine learning methods, very few examined their consistency in applications. This project comprehensively examines the accuracy and consistency of selected machine learning models in predicting cognition for older adults.

Method: Sample of the data included 158 community-dwelling older adults (72.4% female), of which 75 were healthy, 50 were with subjective cognitive decline (SCD), and 49 were with mild cognitive impairment (MCI). The participants completed the 1-week of n-back stimuli tests by guessing the correct shape appeared on the wearable smartwatch screens. Their performance on the n-back measures was used as predictors for their cognitive status. All data were analyzed using selected machine learning methods, including logistic regression, random forest, decision trees, naive Bayes, k-nearest neighbors, Ridge, LASSO, elastic net, and supporter vector machines. Consistency was examined using the newly proposed Bootstrapping-based approach while accuracy was evaluated using AUC and diagnostic statistics such as Youden index, sensitivity, and specificity.

Results: Ridge regression was the most consistent algorithm in the classification model with a 0.90 consistency rate, followed by LASSO (0.89) and Naive Bayes (0.84). Logistic regression was the most accurate algorithm with a 0.63 accuracy rate and an AUC value of 0.64, followed by Naive Bayes, LASSO, and elastic net.

Conclusion: There is no sole method superior in both accuracy and consistency. Selection of an optimal algorithm should be made with caution. More research is needed to further explore the performance of machine learning in prediction cognition.

Poster 35

Studying the Change of Polycyclic Aromatic Hydrocarbons (Pahs) and Nitro-pahs (Npahs) over the Years

Undergraduate Researcher: Tristen Wheaton, *Embry-Riddle Aeronautical University*

Co-Authors: Jun Meng

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

Polycyclic Aromatic Hydrocarbons (PAHs) and Nitro-Polycyclic Aromatic Hydrocarbons (NPAHs) are chemicals that are mostly found in coals, gas, and crude oil. These chemicals are harmful to people and are known to cause several diseases including cancer, obesity, and developmental issues in many children. For this research project, I conducted a literature review to find the ambient concentrations of certain chemicals called Fluoranthene and its derivative 2-Nitro Fluoranthene in the environment. Through this study, I found that there has been a big increase in both concentrations of these chemicals since 1990. Most of this increase tends to happen during the winter months when people need heating to counteract the natural chill outside. These findings suggest that the amount of pollutants found in the air are going to continue to increase at a problematic rate throughout the world, indicating a need to cut back the amount of emissions that humans are producing every day.

Poster 36

Emergent Viscosity in a 1D Bose-Einstein Condensate

Undergraduate Researcher: James Aygun, *Illinois State University*

Co-Authors: Michael McNeil Forbes

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

According to the classical hydrodynamic equations, when a classical fluid flows across a barrier, it will experience a drag force from viscosity in the fluid. The flow of a Bose-Einstein condensate on the other hand is usually described by the Gross-Pitaevskii equation, not classical hydrodynamics. The technical challenge comes from the fact that superfluids flowing in a ring can support a persistent current, if the flow is slow enough not to excite vortices. This can be seen from the topological property of the phase, which must wind by an integer multiple of 2 around the ring and can only unwind if a vortex moves from the inside to the outside. Locally this seems to imply that there is no viscosity or dissipation when a superfluid flows, but it seems from the simulations we are running in 1D that this may not be the case. One caution is that there can be viscosity in superfluids, although it is very small. This is one effect missing from the Gross-Pitaevskii equation; however, its absence makes the Gross-Pitaevskii equation a reasonable place to test other effects. We hypothesize that we can model the decay of the center of mass oscillations in a one dimensionally trapped Bose-Einstein condensate with a weak barrier as an emergent effective viscosity corresponding to hydrodynamic theory. Our insight is that in the classical hydrodynamic theory, this decay can be described as viscous dissipation. Understanding viscosity in a Bose-Einstein condensate might allow us to use cold-atom experiments as a platform for studying classical hydrodynamics, especially phenomena related to compressible turbulence.

Poster 37

Examining the Effects of Ambient Temperature on Cognitive Performance in Older Adults

Undergraduate Researcher: Phillip Stilson, *Washington State University*

Co-Authors: Kim Meidenbauer

Summer Research Program: Gerontechnology (Diane Cook and Maureen Schmitter-Edgecombe)

Abstract

Alzheimer's Disease and Related Dementias (ADRDs) are classified as diseases that create a loss in cognitive functioning, such as working memory, reasoning, and the ability to complete simple tasks and regulate emotions. Importantly, some studies have shown that higher temperatures are related to this decline in cognitive function (Hou, 2023). Many studies examining risks for heat-related illness have identified older adults, especially those with ADRD, as being at high risk for heat-related vulnerabilities due to their diminished thermoregulation capacity. Furthering research to understand this is critical for developing treatment and suitable interventions during extreme temperature events.

A popular methodology developed to capture real-time information on the experiences of people's lives is known as the Ecological Momentary Assessment (EMA). One of EMA's greatest strengths is its adaptability to different forms of technology (cell phones, smart watches, etc.). EMA can be programmed to prompt individuals to complete a number of tests and questions during everyday life, including cognitive tasks such as the n-back (NB). This methodology allows the user to respond when prompted at any point throughout the day for ongoing measurement of changes in cognitive function as a result of external factors. These tests also enable the examination of other factors that may affect their cognitive abilities, such as emotions or distractions.

To understand the relationship between heat and cognition, this study will analyze the link between ambient temperature (using home temperature monitors) and cognitive functioning (via EMA smartwatches) in a real-world setting. We hypothesize that exposure to hotter ambient temperatures will be associated with worse performance on the n-back task. Testing this in older adult's daily lives will provide more contextual information about heat's effect on cognitive function in a high-risk population.

Poster 38

Empathy in Action: Analyzing Officer-Community Interactions During Welfare Checks

Undergraduate Researcher: Paige Yedinak, *Washington State University*

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

In the wake of tragic events like the murder of Kelly Thomas, it is clear that police responses to crisis situations need to improve. Despite their critical role, officers often lack effective training or support for managing these interactions. Over the past decade, police officers have increasingly served as the primary response to those in crisis, with increasing calls to minimize their response by transferring those contacts to more appropriate service providers. While types of calls to law enforcement vary immensely, when an officer responds to a crisis, these calls should reflect a caretaking function. Despite this responsibility, there remains a lack of research examining how police respond to and manage these interactions. Using a random sample of over 100 unredacted body-worn camera videos of welfare checks from a mid-size police agency in the Pacific Northwest, this research applies systematic social event modeling (SSEM) to isolate the presence of negative emotionality and cognitive functioning, as well as the prevalence of active listening skills, sympathy, empathy, and rapport building from the law enforcement officer. By isolating the behaviors and actions of those in crisis and the officer's response, this research contributes to the foundation for improving crisis resolution skills, which has the potential to mitigate the escalation of these calls into instances of brutality and tragedy, many of which begin with a simple request for help.

Poster 39

Mechanical Performance of Thermally Modified CLT Connections

Undergraduate Researcher: Johannes Darnell, *Washington State University*

Co-Authors: Pouria Bahmani, Ashish Shrestha, Hui Li, Karl Englund

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

Heat treatment significantly affects the mechanical properties of wood. It has been shown that thermal treatment of wood increases dimensional stability and lower equilibrium moisture content (EMC) compared to untreated lumber, mitigating moisture-related internal stresses and enabling tighter tolerances during joint fabrication and facilitating modular construction. Although the behavior of thermally modified lumber is well-documented, little work to date has been done regarding the mechanical behavior of CLT panels manufactured from thermally modified lumber. Current predictive equations in the *National Design Specification (NDS) for Wood Construction* for lateral resistance and dowel bearing do not account the effect of thermal modification on the mechanical behavior of wood. In addition, no research has been conducted to investigate the mechanical performance of thermally modified CLT (TMCLT) made from coastal Western Hemlock despite the prevalence of the species in the Pacific Northwest. To this end, 40 TMCLT panels manufactured from thermally modified Western Hemlock lumber were selected and assigned to test regimes based on panel bond quality and presence of defects. Dowel bearing perpendicular- and parallel-to-grain for dowel diameter of 1/8", ¼", 3/8" were determined per ASTM D5765-24 standard. Test results were compared to NDS predictions for lateral resistance and dowel bearing in lumber and CLT.

Poster 40

Examining the relationship between error monitoring, mood, and trait neuroticism

Undergraduate Researcher: Emma Flodin, *Washington State University*

Co-Authors: Nicole Whiteley, Maureen Schmitter-Edgecombe

Summer Research Program: Gerontechnology (Diane Cook and Maureen Schmitter-Edgecombe)

Abstract

Objective: Error-monitoring (EM), or the ability to recognize one's errors, is important for correction of mistakes in everyday life. Objective EM refers to an individual's ability to accurately recognize an error, while subjective EM is an individual's perceived success in recognizing errors. We examined the relationship between subjective and objective EM, and state and trait characteristics. We hypothesize that anxiety, depression, and fatigue will be significantly related to subjective EM, and that neuroticism will be associated with objective EM.

Participants and Methods: Ninety-eight midlife and older adults (age M = 69.95 SD = 8.43; 78% female; M education = 16.62, SD = 2.25) completed self-report measures of depression, fatigue, and anxiety. Trait anxiety was measured using a neuroticism scale. A sustained attention measure was modified to capture objective EM (Sustained Attention to Response Task; SART), such that participants verbally indicated when they committed an error, and microslips were observed (i.e., participants physically caught themselves before fully committing an error). Participants were also asked to rate their estimated EM abilities before and after the SART, to measure subjective EM.

Results: Multiple regression analyses revealed lower anxiety predicted more microslips (b = -.57, t = -2.24, p = .03) above and beyond age, while depression, fatigue and neuroticism did not. Although the model was not significant, higher ratings of fatigue predicted bigger subjective EM differences (b = .37, t = 3.19, p = .002). The model was not significant for objective EM, nor were any of the predictors significant.

Discussion: The findings revealed better ability to catch partial errors in those with lower levels of anxiety. Higher self-reported fatigue also resulted in less consistent subjective EM predictions. This suggests that a temporary state of heightened anxiety or fatigue may negatively impact real world error monitoring abilities.

Poster 41

Aggregation and Stability Behavior of Tire and Road Wear Particles in Different Water Environments from Stormwater Runoff

Undergraduate Researcher: Joana Ventura, *Sinclair Community College*

Co-Authors: Rayeed Ahmed, Tim Ginn, Indranil Chowdhury

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

There has been a growing concern for the impact of microplastics (size range 1-5000 μm) and nanoplastics (<1 μm) derived from tire and road wear particles (TRWPs) upon entering the aquatic environment through stormwater runoff from highways. TRWPs contain harmful additives that leach into water bodies and cause lethal mortality among aquatic life. The fate and transport of such harmful microplastics and particularly nanoscale TRWPs is vastly unknown. The objective of this study is to assess the varying stability and aggregation behaviors of TRWPs in various water types. By studying the colloidal stability of TRWPs in simulated rainwater, groundwater, surface water, seawater, and wastewater the fate of TRWPs can be deduced in natural bodies of water as well as the aqueous transport of these particles. Aggregation behavior of TRWPs in simulated waters was analyzed through changes in particle size, zeta potential, and concentration over time. The critical coagulation concentration (CCC) value observed for MgCl2 (3mM) showed higher aggregation in comparison to NaCl (200mM) indicating that CaCl2 and higher salinity solutions will destabilize TRWPs more aggressively. Preliminary results in simulated rainwater and groundwater have shown minimal aggregation indicating that TRWPs will be highly mobile in stormwater runoff. It is anticipated that wastewater and sea water will have higher aggregation, while surface water will have minimal aggregation due to low salinity. By improved understanding how and where TRWPs are reaching in the aquatic environment, advanced mitigation practices can be implemented to reduce the harmful effects of TRWPs on the environment.

Poster 42

A Conversation Beyond Words: Examining Police Perceptions, Implicit & Explicit Bias as it Pertains to Body Language & Police Interaction

Undergraduate Researcher: Jayden Smith, *Prairie View A&M University*

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

With the advent of modern technology, society has been increasingly aware of breakdowns in police-community communication, both generally and within specific interactions, consequently creating tense relationships. As most communication between individuals is non-verbal, it is essential to look at these aspects to understand a holistic view of message conveyance and comprehension, especially given its impact on perception. This study serves as an initial investigation of citizen nonverbal communication— signs of cognitive impairment, physical injury, and general bodily behavior— can influence police interactions. Using systematic social event modeling, this study used over 100 unredacted police body-worn camera videos from a mid-sized agency in the Pacific Northwest. Specifically, the sample focused on crisis contacts due to an increased likelihood of emotional expression, and consequently, nonverbal communication. The results will highlight the variability in citizen body language within a police interaction and seek to uncover how such may influence police behavior.

Poster 43

Gallium Oxide Doped With Zinc and It's Defects at Low Temperatures

Undergraduate Researcher: Noah Shevy, *Northern Michigan University*

Co-Authors: Matthew D. McCluskey, Julianne Miller

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

Gallium Oxide (Ga_2O_3) is a semiconductor that has been getting a lot of attention in the past few years. Its large band gap (4.8 eV) is very useful in photovoltaics as it leads to a low capacitance and high energy output. Most dopants in Ga_2O_3 make the material n-type which means that it has extra donors. Ga_2O_3 doped with Zinc (Ga_2O_3:Zn) has never been studied with varying temperatures. The experiment that follows shows the results of measuring the spectroscopy of the material at different temperatures. By using Fourier Transform Infrared spectroscopy (FTIR), we were able to probe the material by shining variable frequencies of infrared light at a sample and measured the absorbance. This method tells us what impurities are in the sample by displaying peaks at the frequencies of light where it is absorbed by the sample. By knowing what frequencies are absorbed, we can tell the frequency of the vibrational mode between the sample and the impurities. With increasing temperature, the distance of the perturbing atom, Oxygen, from the origin (d) increases. Since the probability of the Oxygen atoms overlapping with the d-orbital of the Iridium (Ir) atoms increases with increasing d, we expect stronger absorbance, meaning a stronger Ir peak, with increasing temperature. This effect also shifts the peak as it changes the frequency of the vibrational modes. For the Iridium defect peak we observed a shift in frequency from 5148.4 cm^{-1} to 5151.1 cm^{-1}. For this experiment we were also looking at the Zinc Hydrogen (Zn-H) vibrational mode which occurs at a frequency of around 3480 cm^{-1}, and we observed a shift in the vibrational frequency of the Zn-H bond from 3487.2 cm^{-1} to 3472.9 cm^{-1}. This shift was seen in a temperature range of 20 Kelvin to 220 Kelvin respectively for both experiments.

Poster 44

Binary Mass Fraction in Open Clusters

Undergraduate Researcher: Kianna Cabral, *Northeastern University*

Co-Authors: Guy Worthey

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

Most stars in the Universe evolve in binary systems, where two gravitationally bound stars orbit around a mutual center of mass. Studying this type of system is essential for our understanding of star formation and evolution, as well as tracing the history of our galaxy. In this research, we investigate the binary mass fraction distribution of various open clusters in the Milky Way. By data mining Gaia DR3 astrometry— a rich catalogue of the Milky Way— we collect information such as position, proper motion, and parallax of the stars situated near the clusters. We determine the probability of cluster membership for each star, be it single or double, using Maximum Likelihood Estimation. Then we model the observed binary mass ratio distribution with a power law. We estimate the binary fraction and the power law exponent from the cluster Color-Magnitude diagrams.

We find that, in every cluster, equal mass binary fraction is more likely to occur than unequal mass. This observation constrains theories of star and planet formation.

Poster 45

Within the Boundaries of the Law: Investigating Officer Decision-making in Escalating Situations

Undergraduate Researcher: Lillian Petris, *Washington State University*

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

Following the murder of George Floyd, which galvanized public outrage and sparked widespread calls for reform, the use of force by law enforcement officers has become a pressing concern, with policymakers and researchers alike seeking to develop more effective and equitable strategies for policing. As situations begin to escalate, police officers are required to utilize their legal discretion to navigate a potentially dangerous situation. In doing so, an officer must meet the perceived level of threat perpetrated from the person of interest by responding with a reasonable level of force. Situational factors expand a police officer's options to respond with both fatal and non-fatal types of force, and thus how they effectively handle the dangerous situation at hand. To explore such incidents, the analysis is conducted using a random sample of over 100 unredacted police body-worn camera (BWC) footage of welfare checks and suicide calls from a medium-sized agency in the Pacific Northwest between the timeframe of January and June 2024. Systematic social event modeling (SSEM) is applied to capture how a citizen's threat and resistance levels, along with the addition of officers, influence the types of force used in an escalating situation. The results shed light on how police officers navigate escalating situations based on perceived threat and situational factors.

Poster 46

Evaluation of Trait Changes Across Three Consecutive Weeks in the WSU Apple Breeding Program Phase 2 Accessions

Undergraduate Researcher: Libbie Moore, *Wenatchee Valley College*

Summer Research Program: Agricultural Data Science (Sindhuja Sankaran)

Abstract

Evaluating changes in fruit maturity and quality traits across multiple harvests is crucial in understanding new apple selections. This study focuses on the Washington State University Apple Breeding Program Phase 2 accessions, assessing variations in specific fruit traits over three consecutive weeks of harvest. In 2021 and 2022, a five-fruit sample was collected from each accession using a target Index of Absorbance Difference (I_{AD}) value of I_{AD}±0.1, with the target I_{AD} decreasing by 0.1 for each of three consecutive weekly picks. Samples were placed in storage for two months at 4°C. When each sample was removed from storage, non-destructive (I_{AD}), and destructive measures of starch rating, Soluble Solids Content (SSC), Titratable Acidity (TA), and firmness were collected from the fruit. Averages and standard errors were calculated for all measures of each five-fruit sample from each pick. Comparative analysis and visualization using bar graphs were utilized to evaluate trait changes. As fruit ripens, I_{AD}, firmness and TA are expected to decrease, while starch rating and SSC are expected to increase. Initial observations indicate that each trait within an accession responds differently to the three-week harvest window. For example, in accession 312 the I_{AD}, firmness and TA decreased, while the starch rating increased, and SSC remained relatively constant across the three picks. In accession 349, the values of the traits across all three picks remained relatively constant with the exceptions of TA which decreased in 2021, and firmness which increased in 2022. Evaluating changes in traits over three consecutive picks across different years highlights the stability of certain traits, which provides more insight into the Phase 2 accessions of the WSU Apple Breeding Program.

Poster 47

Transcriptomic approach to unveil the molecular basis underlying apple sunscald development during cold storage

Undergraduate Researcher: Abdur Islam, *Washington State University*

Co-Authors: Huiting Zhang, Stephen Ficklin

Summer Research Program: Agricultural Data Science (Sindhuja Sankaran)

Abstract

Sunscald is a major post-harvest physiological disorder in apples that is induced in cold storage after apples have been exposed to high heat and sun prior to harvest. It results in browning both on the peel and in the cortex of the fruit. The objective of this study was to find genes that contribute to the development of sunscald and provide hypotheses about their biological roles. Peel tissue samples were collected from the sun side and shade side of apples at different weeks during development and RNA was extracted and sequenced (RNA-seq). We used the GEMmaker workflow to quantify gene expression levels and used the EdgeR (R module) to identify differentially expressed genes (DEGs). Functional enrichment analysis was performed on the list of DEGs to indicate potential functional roles of these genes. A list of 113 DEGs were found in sun samples compared to the shade samples. Those DEGs are enriched in functions such as proline degradation and Abscisic acid biosynthesis, which are well known stress response pathways in plant. With the list of genes and their function, this research can be expanded on by finding the different biological systems and involvement in these processes. Further investigation into the function of these genes will give us insight into how those genes play a role in the onset and development of sunscald and lead towards the prevention of this disorder by manipulating those pathways in apples in cold storage.

Poster 48

Relationship of Phenomics and Agronomics on Irrigated Spring Wheat

Undergraduate Researcher: Lucy Goracke, *Oregon State University*

Co-Authors: Peter Schmuker, Sheri Rynearson, Chamaporn Paiboonvorachat, Milton Valencia Ortiz, Kesaven Veloo, Sindhuja Sankaran, Michael Pumphrey

Summer Research Program: Agricultural Data Science (Sindhuja Sankaran)

Abstract

With the rise of high throughput phenotyping, interest regarding the relationship between phenomic and agronomic data has grown within agricultural research. The study of phenomic data can help paint a picture of what occurs during plant growth and development, a portion of the story that may be overlooked when only agronomic end traits are used to assess variety/trial output. To better understand this relationship, we used two years of data from a spring wheat trial that included three irrigation treatments. Six genotypes were grown, three hard red varieties and three soft white varieties. Phenomics data include four weekly NDVI measurements and two timepoints of photosynthesis measurements. Three agronomic end traits: yield, protein content, and yield/protein deviation were measured at harvest. The greatest correlation between phenomic and agronomic traits were determined to select the most representative date for both NDVI and photosynthesis measurements within each year. After establishing the most representative dates for each year, we further broke down the analysis to look at the impact of irrigation treatments on each selected date. When assessing the relationship between the phenomic data at our selected timepoint and agronomic data within each irrigation level, we found the association between phenomic and agronomic data was generally reduced. This suggests that the initial high correlation between the phenomic data timepoints and the agronomic data had more to do with management practices than genotype performance within each irrigation regimen.

Poster 49

Analysis of Multispectral Pipelines

Undergraduate Researcher: Savannah Pluma, *University of California, Davis*

Co-Authors: Arron Carter, Melinda Zubrod

Summer Research Program: Agricultural Data Science (Sindhuja Sankaran)

Abstract

A multispectral analysis pipeline is a specific set of methods and softwares used to collect, process, and analyze data from a multispectral sensor. A study comparing multispectral image analysis pipelines found that vegetative index values from the WSU winter wheat breeding pipeline and Texas A&M University (TAMU) image analysis pipeline were statistically different. As such, the objective of this project is to further evaluate the similarities and differences of index values produced by these pipelines by calculating Pearson correlation coefficients, analyzing if the rank of each variety changes, and assessing if these pipelines have the same predictive power. The data used in this study was collected during the heading stage of winter wheat in 2023 in Walla Walla, Washington using a Sentera 6X multispectral sensor mounted on a DJI Inspire 2 roto copter. The indices compared were Normalized Difference Vegetation Index (NDVI) and Normalized Difference Red Edge (NDRE). Each pipeline was assessed for its effects on the rank and prediction power of different lines. Using R, Pearson correlation coefficients were calculated to analyze similarities of index values from each pipeline resulting in a Pearson correlation coefficient of 0.95 for NDVI and 0.98 for NDRE. Pearson correlation coefficients were also calculated between each index and yield to assess the predictive power of the different pipelines, this resulted in similar Pearson correlation coefficients across all treatments. These results suggest that the predictive power of the vegetative indices calculated from each pipeline is not affected by the pipeline. Index values may be scaled differently due to calibration processes of different pipelines producing values that are statistically different but have the same predictive power.

Poster 50

Deep Learning with Synthetic Aperture Radar

Undergraduate Researcher: Zubair Rashaad, *University of Texas at Arlington*

Co-Authors: Mohammed Amine Gharsallaoui, Subhanshu Gupta

Summer Research Program: Agricultural Data Science (Sindhuja Sankaran)

Abstract

We design a Convolutional Neural Network (CNN) to accurately classify multi-class Synthetic Aperture Radar (SAR) imagery. SAR is a remote sensing technology which uses antennas that move around a specified target area. While the antenna moves, it takes many radar 'snapshots' of the target. The raw captured SAR data is then processed to form high resolution images. One of the biggest advantages of SAR imagery is that it can combat any weather situation, such as clouds and can also work at night. Our objective is to design a CNN architecture with a complexity of O(nlogn), which is significantly lower than the typical complexity of O(n2) for similar tasks, while striving to maintain high accuracy. We pre-process the SAR data using noise speckling, histogram equalization, and normalization to enhance the quality of the input data. Our CNN architecture consists of convolution layers, max pooling, batch normalization, and fully connected layers, with the softmax activation function used for multi-class classification. We evaluate our CNN, achieving an accuracy of 87%. We aim to further optimize our model's architecture to reach the desired complexity while improving the accuracy to 93%. To achieve this, we propose incorporating additional pre-processing steps such as Fast Fourier Transform (FFT) and Wavelet Transform, which help extract relevant features and reduce the complexity of the CNN's task. By optimizing the balance between complexity and accuracy, our work contributes to the advancement of efficient and reliable CNN-based classification techniques for SAR imagery. The development of a CNN architecture with reduced complexity has the potential to revolutionize SAR image analysis. It enables faster processing times, lower computational costs, and improved real-time performance, making it suitable for a wide range of applications such as crop health monitoring, environmental monitoring and disaster response.

Poster 51

Phenomic Tools in Raspberry Breeding: color Perception and Ai-driven Strategies for Enhancing Breeder Adoption

Undergraduate Researcher: Roslyn Willoughby, *Washington State University*

Co-Authors: Sindhuja Sankaran, Lisa Wasko DeVetter

Summer Research Program: Agricultural Data Science (Sindhuja Sankaran)

Abstract

Field phenomics offers a promising avenue for accelerating the development of high-performing raspberry genotypes. Numerous studies provide valuable insights into improved crop performance through selective breeding techniques and advanced sensing methods. However, these approaches often face challenges due to a lack of return on investment (RoI) and knowledge transfer for stakeholders not directly involved in the phenomics field. Bridging this gap requires a coordinated effort to develop dynamic knowledge strategies and open-access data platforms that can democratize phenomics research.

We propose using The Phenomics Guide, a finetuned large language model (LLM), to educate and advocate breeders for phenomics tools in raspberry breeding. We will assess breeders' attitudes towards these tools before and after the LLM interaction to gauge the effectiveness of AI knowledge transfer. This project aims to bridge the knowledge gap and promote the widespread adoption of phenomics tools in raspberry breeding.

We used a Python algorithm to identify berries and extract average red, green, and blue (RGB) values. We then grouped a dataset of 400 raspberries and their respective RGB values by genotype. After grouping, we ran an ANOVA to determine statistically significant differences between the mean RGB values of the eight genotypes. To demonstrate the significance of phenomic tools, we compared the color assessment abilities of breeders and non-breeders using the extracted RGB values. Participants were asked to determine the amount of red, green, and blue in the provided images.

We hypothesized that breeders would outperform non-breeders in color assessment. We anticipated that the percentage of errors made by breeders in assessing RGB values of raspberry color would exceed the maximum allowable error margin, adversely affecting profitability. By leveraging AI-driven tools, we aim to enhance the precision and profitability of raspberry breeding through advanced phenomics techniques.

Poster 52

Supermassive Black Holes in Nuclear Star Clusters

Undergraduate Researcher: Julia Jitkov, *Washington State University*

Co-Authors: Vivienne Baldassare

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

I will present a search for spectroscopic evidence of supermassive black holes (SMBHs) in a sample of low-mass galaxies with nuclear star clusters (NSC). It was previously thought that NSCs and SMBHs were mutually exclusive, but it is now theorized that NSCs may facilitate the formation of a SMBH. I am analyzing 49 galaxies that have preliminary X-ray evidence for a SMBH in a NSC, from Baldassare et al. 2022. I'm looking for optical and infrared signatures that indicate photoionization from an active SMBH. Preliminary analysis shows that about 30% of these objects have optical spectroscopic evidence for a SMBH, while only 3% of the galaxies show infrared evidence. If we find emission lines characteristic of a BH in these galaxies, we will strongly increase the number of galaxies known to contain both a SMBH and NSC and improve our understanding of how SMBHs form.

Poster 53

Optimizing Biofilm Propagation and Hydrogen Production in Microbial Electrolysis Cells: Impact of Applied Potentials

Undergraduate Researcher: Samuel Transtrum, *Arizona State University*

Co-Authors: Mohamad Abdallah, Christina Webster, Haluk Beyenal, Dylan Peach

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

The microbial electrolysis cell (MEC) is one of the most promising technologies in current wastewater treatment research due to its low energetic demand and efficient hydrogen production capabilities. MECs take advantage of electrochemically active bacteria, which have the ability to donate to and accept electrons from redox-active substances outside their cells. These bacteria grow as a biofilm on the MEC's electrodes. By applying a voltage to the electrodes, electrons can be harvested from the bacteria and used to produce hydrogen gas, making MECs a promising source of renewable energy. One of the biggest bottlenecks in microbial electrochemistry research is biofilm propagation time. By measuring the generated current with respect to time, one can monitor how quickly the reactors' colonies reach their full metabolic capacity at different applied potentials. The MECs used are three-electrode systems submerged in real effluent. Using a mixed culture of electrochemically active bacteria, voltages of -100 mV, 100 mV , 300 mV, and 400 mV (vs. Ag/AgCl) were applied to separate, identical MECs. The expectation is for certain applied potentials to generate a high current more quickly than others. Future research is needed to establish the feasibility of implementing this technology in real wastewater treatment plants.

Poster 54

Communicating Through Crisis: How Language Barriers Impact Police Interactions

Undergraduate Researcher: Joanna Rodriguez Sanchez, *California State University of San Marcos*

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

Effective communication is a cornerstone to delivering police services, failure to communicate effectively can reduce police legitimacy and impede properly servicing the community. Approximately 7 to 10 percent of the population display Limited English Proficiency (LEP), which may vary considerably depending on the community. In response, research demonstrated critical gaps at the intersection of public safety and public health, specifically concerning how police navigate language barriers when providing services.This research investigates police-community interactions when language barriers are present to understand how officers navigate these interactions. Using a random sample of over 100 unredacted police body-worn camera (BWC) footage from a participant agency in the Pacific Northwest, using systematic social event modeling (SSEM) welfare checks and crisis contacts were analyzed due to the compounding effect of communication efficiency and emotionality. The data collected considered the presence of a language barrier, officer response to an identified language barrier, type of response, and the effectiveness of the response, with a purpose to understand how police adapt to such communication barriers. Results of this study reveal the frequency, nature, and duration associated with the presence of LEP when providing services. That can affect interactions and community relationships and analyzes how police can adapt to better serve their communities.

Poster 55

Improving the Sensitivity of LIGO Searches to Binary Black Hole Signals with Smarter Detection Algorithms

Undergraduate Researcher: Jaxson Mitchell, *Embry-Riddle Aeronautical University*

Co-Authors: Sukanta Bose

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

Einstein's theory of general relativity predicts the existence of gravitational waves which are ripples in space and time. Gravitational waves form, e.g., from collisions of compact objects such as black holes and neutron stars. The ripples from these astrophysical mergers are detected within LIGO. In the search for these signals, matched filtering is employed which compares the signal to theoretical predictions from general relativity. This technique relies on using a bank of many different precomputed signals to detect gravitational waves which becomes computationally burdensome. Another downside of this technique lies in the fact it does not work well with glitches, noise that is from the detector or environment. Instead, we study the use of a different algorithm, singular value decomposition (SVD), to replace the large bank by creating an approximate waveform basis. This speeds up computation by using a basis of waveforms instead of a densely packed template bank. Using this new basis also enables the analysis of common glitches within the LIGO detector by creating a basis of vectors that describe the primary behavior of the glitch. Specifically, we focus on the blip glitch in intermediate mass binary black hole (BBH) systems and analyze noise through SVD. We estimate how much improvement this brings about to the sensitivity of LIGO searches to BBH signals.

Poster 56

Measurement and Characterization of Gaseous Emissions from Green Waste Composting

Undergraduate Researcher: Jacob Shiller, *Pitzer College*

Co-Authors: Tom Jobson, Adeniyi Adesina

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

Washington's organic materials management law requires diversion of biodegradable organic waste such as food and wood waste from landfills to other management systems such as composting to reduce greenhouse gas emissions. However, compost expansion is potentially restricted by air emission permitting needs. Composting is thought to be a major emission source of Green House Gases (GHG) and pollutants regulated by the Clean Air Act such as Volatile Organic Compounds (VOCs), some of which are also regulated as Toxic Air Pollutants (TAPS). But there is very limited data on actual mass emission rates and emission factors needed for regulation decisions. Therefore, the characterization and measurement of composting emissions are essential for improved air permitting information and accounting of greenhouse gas emission to mitigate radiative forcing of climate. For this study, multiple sampling and analytical methods were employed to detect VOCs and GHG emitted from negative aerated compost piles containing mixture of green waste (yard waste) and pre-consumer food waste. Preliminary research shows measurements from duct air pulled from the piles dominating emission profiles (91.7 - 99.8 wt.%), as opposed to surface flux emissions. For GHGs large N_2O fluxes, up to ~18500 mg hr^{-1}, were observed during the mesophilic stage of composting. This gives N_2O a larger overall by mass CO_{2e} compared with CH_4. Further work will examine what VOCs are emitted, their emission rates and emission factors to assess at what scale of feedstock throughput a composting facility would be considered a major air pollution source.

Poster 57

Examining behaviors from law enforcement during mental health crises: a study of body-worn camera footage

Undergraduate Researcher: Archana Sathiyamoorthy, *University of Maryland*

Co-Authors: Christina Shellabarger

Summer Research Program: Studying Race and Policing in the Complex Social Interactions Lab (Dale Willits)

Abstract

The deinstitutionalization movement in the United States was the catalyst for discussions surrounding the way that law enforcement interacts with individuals experiencing mental health crises. This has been coupled with the understanding that mental health crises extend beyond populations experiencing severe mental illness and can involve anyone in a heightened emotional or cognitive state. When handling individuals in crisis, officers may misconstrue certain behaviors as an escalation and change their manner of behavior in a crisis. The current study examines how officer behavior is influenced by the community member's perceived crisis state. This study analyzes a random sample of over 100 unredacted police body-worn camera videos from a mid-sized agency in the Pacific Northwest. The sample consisted predominately of welfare checks due to the increased probability of these calls including an individual exhibiting crisis behavior. Perceived crisis levels were determined by expressions of cognitive functioning and emotional expression, while officer behaviors include both procedural and interpersonal conduct. These results shed light on what factors influence officer behavior during crisis responses and can work towards improving crisis resolution training.

Poster 58

The Association Between Cognitive Abilities and In-home Naturalistic Behaviors

Undergraduate Researcher: Michael Wooden, *Washington State University*

Co-Authors: Regan Jenkins, Keira Monaghan, Maureen Schmitter-Edgecombe

Summer Research Program: Gerontechnology (Diane Cook and Maureen Schmitter-Edgecombe)

Abstract

Introduction: Across a continuum of cognitive difficulties, older adults can experience challenges and difficulties in their ability to complete everyday tasks. We hypothesized that poorer cognitive performance will be associated with more objectively observed difficulties as older adults' complete everyday tasks in their own home environment.

Methods: Data was collected from 28 older adults across a continuum of cognition (*M* age = 74.43, *SD* = 8.42; *M* education = 15.89 years, *SD* = 2.28, % female = 71.4) with an in-home neuropsychological assessment. Age-corrected measures of immediate memory, visuospatial/constructional abilities, language, attention, delayed memory, executive functioning and working memory were derived. Naturalistic observations were conducted with minimal intervention. Participants were instructed to engage in everyday activities. Operational codes were developed to systematically code behaviors as individuals completed everyday tasks. These codes included multitasking, risk, socialization, self-monitoring and self-correction, hesitancies, microslips and optimizing strategy use. Bivariate correlations examined the relationships between the operational codes and cognitive measures.

Results: Findings revealed that poorer attention (r_s = -.48) and working memory (r_s = -.53) were associated with greater inefficiencies when completing everyday tasks. Optimizing strategy use (r_s = .44*) was associated with higher delayed memory abilities. Greater risk-taking behavior (r_s = .42) was associated with higher levels of mental flexibility. Higher socialization (r_s > -.46), including with pets (e.g., petting), was associated with poorer language and executive skills. No significant associations with cognition were found for multitasking, hesitancies and self-monitoring and self-correction.

Conclusions: The results highlight significant relationships in how cognitive ability influences everyday activities. These patterns suggest that different cognitive abilities may impact different behaviors, which could inform future interventions in daily life. Targeting specific interventions and behaviors based on people's unique cognitive performance may improve independent living.

Poster 59

Connecting Long-Term Optical AGN Variability to Black Hole and Host Galaxy Properties

Undergraduate Researcher: Valerie Hanes, *Whitworth University*

Co-Authors: Vivienne Baldassare, Allison Acosta

Summer Research Program: Waves in the Universe and Technology (Brian Collins and Anya Guy)

Abstract

This study was focused on analyzing the long-term variability of optically variable AGN. Understanding long-term AGN variability is an important step toward understanding the accretion disks that surround active black holes and finding the timescales on which AGNs turn on and off. We conducted our study by analyzing the variability in both Broad-Line and Narrow-Line AGN. Our samples came from objects surveyed via the Palomar Transient Facility (PTF) as well as the Zwicky Transient Facility (ZTF). The R-band observations from these surveys allowed us to construct light curves comparing the optical variability during two time periods of about 10 years each. We modeled the light curves via a damped random walk model, finding that 44.8% (10%) of the Broad-Line (Narrow-Line) objects remained variable in the ZTF survey. We then analyzed the properties of the AGN and their host galaxies to explain the change in variability in the other 55.2% (90%). Through this, we found that variability is not dependent on black hole mass. Plotting the objects on a standard BPT diagram, it was found that there are higher [OIII] luminosities in variable-persistent objects which could equate to stronger AGN. Further, we found that objects showing no variability tended to be redder in both Broad-Line and Narrow-Line AGN. It was also seen that both samples had higher star formation rates in their variable-persistent objects. This may suggest that the galaxies of variable-persistent objects have more gas fueling both AGN accretion and star formation.

Poster 60

Improved Precipitation Phase Partitioning in Hydrology Models Results in Less Drastic Projected Climate Change Impacts

Undergraduate Researcher: Ethan Zarek, *Pennsylvania State University*

Co-Authors: Kirti Rajagopalan, Supriya Savalkar, Bhupinderjeet Singh

Summer Research Program: Environmental Engineering: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

Abstract

Accurate partitioning of rain and snow precipitation is fundamental to the estimation of snow and streamflow by hydrology models. Hydrology models take a simplistic temperature based static approach to precipitation partitioning. Recent research suggests that switching to dynamic partitioning that considers multiple meteorological variables improves hydrological model performance related to snow magnitude and phenology metrics. This change will also impact what fraction of streamflow in a region is snowmelt driven, although the level of impact is unclear. Given this is a key consideration for snowmelt dominant watersheds, our goal is to (a) quantify how dynamic partitioning changes the snowmelt contribution to runoff compared to static partitioning and (b) evaluate how this can alter transitions across watershed classification (snow-dominant, transitional, and rain dominant) in a climate change context. The VIC-CropSyst model was applied to the Yakima River Basin as a case study to address these questions. We considered two contrasting future climate change scenarios, one where future emissions are reduced, thereby limiting temperature increases and another where future emissions increase. We found that, on average, for the historical time frame, dynamic partitioning resulted in a higher snowmelt contribution to streamflow (30% overall in the Yakima River basin and 5% to 75% depending on the sub watershed). This increase is much larger in future simulations ranging from 15% to 600% depending on the watershed, scenario, and time frame, with the highest changes occurring in the lower elevation areas of the basin. As a result, the projected transitions of watersheds from snow-dominant to transitional or rain dominant in a changing climate are less extreme than our current understanding.

Poster 61

Grow It Out Or *buzz* It Off: Investigating How Root Hairs Grow

Undergraduate Researcher: Mya Mackowski, *Washington State University*

Co-Authors: Karen A. Sanguinet, Miguel A. Rosas

Summer Research Program: Improving Crop Resiliency: Agriculture in Changing Climate (Andrei Smertenko and Matt Peck)

Abstract

The recently identified root hairless mutant, *buzz*, in the model grass species *Brachypodium distachyon* can be used to study cell expansion, a fundamental cellular process. *BUZZ* has been identified as a cyclin dependent kinase-like gene that regulates root hair growth post initiation. In addition to a root hairless phenotype *buzz* also has a longer primary root compared to the wild type, Bd21. To unravel the signaling pathway that orchestrates *BUZZ*-mediated tip expansion we used a yeast two-hybrid (Y2H) screen using a *B. distachyon* specific cDNA library and identify 3 interaction partners including SRP, XLG3, and Aldose 1-epimerase. Additionally, we generated CRISPR knockout lines to characterize these interacting partners. If the identified interaction partners act on the same signaling pathway as *buzz* to control root hair growth, we hypothesized the CRISPR mutants to be phenotypically similar to *buzz*. To test this, we grew Bd21, *buzz*, and the confirmed CRISPR plants on ½ MS plates for 5 days and measured root growth rates in 24hr intervals for 5 days. We also measured the root hairs of each plant in the late elongation zone of the root. Our results show that after 5 days *xlg3* displayed the greatest difference in root growth rate, but at the end of the trial all lines showed a significant decrease in root growth, compared to Bd21. This suggest that the SRP, XLG3, and Aldose 1-epimerase proteins interact with BUZZ to control root growth, yet it is unclear wether they regulate root hair growth.

Poster 62

Neutrophil cells inflammatory response to influenza and rhinovirus individual infection and coinfection

Undergraduate Researcher: Sofia Cordero, *University of Idaho*

Co-Authors: Tanya Miura

Summer Research Program: Miura Laboratory, UI (Tanya Miura)

Abstract

Neutrophils play a crucial role in the immune defense against respiratory viral infections. While they help eliminate pathogens, their response can lead to excessive inflammation, potentially harming the host. Previous studies have shown that rhinovirus (RV) infection can mitigate the inflammatory response to subsequent influenza virus (PR8) infection in mice, but the underlying mechanisms remain unclear. This study aims to develop an in vitro model to investigate how neutrophils respond to respiratory viral infections and how stimulation of neutrophils with RV affects the inflammatory response to PR8. An immortalized monocytic cell line, HL-60, will be differentiated toward a neutrophil phenotype, confirmed by morphological and functional changes. Differentiated HL-60 will be infected with RV, PR8, or RV followed by PR8. Inflammatory responses will be assessed by measuring mRNA and protein levels of cytokines and chemokines using reverse transcription-quantitative polymerase chain reaction (RT-qPCR). and enzyme-linked immunosorbent assays (ELISAs). It is anticipated that pre-infection of HL-60 cells with RV will dampen the inflammatory response to PR8. Understanding the mechanisms whereby neutrophil responses are altered during respiratory viral coinfection may contribute to developing strategies to reduce excessive inflammation, ultimately improving patient outcomes.

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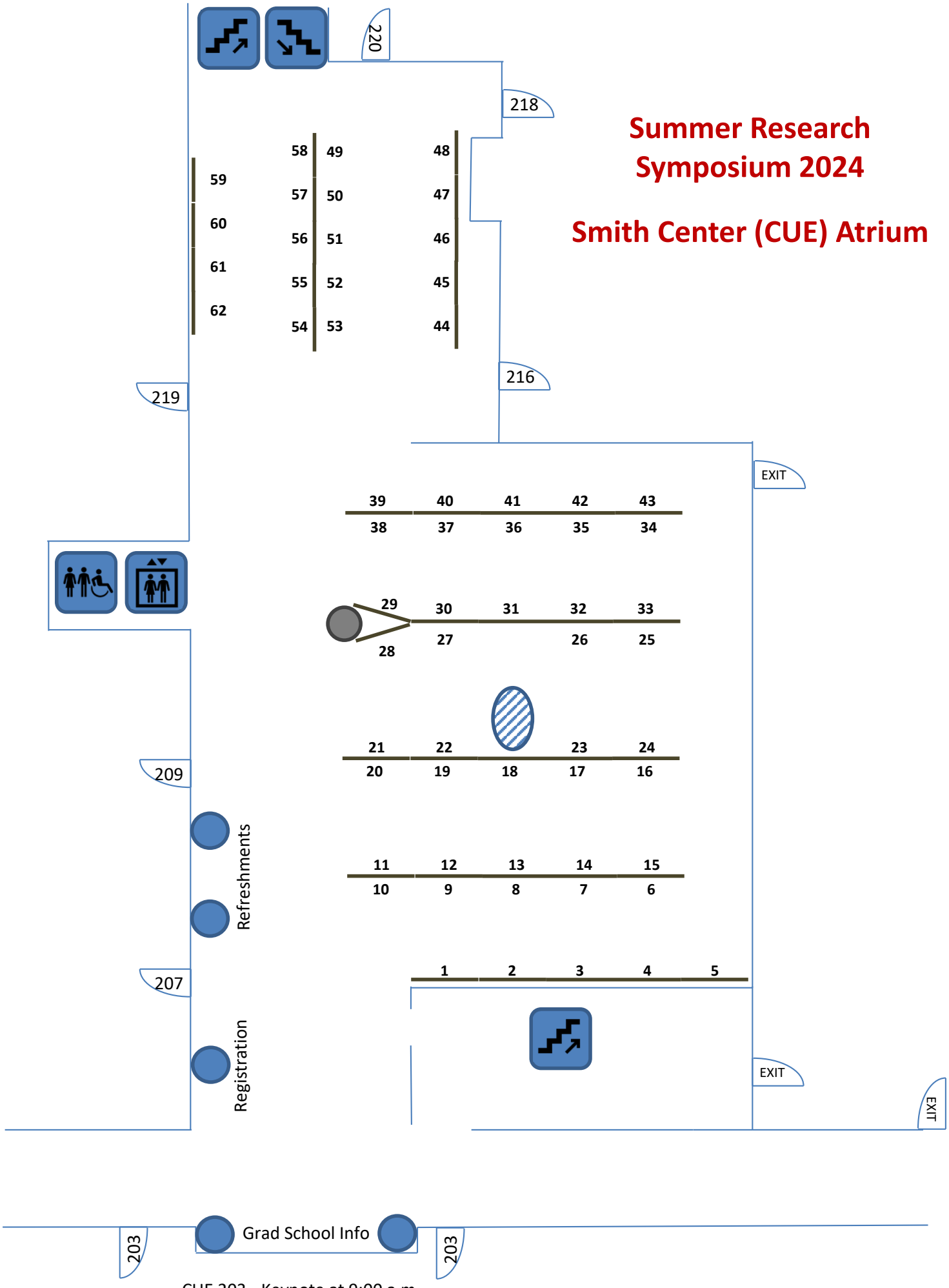
Smith Center (CUE) Atrium



CUE 203 - Keynote at 9:00 a.m.