# The 2022

# SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM

## at Washington State University


## SUMMERRESEARCH.WSU.EDU

**Poster Number:** 1

**Student Name, *Home Institution*:** Dakota Donaldson, *Frostburg State University*

**Project Title:** Transport Mechanics of Microplastic Fibers in a Porous Media Model

**Co-Authors:** Tyler Fouty, Nick Engdahl

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Microplastic Fibers (MPF) are potential emerging contaminants due to harmful capabilities to both humans and the environment. The presence of microplastics in diverse settings around the world has been confirmed and it has been shown that the largest fraction of microplastics by volume are MPFs, but questions of how they got there and, more importantly, where they are going have not been addressed. It is expected that terrestrial and aquatic soils are known to be the largest sinks for MPFs, but the specific mechanisms of MPF transport through the environment are largely unknown. Our research focuses on developing an understanding of the dynamics of MPF movement/transport in porous media. An intermediate scale (50cm by 20cm) “meso-model” of a periodic porous media was used to conduct laboratory experiments of MPF transport. MPF were added to a steady-state flow through the flow cell water that passed through the meso-model and their trajectories were captured using an HD video camera. The videos were analyzed using Fiji (ImageJ) software and MATLAB scripts allowing a dataset of their trajectories to be created. Three different lengths of fibers (5, 10, and 15mm) were evaluated independently under three different discharges, for nine total configurations. The results showed that the longer fibers flex in the shape of a “C” in the narrow sections of the model but later return to a straight line. The smaller fibers traveled as a rigid straight fiber, and the results suggest that MPF will move as a straight rigid fiber as well. The findings offer unique insights into the transport mechanisms and features of MPF migration, which can lead to better models to describe their transport in the environment and better inform environmental policy.

**Poster Number:** 2

**Student Name, *Home Institution*:** Jared Kelnhofer, *WSU*

**Project Title:** Self-supervised Vs LSTM Approach to EEG Emotion Detection Tasks

**Co-Authors:** Mona Ghandi, Marcus Blaisdell

**Summer Research Program:** Wearable Computing (Hassan Ghasemzadeh)

**Abstract:** EEG emotion detection offers many potential benefits in the fields of health and architecture. Smart environments equipped with this technology may enable users with certain forms of Autism or PTSD to engage with others and their environment in new ways. In this paper, two approaches to EEG emotion detection are compared: a traditional LSTM based approach, and a self-supervised approach inspired by Facebook AI's recent SEER approach to computer vision problems. Instead of working with a large amount of labeled training data, the self-supervised learning approach combines eight different EEG datasets, and learns to reconstruct the signals from these datasets. The network is then combined with a prediction network once it has learned to accurately extract features from the data, and may be used to detect emotions in short EEG readings. The training and testing of the emotion detection portion of the network is performed on a custom dataset collected over two years in which participants self-reported emotions while watching different video clips at random intervals.

**Poster Number:** 3

**Student Name, *Home Institution*:** Nhu-Y Do, *Bellevue College*

**Project Title:** Enumeration and Confirmation of Bacillus cereus in Cooked Rice Noodles Stored at Different Temperatures

**Co-Authors:** Barakatullah Mohammadi, Stephanie Smith

**Summer Research Program:** Sustainable High-value Horticulture and Processing (Doug Collins)

**Abstract:** *Bacillus cereus* is a bacterium found in raw foods, such as vegetables, and foods that have been processed and cooked, such as rice and other grains. Foods that have been temperature abused can result in food poisoning due to the outgrowth of *B. cereus* and other pathogens. The aerobic count of *B. cereus* in temperature abused food can reach over a million organisms per gram of food. *B. cereus* is especially concerning as this organism forms spores. A spore is a protective coating/shell surrounding the bacterium's DNA which protects the bacterium from heat inactivation. The purpose of this study was to determine the *B. cereus* concentration of rice noodles held for extended periods at ambient temperatures and determine the threshold where the noodles are no longer safe to eat. In this study, rice noodles were made in the lab and incubated at 22° C for 4, 12, 24, 48, and 72-hour intervals. Noodles stored at 4°C were used to compare the growth of *B. cereus* to unrefrigerated rice noodles. The rice noodle samples were mixed with Butterfield buffer and diluted at 10^-1 to 10^-5. Each diluted concentration of the rice noodle mixture was plated onto MYP agar, then incubated for 18 to 24 hours. After counting the number of bacterial colonies grown on each plate, *B. cereus* was confirmed by inoculating a new MYP plate and checking the color(s) of the colonies after incubation. Data showed *B. cereus* growth in both refrigerated and unrefrigerated samples for all time intervals tested. The longer rice noodles are kept unrefrigerated, the growth of *B. cereus* increases, posing a greater risk of food poisoning.

**Poster Number:** 4

**Student Name, *Home Institution*:** Nhan H. Nguyen, *Washington State University*

**Project Title:** Quantifying Superficial Scald in Granny Smith Apple Using Image Segmentation Techniques and a Convolutional Neural Network

**Co-Authors:** Heidi Hargarten, Loren Honaas, Stephen Ficklin

**Summer Research Program:** Phenomics Big Data Management (Sindhuja Sankaran)

**Abstract:** To preserve postharvest fruit quality in apples, there are multiple storage treatments that are employed, including chilling, controlled atmosphere, and application of the Ethylene blocker 1-Methylcylocpropene (1-MCP). However, during storage, superficial scald can occur. Superficial scald is a physiological disorder that occurs following a chilling injury during the early weeks of fruit storage, but with delayed symptom development - most notably peel necrosis that occurs in irregular patterns. Apples with superficial scald, especially Granny Smith, cannot be sold to the customers, causing financial loss to the industry. Currently, quantification of the superficial scald incidence is performed manually by trained technicians, often using a small set of rating values. However, human error, individual bias, and the coarse-grained rating scale can lead to inconsistencies in the estimation of disorder severity. Here, we report on a combined model of image segmentation and machine learning techniques that detects individual apples on trays, calculates regions covered by scald, and returns a finer-scale rating of the amount of superficial scald. Provided by the Honaas lab at the USDA ARS Tree Fruit Research Lab, from 4032 images of in-storage and post-acclimation Granny Smith apples, the model was trained, validated, and evaluated exclusively on Kamiak, Washington State University's high-performance computing cluster. During evaluation, to determine the best coefficients for scald measurement, a neural network that contains convolutional layers, pooling layers, and fully connected layers was constructed. By focusing on the difference between scalded versus non-scalded regions, the most outstanding model was able to detect superficial scald with 83.19% accuracy, increasing to approximately 92% accuracy on heavily scalded apples. For future research purposes, the results could potentially be improved with a larger dataset and a rectified approach to the image segmentation/machine learning techniques.

**Poster Number:** 5

**Student Name, *Home Institution*:** Sandra Illescas, *California State University Northridge*

**Project Title:** Examining the Impacts of a CURE in an Undergraduate Introductory Biology Course for Minoritized Groups

**Co-Authors:** Gretchen Rollwagen-Bollens

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** Educational equity in STEM is something that has been studied for many years and by many institutions. Washington State University-Vancouver (WSU-Vancouver) set out to find how demography influences student performance in an introductory biology class when students have the opportunity to participate in a course-based undergraduate research experience (CURE). Biology 106 was taught at WSU-Vancouver as a CURE for four fall semesters from 2017-2020. In 2017-2018, the population of approximately 150 students focused on studying invasive clams as part of their course. Students were asked to take the Test Of Scientific Literacy Skills (TOSLS) before and after the CURE course as a way of measuring their starting foundation and their gains after their participation. Our focus was comparing minoritized groups and non-minoritized groups to identify differences in their gains based on various demographics such as race/ethnicity, first-generation and veteran status. The interpretation of the data shows that minoritized groups, such as first-generation students, tend to initially score lower than their continuing-generation counterpart, but were able to obtain higher gains. Similar findings were observed for students who identified with a underrepresented race/ethnic group and veteran students. This data suggests that CURE courses may be the kind of experience that students need in order to decrease the equity gaps in learning in STEM for minoritized students.

**Poster Number:** 6

**Student Name, *Home Institution*:** Duncan Jurayj, *Brown University*

**Project Title:** Modeling the Impact of Cropping Systems on Irrigation Reliability

**Co-Authors:** Jan Boll

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** In the Yakima River Basin (YRB), hydroelectric diversions, irrigated-agriculture demands, and instream flow requirements all compete for limited water resources, especially during drought years and low flow periods. During the agricultural growing season, irrigation demand for water accounts for over half of the unregulated streamflow in the YRB, making the sector sensitive to droughts and low flows. Changes to crop types, relative crop areas, planting dates, and irrigation technologies can all improve the ability of water supply to meet water demand by changing the timing and amount of irrigation water needs. We designed a system dynamics model that depicts the water balance of the YRB. The model includes simulated naturalized streamflow, instream flow requirements, hydro-electric canal diversions, and the irrigation needs of over 15 different crops. Individual irrigation schedules were derived from a mechanistic spreadsheet model that used climate data, soil parameters, and crop parameters to calculate the water balance of the irrigated soil. The framework we used to measure the impact of cropping systems on the YRB water balance was irrigation reliability (IR), calculated as the amount of water delivered to irrigated agriculture divided by the water demand of that agriculture. The system dynamics model and the spreadsheet model were linked dynamically in an effort to combine the experimental capabilities of a system dynamics model with the detailed accuracy of a mechanistic model. This method proved possible and would benefit from further streamlining and development. We expect to see that certain crops allow for higher irrigation reliabilities either because they do not require as much water, or because their peak water demand occurs at a time when there is more total surface water storage in the YRB. These types of changes have the potential to increase the resilience and consistency of the agricultural sector in the YRB.

**Poster Number:** 7

**Student Name, *Home Institution*:** Sasha Campana, *Randolph-Macon College*

**Project Title:** A Comparison of Variable and Spectroscopically Selected Active Galactic Nuclei in Dwarf Galaxies

**Co-Authors:** Vivienne Baldassare, Erik Wasleske, Christopher Carroll

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

**Abstract:** We present the results of a comparison between two samples of dwarf galaxies hosting active galactic nuclei (AGNs), where each sample was constructed using different selection criteria—optical emission line diagnostics versus long-term optical variability. AGNs observed in dwarf galaxies today are thought to be analogous to those found in the early universe, thus by studying these systems we hope to constrain galaxy—black hole coevolution through cosmic time. The goal of this comparison is to determine if inferred galactic properties (e.g., star-formation rate, extinction by gas and dust, AGN power) are affected by the different AGN selection methods. To estimate these physical properties, we model the spectral energy distributions (SEDs) of our sources with X-CIGALE, using multiwavelength data spanning a range of the electromagnetic spectrum (X-ray to infrared). Our results suggest a difference in star formation rates between the two samples, demonstrating the necessity of using multiple selection techniques to better capture AGNs in dwarf galaxies.

**Poster Number:** 8

**Student Name, *Home Institution*:** Sienna Alicea, *North Central College*

**Project Title:** Improving Satellite Imagery-based Estimates of Crop Residue Cover in the Pacific Northwest by Integrating Moisture Dependency Effects

**Co-Authors:** Kirti Rajagopalan, Siddharth Chaudhary, Haly Lury Neely

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Low-intensity tillage practices are positively correlated with favorable soil and environmental health (e.g. reduced erosion levels). Regional mapping of tillage practices offers agencies such as the Natural Resources Conservation Service the ability to monitor the implementation of tillage practices and assess resulting benefits. Large-spatial-scale mapping of tillage practices does not currently exist for most regions in the US, and satellite imagery analysis has potential as a low-cost method for achieving this at regional-scales. Typically, satellite-based approaches quantify the fraction of observed crop residue on the soil as a proxy for tillage practices. This is based on spectral indices that capture differences in reflectance between residues and soils. However, creating these indices presents multiple challenges, one of which is the impact of moisture levels on the index which reduces its accuracy in determining fractional residue cover in non-dry conditions. Our objective is to develop adjustments for this moisture dependency and improve satellite-imagery based estimates of crop residue cover for the dryland Pacific Northwest (PNW) . During the 2022 field season, researchers collected samples of five different crop residues and four different soils prevalent in the PNW. Laboratory spectrometry experiments produced spectral signatures for these residues and soils at varying moisture levels. Linear mixture combinations of crop and soil signatures and resulting spectral indices were calculated for a range of fractional crop residue and moisture levels. Ultimately, regression relationships were developed between the spectral indices and fractional residue cover accounting for the varying moisture content. Preliminary results indicate that the moisture corrections work well and improve the accuracy of fractional residue cover estimates. These results are promising and indicate that there is potential to implement large-scale monitoring platforms that equip regional agencies with data to assess the benefits associated with low-intensity tillage practices.

**Poster Number:** 9

**Student Name, *Home Institution*:** Steven Binder, *The University of Georgia*

**Project Title:** XLINX Satellite Communication System

**Co-Authors:** Adam Slater, Anika Raisa Khan, Christian Nicoll, Dr. Subhanshu Gupta

**Summer Research Program:** Phenomics Big Data Management (Sindhuja Sankaran)

**Abstract:** Photographing the sun using an extreme ultraviolet detector and photon sieve provides critical information about the corona's energization. Traditional telescopes fail to capture accurate, high-quality photos of the corona due to limitations caused by the alignment of their optics. The Virtual Super-resolution Optics with Reconfigurable Swarms (VISORS) system is a distributed telescope comprised of two cube satellites. With optical components housed in one satellite and the detectors in the other, VISORS provides a highly scalable telescope that can operate near its diffraction limit to take highly accurate photos. The XLINX communication system will provide a reliable RF connection between the satellites to ensure proper alignment. XLINX is comprised of six antennas per satellite, a switch board, amplifier, and control unit. Each sub-system was designed as a printed circuit board (PCB) to maximize reliability and minimize their footprint. To ensure minimal signal attenuation, simulations of the switch board and amplifier were performed in Advanced Design System (ADS) prior to the creation of a PCB design.

**Poster Number:** 10

**Student Name, *Home Institution*:** Kayden Cantrell, *Willamette University*

**Project Title:** COVID-era Teaching Tools: An Assessment of Learning Gains Across In-person, Online, and Hybrid Formats of a Developmental Biology CURE

**Co-Authors:** Erica Crespi, Cleve Young

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** The Covid-19 pandemic has had a dramatic sudden effect on classroom instruction, forcing classes of every size and format into online or hybrid formats, but this was also an opportunity to explore how course delivery affected the undergraduate learning experience. We performed a mixed methods analysis of responses to a Student Assessment of Learning Gains (SALG) survey and lab report grades across in-person, online, and hybrid formats of an upper-level animal development course-based undergraduate research experience (CURE) from 2016-2022. We assessed the value of the laboratory experience in concept learning, aspects of the course that were particularly helpful to students, how being online affected the laboratory experience, and students' views of their gains in scientific skills, such as statistical analysis, graphing, and writing. The majority of students consistently reported that the lab was important in their learning of class concepts, even when fully or partially online When the course was in person, students reported that in-class activities, collaboration with peers, and homework were the most helpful in their learning of animal development concepts, but while the course was fully online, they reported online resources such as recorded lectures and labs were most helpful. Interestingly, students in 2022 who experienced a combination of in-person and on-line labs placed high value on both online resources and in-class activities. As expected, students reported lower gains in collaboration and understanding of methods of scientific inquiry, but surprisingly, we observed an improvement in lab report grades and their reported learning of scientific literacy skills during on-line delivery. These findings suggest that the COVID-19 pandemic inspired the development of learning tools that benefit student learning, and a hybrid instruction format may be optimal for the multidimensional learning outcomes of CUREs.

**Poster Number:** 11

**Student Name, *Home Institution*:** Sara Murillo, *The University of Texas at Austin*

**Project Title:** Integrating Pumped Storage Hydropower with Renewable Energy Sources to Improve Electric Grid Reliability and Financial Stability

**Co-Authors:** Jennifer Adam, Matthew Yourek

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** As climate change accelerates globally, politicians have made commitments to reduce CO2 emissions. Non-hydroelectric renewables can help, but their intermittency creates a need for reliable electricity storage. In Washington State, where the Climate Commitment Act sets stringent emissions goals, storage is particularly important. The majority of Washington's electricity comes from hydroelectric dams, which are subject to changes in production as climate change and droughts affect flow rates. Given the grid's sensitivity to changes in flow rate and the need for increased non-hydroelectric renewables, we are studying the use of closed loop pumped storage hydropower (PSH) as electricity storage.

Our research question investigates how PSH facilities could improve financial stability and grid reliability as the use of intermittent renewable energy sources increases in Washington State. We address this question by using Stella, a systems modeling software that simulates a PSH plant's storage capacity through its electricity generation and consumption. We ran scenarios wherein non-hydroelectric renewable generation is increased and others that incorporate changes in hydroelectric power based on projections for a drought year. In the same model, we run a rudimentary economic analysis where the plant's cumulative revenue is compared to initial capital costs.

We found that in Washington, PSH has the potential to increase grid resiliency when renewables are integrated into the electric grid. Though initial capital costs are high, over time PSH becomes profitable, which helps offset costs lost through decreased hydroelectric power. These initial results demonstrate a financially feasible solution for increasing renewable energy while maintaining grid stability.

**Poster Number:** 12

**Student Name, *Home Institution*:** Andrew Liu, *University of Pittsburgh*

**Project Title:** Validation of Enterococcus Faecium NRRL B-2354 as a Surrogate of Listeria Monocytogenes During Sanitizer Intervention in Simulated Water

**Co-Authors:** Yuan Su, Meijun Zhu

**Summer Research Program:** Sustainable High-value Horticulture and Processing (Doug Collins)

**Abstract:** *Listeria monocytogenes*, a harmful bacteria, naturally exists in the produce production and processing environment and can cause fatal illnesses. Recent listeriosis outbreaks linked to caramel apples and multiple recent *L. monocytogenes* recalls associated with fresh apples have brought apple microbial safety to the public's attention. In commercial plants, apples are first handled by large dump tanks and flume water systems to gently transport apples from harvest bins to the packing line. The dump tank and flume system use thousands of gallons of water, making it difficult to drain and refill with fresh water. Consequently, this water is commonly reused for several processing days. However, the reuse of dump tank water results in the accumulation of organic matter and potentially cross-contamination of foodborne pathogens, including *L. monocytogenes*. To reduce cross contamination, chemical sanitizers like chlorine and peroxyacetic acid (PAA) are extensively used in dump tank flume water. However, their practical efficacies are lesser known and require a non-pathogenic surrogate bacterium to test their effectiveness in-plant. In this study, the efficacy of chlorine and PAA against *L. monocytogenes* in simulated dunk tank water (SDTW) was analyzed using a bench-top system and further compared with a presumable surrogate, *Enterococcus faecium* NRRL B-2354. Chlorine at the 25, 50, and 100 ppm for 0.5-5 min contact in water with 1000 ppm chemical oxygen demand (COD) caused a reduction of xx-xx, xx-xx, and xx-xx log10 CFU/ml in *L. monocytogenes* while reductions of 3.78-4.53, 3.84-5.20, and 3.83-5.48 log10 CFU/ml were observed for that of *E. faecium*. In summary, we proved *E. faecium* as a suitable surrogate microorganism of *L. monocytogenes* in chlorine treatments in SDTW water.

**Poster Number:** 13

**Student Name, *Home Institution*:** Alex Heinrich, *Washington State University*

**Project Title:** Rubidium Repolarization by Hyperpolarized Xenon

**Co-Authors:** Adnan Nahlawi, Zahra Armanfard, Brian Saam

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

**Abstract:** Using typical methods of spin exchange optical pumping (SEOP) to produce hyperpolarized xenon, we measured the spin relaxation rate of rubidium-85 in the extra low polarization regime to assess the evolution of its time constant throughout a multiexponential decay. In contrast to the high and low polarization limits, this extra low regime is shown to be dominated by xenon's spin exchange rate, suggesting a measurable repolarization of rubidium by xenon. Our data reveals a repolarization rate with a characteristic time of 28.57 ± 0.60 seconds that matches our previous measurements of xenon's exchange rate within an order of magnitude. This notably contrasts with a characteristic time of 1.188 ± 0.050 microseconds that we measured in rubidium's low polarization limit. These results indicate the contribution of an additional time constant in rubidium's spin relaxation with xenon that could be used to further investigate the dynamics of SEOP.

**Poster Number:** 14

**Student Name, *Home Institution*:** Rowan Orlijan-Rhyne, *Swarthmore College*

**Project Title:** Modeling Crop Residue's Effect on Sugarcane Soil Moisture

**Co-Authors:** Fabio Scarpare

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Agricultural yields and activity are inextricably linked to climate conditions, and as Brazil's main source of renewable energy and among the country's primary exports, the demand for greater sugarcane yields is ever-increasing. Traditionally, sugarcane is rainfed, but with expansion of sugarcane cultivation to hotter and drier regions in Brazil and with the future aridification due to climate change of wetter regions in which the crop has been grown for centuries, issues have arisen with the crop's water supply. There has been increased pressure to optimize sugarcane management strategies in order to minimize water use, maximize sugar yields, and maximize biofuel production from excess crop biomass. One potential solution to these challenges is green cane management, a harvesting strategy which employs the deposition on the soil of large amounts of plant litter (also called straw or residue) after each harvest. In the context of this study, the technique is hypothesized to increase soil water holding capacity, lessening the need to irrigate the crop and producing greater yields under low precipitation conditions. To test this relationship, this project uses CropSyst, a field-scale, multi-year, multi-crop model composed of a complex web of subprograms and equations which simulate the behavior of agricultural systems given location- and farm-specific conditions. In combination with CropSyst simulations of these quantities, aboveground biomass (AGBM), leaf area index (LAI), and soil water content data from three sites in Brazil are used to calibrate and validate the model so that it can be reliably employed to test variation in yields and soil water content levels in response to using variable quantities of crop residue as mulch.

**Poster Number:** 15

**Student Name, *Home Institution*:** Aengus Kennedy, *Tufts University*

**Project Title:** Developing Phenomics Tools for Pea Breeding

**Co-Authors:** Sintayehu Daba, Puneet Mangat, Milton Valencia Ortiz, Rebecca McGee

**Summer Research Program:** Phenomics Big Data Management (Sindhuja Sankaran)

**Abstract:** Predictive crop selection methods have the potential to accelerate pea cultivar development by shortening breeding cycles and increasing numbers of progeny and precision of selection. Two developing selection strategies were applied to two pea populations: 1) marker-assisted selection was performed using kompetitive allele-specific PCR (KASPar™) assays to identify a specific genomic region associated with high protein concentration in mature pea seeds, and 2) a population of 288 breeding lines was genotyped using genotyping-by-sequencing (GBS) and will be used to develop a genomic selection (GS) model to predict the performance of other peas using their genotype. With the marker-assisted selection population, quantitative trait loci (QTL) associated with high protein concentration in peas were identified using single-nucleotide polymorphism (SNP) markers in a bi-parental mapping population. This population was developed from a cross between the smooth but low-protein field pea cultivar 'Aragorn' and the high-protein vegetable pea cultivar 'Kiflica'. DNA was extracted and purified from 25 F6 plants, and 64 SNP markers were used to identify the individuals that were heterozygous in a 2 million base pair (Mbp) region of Chromosome III. Three heterozygous individuals were identified and will be used to further fine-map this region of the pea genome. With the GS population, DNA was extracted from 288 breeding lines and submitted for sequencing. Agronomic data including height, lodging, canopy cover, and pod quantity was previously collected, both manually and using UAV-mounted cameras from advanced yield trials in which the 288 lines were evaluated between 2011-2021. As the DNA sequencing data will not be available until the end of the summer, analysis of these data sets using WSU's Kamiak high-performance computing cluster will continue to take place in the coming months. Using these genotypic and phenotypic data sets, a model will be built to predict the performance of early generation breeding lines.

**Poster Number:** 16

**Student Name, *Home Institution*:** Cleve Young, *University of Nebraska-Lincoln*

**Project Title:** A Development CURE for Vision and Change: Do Cures Advance Learning of Key Competencies and Extend Scientific Thinking From the Classroom Into Their Lives?

**Co-Authors:** Kayden Cantrell, Erica Crespi

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** In 2011 Vision and Change called for reform in life Sciences education, noting a need for all students to gain:

- Understanding of key concepts
- Key competencies
- The ability to apply their knowledge to all facets of their personal lives as citizens

To determine to what extent Course-based Undergraduate Research Experiences (CUREs) manifest these learning outcomes, we assessed SALG post-course surveys of a CURE implemented in an upper-level animal development course at a northwestern public research university from 2016-2017/2020-2022. In this CURE, students worked in groups to address the overarching question of "How does pollution affect early development?" They performed/analyzed two experiments to test a hypothesis related to a pollutant on embryonic development within a One Health framework. Afterwards students reported the greatest learning gains related to the V&C competencies of Communicate and Collaborate (55.99%), Quantitative Reasoning (46.07%), and Process of Science (12.85%). Although other V&C competencies were incorporated in the CURE (Interdisciplinary, and Relationship Between Science and Society), no students mentioned them. Likert questions reinforced this but provided some insight, as more than 60% of each class on average reported "A lot/great deal" in their confidence in practicing all three of these competencies. Responding to "Please comment on how your understanding of how concepts of animal development integrate with issues outside of biology (e.g., social, political) has changed as a result of this course," student responses indicated their identity as a consumer, a voter, a parent, increased awareness in the importance of science, communicating science to the public, and the interrelatedness of species. Because a CURE exposes more students to research than independent research, more students had an opportunity to gain highly transferable V&C competencies. Perhaps most valuable, we also found that this CURE allowed students to connect science to their roles as citizens according to their diverse interests.

**Poster Number:** 17

**Student Name, *Home Institution*:** Brandt Geist, *Cornell University*

**Project Title:** Evaluating the Streamflow Augmentation Potential of Partially Leasing Agricultural Water Rights via Deficit Irrigation under Future Climate Change Scenarios

**Co-Authors:** Kirti Rajagopalan, Siddharth Chaudhary, Bhupinderjeet Singh, Roger Nelson

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** Freshwater demands for irrigating cropland is one of the primary reasons for extensive withdrawals in the Columbia River basin. Devising management plans for enhancing instream flow has proven to be quite a challenge in many of the watersheds. Water markets have the ability to alleviate water shortages, but said markets are institutionally constrained to either lease the entire water right or not lease the water right at all. Recent work demonstrated that relaxing this constraint and allowing farmers to lease a portion of their water right (partial leasing) by adopting deficit irrigation practices creates a win-win situation as it augments instream flows while also increasing the profitability for farmers. Our objective is to quantify how this instream flow augmentation potential of partial leasing changes under future climate scenarios where both irrigation demands and water supply are expected to change in magnitude and timing. The Walla Walla watershed – which experiences low flows on a regular basis – is considered as a case study using wheat and corn as the crops of choice. The following analysis was performed for historical as well as two future timeframes (mid century and end of century) with nineteen general circulation models and two greenhouse gas concentration scenarios. Initially, the crop model runs provided the crop responses to deficit irrigation. Next, the most economically profitable deficit application was calculated as an optimization problem. Finally, the instream augmentation was calculated for each year depending on the calculated profitable outcome. The results are currently being finalized.

**Poster Number:** 18

**Student Name, *Home Institution*:** Daviti Vardishvili, *Washington State University*

**Project Title:** Supporting ornamental, flower, and bulb crop productions in the Pacific Northwest through applied research

**Co-Authors:** Joseph Michael Hulbert, Gary A. Chastagner

**Summer Research Program:** Sustainable High-value Horticulture and Processing (Doug Collins)

**Abstract:** During REEU 2022 internship at WSU Puyallup Research and Extention Center, we aimed to investigate how different soil treatements affect peony growth and development as well as how various hydrating solutions affect the vase life of cut peonies. Through this research, we help and support local growers who face many challenges like disease and storage.

For the soil experiment, we used multiple combinations of three ammendments which were compost, fertilizer and boron. We measured the effect those ammendments on two different varieties of peonies. We measured height, stem diemeter, bud diameter, bud development stage, as well as diesease rating. For the hydration test, we had three different solutions where three different varieties of peonies were soaked for 5 and 28 days. Then we set up the station to see how many days each cut flower would live and assess their condition daily.

For the soil test, we've noticed that there was a considerable difference in early development stage of peony plants between compost and no compost treatement, however it evened out eventually, the results are yet to be calculated. Hydration test data is still being collected and it's yet to be calculated as well.

**Poster Number:** 19

**Student Name, *Home Institution*:** Alexander Lewis, *Loyola University Chicago*

**Project Title:** Off-Resonant Optical Pumping in Rb-Xe Mixtures

**Co-Authors:** Adnan Nahlawi, Brian Saam

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

**Abstract:** Alkali metal can be readily spin-polarized by optical pumping. Hyperpolarization of noble gases for medical imaging, atomic clocks, and precision magnetometers are among many applications that can benefit from optical pumping efficiency improvement [1]. In this work, we characterize the Rb D1 absorption line and investigate resonant and off-resonant optical pumping in Rb-Xe mixtures. Our measurements show that increasing the temperature of the vapor cell beyond a certain point leads to a significant decrease in the optical pumping efficiency for the resonant light. However, this effect seems to disappear for off-resonant light. In fact, increased Rb polarization is detected when the incident laser light is detuned off-resonance at high temperatures and a dip in the polarization peak is observed. This result is consistent with the hypothesis that due to increasing alkali vapor density with rising temperatures, a boundary layer of unpolarized Rb is formed in the vicinity of the cell walls within which circularly polarized resonant light is strongly absorbed [2].

[1] Happer, W., and W. A. Van Wijngaarden. "An optical pumping primer." Hyperfine Interactions 38.1 (1987): 435-470.

[2] Wagshul, M. E., and T. E. Chupp. "Laser optical pumping of high-density rb in polarized he 3 targets." Physical Review A 49.5 (1994): 3854.

**Poster Number:** 20

**Student Name, *Home Institution*:** Lourdes Loera, *Arizona State University*

**Project Title:** Evaluating the Transport of the Antibiotic Resistance Gene NPTII in Saturated Soil

**Co-Authors:** Courtney M. Gardner, Sandra Un Jan Contreras

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Given the increasing prevalence of genetically modified crops in the United States due to their improved resilience and yield, the amount of antibiotic resistant genes (ARGs) present in the environment has risen accordingly. Uncertainty about the unintentional release of this genetic material into the surrounding environment and its potential to horizontally transfer to unrelated microorganisms makes understanding the fate and transport of these genes in soil crucial. NPTII, a type of aminoglycoside phosphotransferase, is an ARG that targets and inactivates aminoglycoside antibiotics. In the present study, the transport of the NPTII gene under saturated conditions was investigated through column experiments, in which the gene was passed through soil containing relatively high clay content and ionic presence sourced from the Palouse region of the northwestern U.S. KBr was tested as a tracer component for the columns to ensure adequate flow as column optimization was key in determining the most realistic transport pathways of the gene.

**Poster Number:** 21

**Student Name, *Home Institution*:** Scottie Teichmer, *Lewis-Clark State College*

**Project Title:** Testing for a New Immunity Trigger in Rice: Luminol Hrp Assay to Test for Ros Response to Elicitor Hydroxycinnamates Ferulic Acid and P-coumaric Acid in Rice Leaf

**Co-Authors:** Leilani Concepcion, Niharika Nonavinakere Chandrakanth, Dr. Laura Bartley

**Summer Research Program:** Plant Biofuels and Functional Genomics REU (Laura Bartley)

**Abstract:** The plant cell wall functions in determining plant structure, development, and defense against pathogens. Investigating how cell walls function in defense can guide development of crops grown for feed, biofuel refining, and other biomass-derived products by preventing unintended consequences of cell wall engineering for these purposes. Damage Associated Molecular Patterns (DAMPs) are molecules from damaged cells that trigger an immune response in neighboring cells. We hypothesize that rice cell wall hydroxycinnamates are potential DAMPs capable of eliciting reactive oxygen species (ROS) as part of an immune response in rice. Rice leaf pieces treated with hydroxycinnamate solution as an elicitor will be tested for the presence of ROS using a luminol hydrogen peroxidase assay. Hydrogen peroxide ($H_2O_2$) released by plants during an immune response reacts with luminol to create photons. Our preliminary results are inconclusive and indicate that leaf pieces floating in wells reduce detection of photons compared to positive control readings of $H_2O_2$ with leaf. To avoid this complication, leaf piece sizes will be made large enough to press against cell walls preventing floating. Luminol horseradish peroxidase reaction with hydrogen peroxide will be tested with the presence of leaf as a positive control. Rice elicitor peptide RaxX can be used as a positive control treatment in the presence of leaf as it has been found to elicit immune response in rice. Negative controls will include assays with the use of RaxX in wells without leaf, and water treatment with leaf and no elicitor. Results of these experiments will provide useful information for further investigation into HCAs as DAMPs in rice and other grasses to support understanding plant cell wall defense and implications of cell wall modification.

**Poster Number:** 22

**Student Name, *Home Institution*:** Leilani Concepcion, *Washington State University*

**Project Title:** Testing the Effect of Hydroxycinnamates on the Immune Response of Rice Plants

**Co-Authors:** Alissa Carreno, Scottie Teichmer, Niharika Nonavinakere Chandrakanth, Laura Bartley

**Summer Research Program:** Plant Biofuels and Functional Genomics REU (Laura Bartley)

**Abstract:** Damage associated molecular patterns (DAMPS) are molecules released due to the presence of a pathogen and trigger an immune response. Our research's primary focus is on the immunity response within the cell wall of rice plants. Understanding the cell wall immunity is of great importance as the cell wall in plants functions as one of the plant's predominant defense mechanisms against diseases and decay. By better understanding the cell wall immunity opens the door to resolving problems in many different fields such as, increasing crop yield and feed for livestock, and refining biofuels. The question we attempted to test through our project was to see whether Kittake rice plant leaves detect Hydroxycinnamates (HCA), Ferulic acid (FA) and p-Coumaric acid (pCA), as a damage associated molecular pattern by measuring the amount of reactive oxygen species (ROS) produced during exogenous. We choose to measure the ROS produced as an elevation in this is commonly due to a DAMP-induced trigger. To test our hypothesis, we conducted two experiments, a Luminol assay and a 3,3' – Diaminobenzidine (DAB) assay. The results from the DAB staining showed a great variability in the accumulation of ROS through every test condition and eventually lead us to the idea of adjusting the solvent used to make the HCA solution. In the Luminol assay, the results were similar to the DAB staining, as they showed a great variability between conditions. Although the results of our experiments were inconclusive, they gave us better insight in how to approach our hypothesis.

**Poster Number:** 23

**Student Name, *Home Institution*:** Carissa Morrison, *Eastern Washington University*

**Project Title:** Examining the Regulation of Alpha-amylase During Grain Germination, a First Step Towards Controlling Preharvest Sprouting in Wheat.

**Co-Authors:** Steber Camille, Yakobchuk Nicholas

**Summer Research Program:** Plant Cell Biology and Biochemistry (Andrei Smertenko)

**Abstract:** Cool, rainy conditions prior to harvest cause problems with *p*re *h*arvest *s*prouting (PHS), the initiation of germination on the mother plant. PHS causes elevated alpha-amylase enzyme levels in wheat grain, and the resulting starch digestion adversely affects end-product quality by reducing the gelling capacity of wheat flour. Elevated alpha-amylase is detected in the industry using the Falling Numbers test (FN), resulting in farmers being forced to sell their crops at discounted prices. The hormone abscisic acid (ABA) represses germination and induction of hydrolytic enzymes including alpha-amylase. The hypothesis is that ABA signaling will repress germination and reduce alpha-amylase levels. A monoclonal antibody, anti-Amy1C, was raised to wheat Amy1 protein sequence. The goal was to develop anti-Amy1C as a tool to detect wheat alpha-amylase protein levels, and determine if alpha-amylase protein expression levels detected during germination correlated with enzyme activity. Thus, germination time course experiments were conducted to investigate: 1) the patterns of alpha-amylase expression and activity during germination, 2) the effects of an ABA hypersensitive mutant called ERA8 (Enhanced Response to ABA8) on the timing of germination and alpha-amylase expression, and 3) the effect of ABA hormone treatment on germination and alpha-amylase. During a 12-hr germination experiment, the apparent alpha-amylase protein levels appeared not to vary over time or agree with enzyme activity measured using the colorimetric SD assay. Increases in alpha-amylase activity were observed between the 6 and 8-hour germination time points. Protein concentrations were measured by Bradford assay after extraction and used to determine protein loading on the Jess, an automated western blotting machine, on the half grains. These results will be used to compare alpha-amylase expression in ABA-treated grains versus untreated grains. These results will deepen our understanding of how ABA hormones and sensitivity affect alpha-amylase expression during PHS. This is important because alpha-amylase determines farmers' fiscal losses.

**Poster Number:** 24

**Student Name, *Home Institution*:** Zachary Cunningham, *Lewis-Clark State College*

**Project Title:** Sustaining Oil Production in Response to Climate Change

**Co-Authors:** Brend'n Blankenship, Matt Garneau, Bhabesh Borphukan, Phil Bates, Karen Sanguinet

**Summer Research Program:** Plant Cell Biology and Biochemistry (Andrei Smertenko)

**Abstract:** *Thlaspi arvense*, commonly known as field pennycress, is a mustard-family plant currently being considered as a promising winter cover crop. While *Thlaspi* seeds are considered a good source of oil and protein, they also contain anti-nutritional compounds such as glucosinolates as well as high levels of erucic acid in their oil. Furthermore, *Thlaspi* plants have many negative agronomic traits including early shattering and delayed germination which limit their value. Much of the recent research involving *Thlaspi* seeds has focused on reducing dormancy and improving seed oil quality. However, how these changes may affect seed development and oil accumulation is still not well understood. The first aim of this project was to describe if/how knock out mutants which reduce seed dormancy (*tt8*) or improve seed oil quality (*fae1*, *rod1*) might affect overall seed development. A growth curve analysis measuring seed growth, the accumulation of oil and protein, as well as gene expression was performed in each mutant line and wild-type through seed maturation. In the second experiment, two pairs of guide RNA sequences were designed for the CRISPR-Cas9 mediated knock out of *Sugar Dependent 1* (*SDP1*); a gene hypothesized to encode a lipase which degrades oil during seed maturation and whose mutation may lead to increased oil content.

**Poster Number:** 25

**Student Name, *Home Institution*:** Dasha Winterer, *Washington State University*

**Project Title:** Impacts of Nitrogen Fixing Bacteria on Plant Growth and Morphology in Soils of the Palouse

**Co-Authors:** Grace Cooper, Rahele Panahabadi, Florence Mus, John Peters, Tarah Sullivan, Laura Bartley

**Summer Research Program:** Plant Cell Biology and Biochemistry (Andrei Smertenko)

**Abstract:** Soil acidification can can be accelerated through nitrogen fertilization via the oxidation of ammonium. As this process lowers pH, aluminum becomes more soluble leading to aluminum toxicity. Biofertilization is an alternative to mineral nitrogen fertilizers, using microbes in a symbiotic relationship providing nitrogen to plants and carbon to microbes, potentially reducing the need for pH-altering nitrogen application. To test the potential of this approach to farming on the Palouse, we grew wheat with both tolerance and sensitivity to aluminum as well as, a bioenergy crop switchgrass in acidic and neutral soils. These samples were inoculated with a biofertilizer Azotobacter, intended to supply nitrogen through nitrogen fixing bacteria. Our trials consisted of two inoculant strains - a wild type and an ammonium excreting strain. An untreated control was not inoculated or fertilized. Following a weekly inoculation schedule for four weeks, we will determine if Azotobacter has a favorable impact on tiller size and root mass in contrast to leggy roots with reduced lateral branching of nitrogen deficient plants. It is our hope that Azotobacter strains can someday reduce the use of nitrogen fertilizers and revolutionize soil management in farming.

**Poster Number:** 26

**Student Name, *Home Institution*:** Grace Cooper, *Gonzaga University*

**Project Title:** Effectiveness of Azotobacter Mutant AvFM2 at Rhizosphere Colonization and Ammonium Secretion for Plant Growth Optimization

**Co-Authors:** Florence Mus, Laura Bartley, Rahele Panahabadi, Dasha Winterers, Maddie Sorensen, John Peters, Jeremy Jewell

**Summer Research Program:** Plant Cell Biology and Biochemistry (Andrei Smertenko)

**Abstract:** Nitrogen fertilizer is highly valued in agriculture for its ability to supply essential nutrients to plants. By increasing the amount of available nitrogen in the soil, fertilizer can optimize crop yield. Excessive fertilization, however, results in consequences including rapid soil acidification and groundwater contamination. To evade these complications, new methods of nitrogen soil supplementation must be adopted. Substances made from living, nitrogen-fixing organisms – known as biofertilizers – are a promising alternative to traditional fertilizers. Researchers at the Institute of Biological Chemistry at Washington State University have developed a mutant strain of *Azotobacter vinelandii* (AvFM2) that is capable of excreting ammonium via the modification of the NifL-NifA system, a two-component regulatory system that governs the transcription of genes required for the biosynthesis of the nitrogenase enzyme. The subsequent research conducted here attempts to identify the effectiveness of this mutant strain at excreting available ammonium when introduced to plants and other microbial associates in a field setting. The ammonium-secreting capacity of AvFM2 was compared to its wild-type counterpart through an experiment in which the bacterial strains were introduced to the rhizospheres of both switchgrass and wheat planted in normal versus acidic soil conditions. By analyzing soil microbiome contents and ammonium levels in conjunction with plant root and shoot architecture, we can begin to identify potential benefits that AvFM2 has on plant growth optimization. The results of this experiment may help guide future development of novel biofertilizers.

**Poster Number:** 27

**Student Name, *Home Institution*:** Hunter Whitlock, *Innovation Highschool*

**Project Title:** Effects of MACET on Microtubule Dynamics

**Co-Authors:** Andrei Smetenko, Tetyana Smertenko

**Summer Research Program:** Plant Cell Biology and Biochemistry (Andrei Smertenko)

**Abstract:** Microtubules are a dynamic component of the cell. They are involved in many critical systems such as mitosis and cellular trafficking. In-plant cells Microtubule Associated Proteins (MAPs) bind to individual tubulin proteins to either stabilize or destabilize microtubules affecting microtubule behavior. One family of proteins called MACET has been shown to play a critical role in phragmoplast construction in Arabidopsis cells during cytokinesis. The goal of our research is to determine the effects of the MACET protein family on microtubule behavior. To understand how MACET interacts with microtubules, they must be tagged with a fluorescent protein to aid in microscopy. Due to the relative size of common fluorescent proteins compared to MACET proteins, it is theorized that adding fluorescent proteins will inhibit MACET-microtubule interactions. Consequently, understanding how MACET is affected by the placement of a fluorescent protein on either the C-terminus or N-terminus is crucial. Our research has shown that MACET reduces microtubule depolymerization rate by a factor of four. Further, the protein activity was higher when GFP was bound to the C-terminus and lower when GFP was bound to the N-terminus. A general reduction in MACET activity would result in a smaller phragmoplast with fewer, less dynamic, microtubules as MACET assists in microtubule nucleation.

**Poster Number:** 28

**Student Name, *Home Institution*:** Tommy Conway, *Washington State University*

**Project Title:** Using Molecular Techniques to Investigate the “Green Bridge” Effect in a Dryland Wheat System

**Co-Authors:** Kimberly Garland-Campbell (USDA-ARS), Nuan Wen (WSU Crop and Soil Sciences), Christina Hagerty (OSU CBARC)

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

**Abstract:** Crop pathogens can survive in fields after harvest by colonizing weeds and volunteers; allowing them to infect crops in the next growing season. This phenomenon is known as the “green bridge”, and it has been a concern for growers since it was discovered in the 1980’s. In the dryland wheat system, two practices are thought to increase the severity of the green bridge effect. The first practice is not employing grassy weed and volunteer control. Another practice is planting before weeds and volunteers dry down enough after herbicide application.

This study investigated how three different weed management practices affected pathogen severity using Clearfield wheat as a host, and rye to simulate grassy weeds that transmit pathogens to the host. In the first treatment, glyphosate was applied to the rye three weeks before planting; in the second, glyphosate was applied the day before planting; in the third, glyphosate was not applied. Wheat plants in each treatment group were later collected. DNA was extracted from root and crown cuttings respectively to assess infection severity of two Fusarium and three Rhizoctonia species, all prominent pathogens in the Inland Northwest. After DNA extraction, the pathogen severity was determined using molecular techniques. We used Real-Time PCR, a rapid high-throughput approach that can be used to detect and quantify specific pathogens based on their unique DNA sequences. While the data is still being analyzed, early results suggest that not applying the herbicide may have caused higher pathogen density for both Rhizoctonia and Fusarium. This study and future investigations can provide growers with better insight into managing pathogen transmission from grassy weeds and volunteers.

**Poster Number:** 29

**Student Name, *Home Institution*:** Edwin Polanco, *University of Massachusetts Boston*

**Project Title:** Automated Image Processing of Pear Rootstock Seedling Vigor Using PlantCV

**Co-Authors:** Kate Evan, Soon Li Teh

**Summer Research Program:** Phenomics Big Data Management (Sindhuja Sankaran)

**Abstract:** The WSU pear rootstock breeding program was started in 2015 at Wenatchee, with the goal of breeding for vigor-controlling pear rootstocks. Routine traditional phenotyping of plant architecture in the orchard is laborious and time-consuming, using tools such as a protractor, a tape measure, a field ruler, and a ladder, which carries a safety concern. Alternatively, field images of plant architecture can be captured for automated downstream analysis to provide comparable phenotypes. Plant Computer Vision (PlantCV) is an open-source image analysis software package. A total of 134 pear rootstock RGB images, taken while the trees were in dormancy, were manually annotated to color-enhance the central leader for extraction of tree height. Current challenges include the presence of overlapping tree branches, and inconsistent camera-to-frame distance and exposures. A workflow for height measuring was completed and data for 554 pear trees (average five trees per original image) was extracted in approximately 11 minutes. The extracted height outputs have a correlation of $R^2 = 0.95$ with the empirically measured tree heights. Additional vigor traits such as branch angle and shoot length will be targeted next. This workflow will provide a safer and more efficient method to determine tree vigor than traditional orchard phenotyping.

**Poster Number:** 30

**Student Name, *Home Institution*:** Emma Stacey, *Georgia State University*

**Project Title:** Health Education through Arts-based Learning (HEAL): Examining Systems Thinking and the Impact of Out of School Contexts Within an Afterschool Science Program

**Co-Authors:** Braelyn Young, Robert Danielson, David Garcia, Elizabeth Grace, Molly Kelton, Ana Maria Diaz-Martinez, Jeb Owen, Kellen Pautzke, Kristin Saba Fisher, Allison White

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** The Health Education through Arts-based Learning (HEAL) project uses out of school settings to conduct programs for students ages 8-10 to engage in arts-integrated STEM curriculum and develop systems-level understandings of health topics at a micro- and macroscopic level. HEAL is coordinated by a team of interdisciplinary collaborators at Washington State University in partnership with rural, predominantly Latinx agricultural communities in central Washington. By combining health-science education and the arts, HEAL seeks to make STEM subjects more equitable and effective for all, allowing more students to see themselves in those fields. Within the scope of our current project is an analysis of a six-week afterschool HEAL program called Care & COVID which uses photographic arts to advance students' visual thinking skills and their comprehension of principles of photographic composition while also engaging students in thinking about how they can protect themselves, their communities, and the globe from COVID-19. In this program, our team collected data in the form of a pre- and post-assessment that included multiple choice questions, an image selection task, and a spatial knowledge activity. We also gathered video and audio recordings and field notes. Using a mixed methods approach that integrates quantitative and qualitative analyses, we are currently exploring and refining two overarching research questions. First, how do students express systems thinking about COVID-19, both before and after the program? Second, how do students take up the out-of-school nature of the learning environment and with what consequences for their learning and engagement?

**Poster Number:** 31

**Student Name, *Home Institution*:** Tessa Irvine, *Allegheny College*

**Project Title:** Responding to Drought Conditions in the Roza Irrigation District

**Co-Authors:** Allyson Beall-King

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** The Roza Irrigation District is one of the leading agricultural producers in the state of Washington, but is also heavily reliant on the Yakima River for irrigation water. As climate change continues to impact river flows and therefore irrigation water, the Roza Irrigation District is in danger of facing severe water shortages and crop failures. The goal of this research is to simulate a shift away from water intensive perennial crops to less water intensive crops in the Roza Irrigation District as an adaptation to future water shortages. We built a computer model using Stella, current crop data, and a bass diffusion structure to estimate the impact of drought and communication between farmers on the potential adoption of new crops. We ran the simulation under current conditions and drought conditions to understand what conditions might lead growers in the Roza Irrigation District to change their growing practices from high water crops, such as apples, to less water intensive crops, such as hops or wine grapes. The results of this research will produce valuable insights into the ways in which changing water supplies affect productive land, as well as simulate how growers in the Roza Irrigation District might change their cropping patterns to respond to prolonged drought conditions.

**Poster Number:** 32

**Student Name, *Home Institution*:** Sofia Franzluebbers, *University of Guelph*

**Project Title:** Fruit Firmness Assessment for High Quality Sweet Cherries

**Co-Authors:** Bernardita Sallato, Matthew Whiting, Carolina Torres

**Summer Research Program:** Sustainable High-value Horticulture and Processing (Doug Collins)

**Abstract:** Sweet cherries are a highly perishable fruit with a limited shelf life, but high nutritional value for consumers. Fruit firmness is among the most important quality traits of sweet cherries. This research investigated the effect of growing conditions on fruit firmness in sweet cherry cultivar 'Chelan' grown on three commercial orchards located in Washington state, during 2021 and 2022. In order to conduct this study, four replicates of 5lb bags of the largest size category obtained after sorting in a packing house were collected and evaluated for fruit firmness and diameter. Mean fruit firmness was significantly different between locations and years. However, the difference between orchards was not consistent for 2021 when compared with 2022. This study demonstrates that the environmental impact on fruit firmness varies depending on local growing conditions and management. To better understand what conditions had a greater impact on fruit firmness, further analysis should be conducted, including nutrient and water management, tree health, among others.

**Poster Number:** 33

**Student Name, *Home Institution*:** Brian Bauer, *Siena College*

**Project Title:** Searching for Equilibration of Quantum Turbulence

**Co-Authors:** Michael Forbes, Edward Eskew

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

**Abstract:** Thermalizing superfluid simulations will allow for the characterization and ultimate determination of turbulence in a quantum system. Quantum turbulence is the "turbulent" interactions of vortices and other solitons in a superfluid. The development of turbulence in a superfluid is perplexing because there is no dissipation at T = 0. However, through the interaction of vortices and solitons energy is able to cascade through the system. No clear distinction for turbulence currently exists, yet the study of power-law energy spectra is considered a key component to its development. It has been previously shown that superfluids with arbitrary initial states will tend towards a characteristic energy spectrum. Using simulations of the nonlinear Schrödinger equation, we explore the process of thermalization through quantum turbulence with and without the presence of topological defects. The goal of this research is to determine whether quantum turbulence is truly “turbulent” in the same definition as in macroscopic classical systems. By observing the cascades of energy over time we hope to see the development and stabilization of energy spectra as well as exploring other statistical characterizations of the system as evidence of turbulence. Through these characterizations we aim to determine the time-scales in which these systems approach a quasi-steady state. Additionally, we are interested in constraining the conditions that produce this energy spectra after its equilibration time. Through this investigation we anticipate that we will be able to characterize the dynamics and approach to thermal equilibrium. Thus, by further developing our understanding of these concepts we will be able to provide evidence of quantum turbulence.

**Poster Number:** 34

**Student Name, *Home Institution*:** Rosario Morales, *Lewis-Clark State College*

**Project Title:** Headspace-Gas Chromatography Analysis of Volatile Organic Compounds from Compost

**Co-Authors:** Shastine Huddleston, Nancy A. C. Johnston

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Compost is known to emit Volatile Organic Compounds (VOCs), as well as greenhouse gases. VOCs are carbon containing substances that have low boiling points and high vapor pressure, with some having odorous properties. A water trap (impinger) was used to capture water soluble compounds from compost piles at the Washington State University (WSU) facility. Headspace-Gas Chromatography (HS-GC) was used to analyze 15 different VOCs including alcohols, acetone, other water soluble or insoluble compounds. Acetone was found in some emissions up to 13 ppm.

**Poster Number:** 35

**Student Name, *Home Institution*:** William Bieker, *Western Washington University*

**Project Title:** Raspberry Color Analysis of 10 New Varieties of Berry

**Co-Authors:** Lisa DeVetter

**Summer Research Program:** Phenomics Big Data Management (Sindhuja Sankaran)

**Abstract:** The raspberry industry commonly uses the Meeker cultivar, this cultivar is relatively high yielding with an attractive color for the processing market which makes up a majority of Western Washington's market. Higher yielding berries could be developed but we need a consistent way of quantifying color for breeding targets. Currently raspberry color is assessed by an individual's observation, this method is subjective and can be difficult to quantify to assess change in color. To remedy this we developed a method for analyzing color using an algorithm to provide RGB colors of fruit. By using a controlled light environment and a reference panel we are able to capture and calibrate images of fruit. These images are then analyzed by the algorithm which provides R,G and B averages of pixels and standard deviation. We found that there is significant variation amongst the cultivars through Tukey and ANOVA tests. With 'Cascade Premier' having a similarly dark berry when compared to 'Meeker'. This result can provide justification for growers to switch cultivation to higher yielding 'Cascade Premier' as well as provide a tool for any raspberry breeding program.

*** Results have not yet been done so this is a fill in results section of this abstract

**Poster Number:** 36

**Student Name, *Home Institution*:** Braelyn Young, *West Virginia University*

**Project Title:** Health Education through Arts-based Learning (HEAL): Examining Systems Thinking and the Impact of Out of School Contexts Within an Afterschool Science Program

**Co-Authors:** Emma Stacey, Robert Danielson, David Garcia, Elizabeth Grace, Molly Kelton, Ana Maria Diaz-Martinez, Jeb Owen, Kellen Pautzke, Kristin Saba Fisher, Allison White

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** The Health Education through Arts-based Learning (HEAL) project uses out of school settings to conduct programs for students ages 8-10 to engage in arts-integrated STEM curriculum and develop systems-level understandings of health topics at a micro- and macroscopic level. HEAL is coordinated by a team of interdisciplinary collaborators at Washington State University in partnership with rural, predominantly Latinx agricultural communities in central Washington. By combining health-science education and the arts, HEAL seeks to make STEM subjects more equitable and effective for all, allowing more students to see themselves in those fields. Within the scope of our current project is an analysis of a six-week afterschool HEAL program called Care & COVID which uses photographic arts to advance students' visual thinking skills and their comprehension of principles of photographic composition while also engaging students in thinking about how they can protect themselves, their communities, and the globe from COVID-19. In this program, our team collected data in the form of a pre- and post-assessment that included multiple choice questions, an image selection task, and a spatial knowledge activity. We also gathered video and audio recordings and field notes. Using a mixed methods approach that integrates quantitative and qualitative analyses, we are currently exploring and refining two overarching research questions. First, how do students express systems thinking about COVID-19, both before and after the program? Second, how do students take up the out-of-school nature of the learning environment and with what consequences for their learning and engagement?

**Poster Number:** 37

**Student Name, *Home Institution*:** Daniel Chaidez, *Cal Poly Humboldt*

**Project Title:** Dynamic Modeling of the Marginal Costs of Sunburn Prevention Methods in Apple Orchards

**Co-Authors:** Michael Brady, Kirti Rajagopalan, Lee Kalcsits

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** Agricultural sectors are considering adaptations to endure more frequent exposure to damage-inducing extreme temperature as a result of climate change. One example is the interest in alleviating annual apples production losses due to sunburn. Sunburn can be mitigated through multiple mechanisms including shade netting – that reduces radiation reaching the tree canopy – and evaporative cooling –that reduces temperatures via overhead misting. The cost and efficacy of these methods are variety dependent. Sunburn risks and the efficacy of mitigation methods are expected to change in the future. For this study I used data collected for the crispp pink and honeycrisp varieties. A portion of the data used came from an extensive literature review and some came from the annual enterprise budgets for specific orchards. The average threshold of sunburn for each of them varies by 43 and 46 degrees celsius respectively for each variety. The purpose of my study was to create a model for each method using the Stella software interface to compare the costs of using these methods to their efficiency in preventing sunburn. Each sunburn mitigation strategy is modeled differently. The netting costs are a one time fixed cost without any variable cost component. The choice variable for an evaporative cooling system has both a fixed and variable cost component. Elements that are dynamic which allows for a deterministic approach in observing the state variable. As a budget is a previously observed occurrence, the model uses a trend of forecasted days that sunburn will occur. From the preliminary results, netting will soon become an obsolete method but being that the same architecture is used for hail damage prevention it will most likely still be used regardless. The implication of constructing such a system is to create a tool for stakeholders to better manage apple orchards.

**Poster Number:** 38

**Student Name, *Home Institution*:** Breana Downs, *Pacific Lutheran University*

**Project Title:** Protein Solubility's Correlation with Direct Expansion During Twin-Screw Extrusion Processing

**Co-Authors:** Jana Richter, Marina Ikuse, Joshua Bernin, Angelika Zak, Nan Chalida, Preston Watanabe, Girish Ganjyal

**Summer Research Program:** Sustainable High-value Horticulture and Processing (Doug Collins)

**Abstract:** The inclusion of high levels of protein into direct expanded extruded snacks leads to dense and undesirable textures. Understanding the reasons that lead to these product characteristics could be vital in choosing the right protein ingredients to increase the nutritional value of snack products. This study aimed to determine how the raw protein solubility affects the direct expansion of extruded products. Three proteins with varying solubility levels were chosen and mixtures of each protein (15, 25, and 35% w/w) and starch were extruded using a co-rotating twin extruder. Extrudates will be analyzed to determine expansion ratio (ER), unit density (UD), specific mechanical energy (SME), viscosity, and water absorption and solubility characteristics. These analyses will help determine how protein solubility affects direct expansion during extrusion. From the data to be collected we anticipate that the results will indicate the need for high protein solubility to obtain extruded products with high expansion and good textures comparable to the control product with no protein content. The results from this research could help food product companies to develop snack products with high protein nutrition and not compromise on the taste and texture that the consumers desire.

**Poster Number:** 39

**Student Name, *Home Institution*:** Jennifer Lopez, *Grinnell College*

**Project Title:** Analysis of Kapitza-Dirac Scattering of a Rb-87 Bose-Einstein Condensate

**Co-Authors:** Annesh Mukhopadhyay, Kamrul Ome, Peter Engels

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

**Abstract:** When a cloud of atoms is cooled to ultracold temperatures near absolute zero, the atoms start behaving like waves and, under appropriate conditions, can form a new state of matter known as a Bose-Einstein condensate (BEC). BECs are a highly versatile testbed for the study of quantum dynamics. This poster describes an experimental and theoretical study of Kapitza-Dirac scattering of a $^{87}$Rb BEC which involves the analysis of momentum-space scattering. In our experiment, we apply modern laser cooling and trapping techniques to prepare a BEC and then briefly pulse on an optical lattice potential. The lattice potential causes the occupation of discrete momentum states which can separately be measured after a time of flight. Plotting the relative momentum populations with respect to pulse lengths enables us to calibrate the optical lattice. The experimentally observed dynamics can be explained theoretically by solving Schrödinger's equation. The excellent agreement between experiment and theory validates our procedure and interpretation. Optical lattices are a central component of many modern experiments with ultracold atoms. With the analysis presented in our work, we have demonstrated an important lattice calibration technique in our experiment that is essential for our research in the field of quantum dynamics.

**Poster Number:** 40

**Student Name, *Home Institution*:** Matthew Zaragoza, *University of Virginia*

**Project Title:** A Climate Change Impact Projection for Heat Damage of Blueberries

**Co-Authors:** Fabio Scarpare, Kirti Rajagopalan

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Sunburn is physiologic damage that occurs on fruits when their surface skin reaches a specific temperature threshold. The fruit surface temperature is frequently 7-11°C warmer than ambient temperatures, allowing sunburn to occur during high ambient temperatures. Rising average summer temperatures in the Pacific Northwest due to climate change pose a significant risk for excessive sunburn of blueberries in future harvests. Blueberry sunburn contributes to crop loss through necrosis, shriveling, and spotting. This research project aims to quantify the number of days under sunburn damage throughout the end of the 21$^{st}$ century for blueberries in the Pacific Northwest and highlight the necessity of expanding evaporative cooling in blueberry farms. An energy balance model for blueberries was conducted to calculate the fruit surface temperature indicating if sunburn would occur. Sunburn was calculated based on its agricultural land use geodatabase location for the Pacific Northwest. Meteorological data were obtained from a compilation of 16 modified multivariate adaptive constructed analog (MACA) models across two representative concentration pathways (RCPs) 4.5 and 8.5 which are future carbon emission scenarios. The high-performance computer Kamiak at Washington State University was used to run the model for over 75 square kilometers of northern highbush blueberry farms between 1950 and 2099. It is anticipated that the higher carbon scenario will show a higher number of average sunburn days. The anticipated increase in sunburn for blueberries indicates a necessity for more evaporative cooling for the fruit in the future.

**Poster Number:** 41

**Student Name, *Home Institution*:** Kevin Hernandez-Ramos, *Wenatchee Valley College*

**Project Title:** Role of Image Ortho-rectification on Crop Vegetative Indices

**Co-Authors:** Kesevan Veloo, Sindhuja Sankaran

**Summer Research Program:** Phenomics Big Data Management (Sindhuja Sankaran)

**Abstract:** Drones have been utilized to capture crop images. These images produce crop vegetation indices (VIs) representing various crop traits. With the introduction of Internet of Things (IoT) camera systems, there is a need to understand how angles affect these crop VIs. Image transformation becomes key to this issue, as it provides a better comparison to the data collection using drones. Accordingly, this research investigated the role of image transformation on data collected at 45° and 60° angles on the VIs extracted from wheat plants using VIs from 90° angle images as a pseudo-reference. This process began by utilizing an IoT camera system that captured an image for each specified angle (45°-60°-90°) for twelve wheat plots, culminating in 36 images. The image acquisition was performed using a reference panel and a white square frame to define the area and to ensure that the VIs was consistently estimated from each wheat plot. Post image acquisition, the images collected at 45° and 60° were rectified using MATLAB prior to estimating VIs. Previous in-lab experiments that utilized a Red-Green-Blue (RGB) camera revealed that the Normalized Difference Vegetation Index (NDVI) of potted plants was consistently greater when extracted from 45° images in comparison to 90° images, with 60° images being relatively close to the pseudo-reference NDVI. The expectations from the wheat field data are no different, as the ortho-rectification of the images will inherently produce a pixel elongation, effectively resulting in a consistent difference in NDVI data between the ortho-rectified images at 45° and 60° and the pseudo-reference of 90°. These findings will inform adjustments to be made to crop image data from IoT cameras at the aforementioned angles.

**Poster Number:** 42

**Student Name, *Home Institution*:** Madeline Lorquet, *Rockland Community College*

**Project Title:** Bridging Equity Gaps in General Chemistry with a Novel Prep Chem Class

**Co-Authors:** Paul Buckley, Angela Hong, Jazmyn Juarez

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** Chemistry 103 is an introductory course developed and taught at Washington State University to prepare students for later chemistry courses as well as narrowing the equity gaps within under-represented and minoritized persons in General Chemistry and in STEM. Chem 103 strives to reassure students that success in chemistry is possible with the approach of flipped classrooms, a novel curricular approach, lessons led by undergraduate teaching assistants, and smaller personable classrooms. Over the span of five semesters, exam averages, homework, and lab grades from students who took the preparatory course were compared to the performances of those who only enrolled in General Chemistry, Chem 105. We also acquired data pertaining to the student's gender identity, race and/or ethnicity, and whether they were a first-generation students or not. We identified first-generation students, under-represented minorities and compared their performances to non-first-generation students and non-under-represented persons. Those who took the preparatory Chemistry course deemed just as much success as those who solely took General Chemistry, however there is still work to be done to further close those equity gaps.

**Poster Number:** 43

**Student Name, *Home Institution*:** Giselle Malloy, *University of Connecticut*

**Project Title:** The Role of Floodplain Restoration in Ellensburg, Washington Managed Aquifer Recharge from Overbank Floods.

**Co-Authors:** Julie Padowski

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** This project focuses on floodplain restoration benefits for Ellensburg, Washington from the renaturalization of a 130 acre and approximately 2-mile reach of the Yakima River south of Ellensburg. Along the Yakima River floodplains are substantially degraded. Primary problems are: groundwater drawdown associated with irrigation that changes base flow conditions and degrades food webs that rely on groundwater; chemical and thermal pollution that prevents proper maturation of fish eggs and juveniles; and extensive gravel mining within the floodplain reaches that has severed groundwater-channel connectivity. Floodplains offer a host of natural functions: reducing floods, peak flows, curbs sedimentation and aquifer recharge. Successfully recharging aquifers could bring multiple benefits for farms and wildlife and help restore the vital interconnection between groundwater and rivers or streams. This project asks the question, to what extent does floodplain restoration along an urbanized waterway provide flood reduction benefits, support improved groundwater recharge, and create additional riparian habitat for the Endangered Bull Trout *"Salvelinus confluentus"* and Steelhead *"Oncorhynchus m. irideus?*" Using a systems dynamics simulation model, we examine how different management decisions impact complex, dynamic systems. In the model, we explore different scenarios involving the and use conversion (e.g., forest, cropland, and rangeland) near Ellensburg to better understand how to optimize the benefits gained from a restored floodplain. The results will provide insights into floodplain restoration effectiveness, both in terms of environmental improvement (e.g., for recharge, fish) and for flood protection for developed areas. To gather data to input into our model, we used R Programming and QGIS to give us accurate numbers to produce results. The model illustrates the positive effects of an increased floodplain in an urbanized area. This concludes floodplain restoration provided benefits to an urbanized area to reduce floods and other benefits.

**Poster Number:** 44

**Student Name, *Home Institution*:** Malachi Ledbetter, *Washington State University*

**Project Title:** Soil and Water Quality for Root Health and Management Verticillium Wilt of Potato

**Co-Authors:** Hatem Younes

**Summer Research Program:** Sustainable High-value Horticulture and Processing (Doug Collins)

**Abstract:** The research I am working on is looking at how different soil amendments and irrigation schedules affect verticillium wilt in potatoes. Verticillium is a kind of fungal diseases that caused a wilt condition in potato plants. Four substrate mixes consisting of sand and mustard green manure, WSU compost, compost tea, and NPK synthetic fertilizer. Some of these substrates are inoculated with verticillium. In addition to testing the different organic soil amendments, this project is also comparing two irrigation schedules. Half the potatoes will receive two liters of water every two days, the other half will receive four liters every 4 days. Moisture sensors will measure the moisture at 6 and 12 inch depth. The impacts of the verticillium will be documented, and the biomass will be weighed.

**Poster Number:** 45

**Student Name, *Home Institution*:** Olivia Laske, *Macalester College*

**Project Title:** Aperture-matched Spectroscopy and Photometry of 132 Early-type Galaxies

**Co-Authors:** Guy Worthey, Xiang Shi, James Schombert

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

**Abstract:** Several fundamental properties, including mass, morphology, star formation history, metal content, abundance ratios, and the initial mass function, characterize early-type galaxies. In this study, we investigate 132 nearby early-type galaxies from the Calar Alto Legacy Integral Field Area (CALIFA) survey in an effort to draw connections between these properties. The CALIFA data has 1 arcsecond spatial pixels. We specifically use the V500 dataset, which has a wavelength range of 3740 to 7500 Å and a spectral resolution of 6.0 Å. Spectroscopy, integrated within a synthetic elliptical aperture equal to 1/3 of the half-light radius, is accompanied by *grizJK* photometry from the Sloan Digital Sky Survey and 2MASS survey.

To process the data, we mapped and subtracted the foreground stars in each image. We then manually inspected and flagged the central 13 individual spectra of each galaxy. Velocity field images were generated from the data cubes using cross correlation with stellar templates. In order to reduce noise in these images, we applied a 5x5 Gaussian smoothing kernel. Each spatial pixel was then corrected for Doppler shift, removing significant rotation. We combined the instrumental resolution ($\sigma$=2.55 Å), stellar velocity dispersion, and artificial Gaussian smoothing such that the final summed galaxy spectra broadened to 300 km $s^{-1}$. Spectral feature depths were measured in Å of equivalent width and were compared to models of galaxy starlight as a function of age, metal content, abundance ratios, and the initial mass function.

Most of the sample is ancient in age and at least as metal rich as the solar neighborhood. We confirm that [Mg/Fe] and [Na/Fe] increase with galaxy mass while [Ca/Fe] is nearly flat, implying a shift of supernova enrichment sources that vary with progenitor galaxy mass.

**Poster Number:** 46

**Student Name, *Home Institution*:** Joshua Pridemore, *St. Mary's University*

**Project Title:** Experimentation and Numerical Simulation of Microplastic Fiber Transport Behaviors in Porous Media

**Co-Authors:** Nicholas Engdahl, Tyler Fouty, Dakota Donaldson

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Microplastics (MPs) are a growing concern in modern environmental policy, and microplastic fibers (MPFs) are the largest source by mass. MPFs shed mainly from synthetic clothing and are commonly discharged into the environment via wastewater. Many studies have quantified the existence of MPs across diverse environments, but the transport mechanics of MPFs and their ability to pass through natural materials have not been thoroughly researched. This represents a significant research deficit in determining the extent of potential problems posed by MPFs. Measuring the detailed movements of MPFs in natural systems is extremely difficult, so a combination of laboratory experiments and modeling was used to develop MPF transport knowledge. Physical experiments used a 3D-printed, intermediate scale (50x20 cm), pseudo-2D flow cell representing an idealized porous medium. A gradient was used to drive a steady flow across the domain and fibers were injected at the inlet. The experiments were illuminated using UV lights and fluorescing fiber trajectories were captured with an HD video camera. The experimental trials involved different lengths/numbers of fibers under different flowrates. The trajectories were extracted from the video with image-capture software and this data formed the reference dataset for numerical re-creations of the experiments. The simulations were created using the MATLAB scripting environment, and preliminary results showed that MPF transport models based on flexible bead-rod chains adequately reproduce the experimental results and reflect similar trends. Some missing simulation capabilities, such as friction and electrostatic interactions between fibers, may be necessary additions. The results are important because they are the first paired physical/numerical experiments based on real MPF trajectories and the approach can be modified to accommodate any simplified 2D geometry. Increased confidence in MPF transport dynamics will lead to better hypotheses and experiments about MPF transport, and these will ultimately help to assess environmental risks posed by MPFs.

**Poster Number:** 47

**Student Name, *Home Institution*:** Guadalupe Iniguez, *Heritage Univeristy*

**Project Title:** Genome-wide Association Studies Used to Find Correlations Between Phenotypic Traits of Wheat Plants

**Co-Authors:** Michael Pumphrey, Peter Schmuker

**Summer Research Program:** Phenomics Big Data Management (Sindhuja Sankaran)

**Abstract:** Wheat a global cultural crop used in many countries and used in many different foods. It is our objective in the Spring Wheat lab to both help increase the yield for wheat in the current uprising demand in food across the world, while also meeting the appropriate quality of wheat for the intended consumer. To accomplish this goal, I believe we must understand the correlation between traits that these wheat plants possess. To do this we will be using GWAS an observational study we're you view the genome of an individual plant and look for genetic variants that may be associated to traits. We do this by finding associations within the single-nucleotide polymorphism (SNPs) which tell us if the variants are associated with the traits. SNPs that have shared significance between traits will be analyzed for their ability to optimize trait combinations. By comparing the significance between SNPs we can understand the genetic relationship between important traits to improve in wheat. Some of the traits I focused on were yield, protein, height, maturity, sedimentation testing, and spectral references values. The purpose I focused on these traits were to find how the correlations between them affected one another and then to potentially learn if these correlations might determine what consumer market the wheat should go to.

**Poster Number:** 48

**Student Name, *Home Institution*:** Arelis Baez Rosario, Vince Ferrizzi, Kelsey Heard, *University of Massachusetts, Boston, Lebanon Valley College, Morehead State University*

**Project Title:** Measuring the Effect of Professional Development for Best Practices in Crafting Exam Questions

**Co-Authors:** Erika Offerdahl

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** Professors who teach undergraduate courses in life and molecular bioscience measure the mastery of the students' content knowledge throughout a course by setting learning outcomes and goals for their students and administering tests aligned with those goals. Yet, many professors lack the formal training to develop exam questions that accurately measure student learning and therefore write exams that are misaligned with best practices in literature. Thus, to help faculty better assess student mastery of learning outcomes, professional development opportunities have been developed to inform instructors on best practices for developing exam questions that measure student learning outcomes. The goal of this study was to analyze exam questions participants submitted before and after professional development, to test the effectiveness of these types of opportunities at improving instructors' exam writing skills. Exam questions were analyzed using a coding scheme based on Michael C. Rodriguez's research that outlines criteria for clear and effective test questions as communicated through *The College Instructor's Guide to Writing Test Items: Measuring Student Learning*. Moving forward, data will be analyzed comparing the coded test question entries from before and after the workshop to determine if differences are statistically significant.

**Poster Number:** 49

**Student Name, *Home Institution*:** Arelis Baez Rosario, Vince Ferrizzi, Kelsey Heard, *University of Massachusetts, Boston, Lebanon Valley College, Morehead State University*

**Project Title:** Exploring the Effects of Task Framing on Student Learning Following the Integration of the Argumentation For Learning Framework

**Co-Authors:** Jessie Arneson, Erika Offerdahl

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** Argumentation is an authentic disciplinary practice of scientists, yet a skill that is seldom the focus of undergraduate science instruction. To address this, we used the Argumentation For Learning (AFL) framework (Asterhan & Schwarz, 2016) to design and implement two argumentation modules for large-lecture introductory biology, each of which pose a "big question" (i.e., How does the single nucleotide mutation in the GF gene affect the phenotype of Dr. Davis' tomato plants). In these modules, students were required to collaborate in small groups to analyze real scientific data and use that data to construct an argument that answers the "big question". At the end of each week, students individually constructed a written argument using the knowledge they acquired from the class. Each semester that the argumentation framework was implemented had a modification for how questions were phrased and presented to the students; one semester engaged students in inductive reasoning while the other required deductive reasoning. We found a statistically significant difference in student effort and performance between the inductive and deductive argumentation modules. To further explore the mechanism underpinning this difference, we developed a codebook to analyze students' written responses to determine the degree to which how students make connections between data sets, and how complex those connections were. We will report on our analysis of students' responses and quantify the difference in students' efforts between inductive and deductive reasoning semesters.

**Poster Number:** 50

**Student Name, *Home Institution*:** Maahi Jaiswal, *Mount Holyoke College*

**Project Title:** Antimicrobial Resistance in Foodborne Pathogens

**Co-Authors:** Dr. Stephanie Smith, Marco Perez Reyes

**Summer Research Program:** Sustainable High-value Horticulture and Processing (Doug Collins)

**Abstract:** Antimicrobial resistance is a growing public health concern due to the overuse and misuse of antibiotics. Due to this, harmful bacteria are becoming resistant to commonly used antibiotics, which could lead to severe illness for people who get infected. Specifically, common foodborne pathogens like *E. coli* and *Salmonella* have dangerous symptoms. As these pathogens are commonly found in lettuce, we chose samples of organic and conventional iceberg lettuce brands from several grocery stores in Pullman, WA. Lettuce is known to be particularly vulnerable to *E. coli*, and is usually contaminated through untreated soil amendments, contaminated agricultural water sources, and other processes in the production cycle. Due to the lack of research on the prevalence and antimicrobial resistance of these pathogens on fresh produce, this study was carried out to add to existing knowledge and examine the prevalence on lettuce. MacConkey-Sorbitol agar and XLD agar were used to identify *E. coli* and *Salmonella*, respectively. Data shows that *E. coli* were detected at high concentrations on most of the lettuce samples. However, no *Salmonella* was detected. In terms of their susceptibility to antibiotics, most of the common antibiotics were able to combat the bacteria. However, many bacteria showed resistance to clindamycin, erythromycin, ampicillin, and vancomycin, which are antibiotics commonly used to treat infections in humans. Hence, we conclude that iceberg lettuce does contain pathogenic bacteria, of which some are resistant to commonly used antibiotics.

**Poster Number:** 51

**Student Name, *Home Institution*:** Carson Beyers, *Illinois College*

**Project Title:** Domain Hypothesis of Self-healing in Disperse Orange 11 Dye-doped PMMA

**Co-Authors:** Acacia Patterson, Elliot Steissberg, Mark Kuzyk, Brian Collins

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

**Abstract:** The goal of this research is to test the hypothesis that domains of dyes are responsible for self-healing after photo-induced degradation of dye-doped polymer. Our approach is to investigate physical evidence of such domains using a variety of x-ray techniques. Aside from inconclusive preliminary studies, the structure of the domains formed by the Disperse Orange 11 (DO11) dye has yet to be extensively studied. This research seeks to replicate and expand upon previous resonant soft x-ray scattering (RSoXS) and Grazing-Incidence Wide-Angle X-ray Scattering (GIWAXS) experiments. Existing results suggest an isosbestic point at concentrations of 4, 5, and 6 weight percent of DO11 in PMMA, suggesting that two species are involved. Two procedures were used to create dye-doped PMMA samples, which were sent to ALS at Berkeley for the synchrotron experiments. Additionally, similarly-produced polymer samples are being tested for self-healing to find correlations between domain structure and healing efficiency. A squeezed polymer sample is pumped with a green pulsed laser to produce red amplified spontaneous emissions (ASE) light. As the sample burns, the dye-doped polymer degrades, and the ASE decreases. Given time to regenerate in the dark, the sample once again produces red ASE light. The RSoXS and GIWAXS data are consistent with previous research. We conclude that the GIWAXS data is unable to determine the domain structure of DO11 within the polymer of the spin-coated samples. RSoXS data is currently being analyzed for a broader range of samples to determine domain structure as a function of concentration. We are also determining if the isosbestic point is replicable or extends beyond the limits of the 4 and 6 weight percentages. These measurements and analyses will shed light on the domain hypothesis of self-healing.

**Poster Number:** 52

**Student Name, *Home Institution*:** Li Wright, *Washington State University*

**Project Title:** Evaluating Microbial Sources of Greenhouse Gas Emissions in Compost

**Co-Authors:** Dr. Courtney Gardner, Sandra Un Jan Contreras

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Composting as a waste management strategy may produce benefits including lower energy consumption and operating costs, nutrient recovery from waste input, and minimized generation of toxic leachate compared to methods such as landfilling or recycling. However, there are gaps in quantifying the potential disbenefits of greenhouse gases that may be emitted to the atmosphere through reductive microbes during biodegradation. One such greenhouse gas is nitrous oxide which is produced during an intermediary step of denitrification. Composting systems can be manipulated by changing the inputs of aerobic or anaerobic microbes, varying oxygen levels, moisture content, and temperature. A vermifiltration system modifies the composting process by using worms to treat wastewater and produce nutrient rich vermipost through worm castings. During the digestive process, worms release nitrous oxide as a byproduct, but the extent that this impacts greenhouse gas emissions is unknown. To better understand these biological processes and evaluate the sustainability of on-site waste management technologies, organic matter was sampled from Washington State University's compost facility and a vermifiltration system located in Royal City, Washington. A three-step procedure involving DNA isolation, PCR, and gel electrophoresis was used to screen for marker genes detecting methanogenic and denitrifying bacteria associated with the release of methane and nitrous oxide respectively (i.e., nirS, nirK, mcrA, norB, and nosZ). Another marker gene related to methanotrophic bacteria, that is bacteria which metabolizes methane versus producing it, was also examined (i.e. pmoA). Gel electrophoresis results indicate low to absent concentrations of nitrite reductase and methanogenic marker genes. This data supports evidence that compost systems emit relatively low concentrations of greenhouse gases.

**Poster Number:** 53

**Student Name, *Home Institution*:** Elijah Persson-Gordon, *Michigan State University*

**Project Title:** Using Images to Detect Herbicide Injury

**Co-Authors:** Andrew Herr, Arron Carter

**Summer Research Program:** Phenomics Big Data Management (Sindhuja Sankaran)

**Abstract:** Weeds in a winter wheat field can cause major yield losses. As a result, farmers typically spray herbicides to try to prevent weeds from growing. If the crop is not resistant to the herbicide, it can become injured, which can result in decreased quality, yield losses, or plant death. In recent years, the winter wheat breeding program has made it a goal to breed varieties for resistance to herbicides, which hasn't been done before. Instead, farmers might choose varieties that are known to be resistant to certain products they would like to use. In order to breed for this trait, we need to know how susceptible each variety is to the herbicide, which is done by injury scoring, where someone estimates an injury score by eye for each plot of sprayed wheat. In this project, I will be analyzing overhead images to see if we can accurately predict injury from reflectance data. If we can, this could be a step toward automating and standardizing injury measurements.

**Poster Number:** 54

**Student Name, *Home Institution*:** Ashly Bailey, *University of Louisville*

**Project Title:** Sea-level Rise Forces Adaptation Measures on King County and Quileute Reservation: Federal Funding for Climate Change May Be an Environmental Justice Issue

**Co-Authors:** Michael Goldsby

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** The earth is getting warmer, and the oceans are continuing to rise. With the rapid increase, even a slight sea-level rise can have destructive impacts on coastal areas and further inland. These effects can cause erosion, wetland flooding, aquifer and soil contamination with salt, and lost habitat for plants, animals, and people. This paper will focus on two areas affected by sea-level rise but have taken measures to preserve land and protect the population - King County and the Quileute Reservation. In both cases, adaptation strategies have been implemented, such as restoring flood plains, dam and levee maintenance creating and restoring sea walls, and placing armor rocks to protect the shoreline. These are expensive projects paid for by taxpayers, business owners, and federal funding. There is one difference between the two areas, however. King County – the most populous county in Washington and home of Seattle – has largely chosen an adapt-in-place strategy. The Quileute, on the other hand, will relocate. Initial research seems to indicate that the decision is the result of a simple cost-benefit analysis, as the per capita cost of an adapt-in-place strategy for the Quileute is many times more expensive than the per capita cost in King County. However, given historical patterns of injustice and the overly optimistic projections upon which King County's plans are based, there is a serious question as to whether the respective plans are just.

**Poster Number:** 55

**Student Name, *Home Institution*:** Olivia Hunt, *Skidmore College*

**Project Title:** Utilization of the Modified Gompertz Equation to Model Rate of Anaerobic Digestion

**Co-Authors:** Liang Yu

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** Anaerobic digestion is a process of biogas formation that provides a potential solution to our climate crisis. Anaerobic digestion occurs when anaerobic bacteria break down organic wastes in the absence of oxygen. This occurs in a four-stage process, cycling between hydrolysis, acidogenesis, acetogenesis, and methanogenesis (Meegoda, J., et al., 2018). The end result of anaerobic digestion is biogas which is 50-75% methane and 25-50% carbon dioxide (Kougias, Angelidaki., 2018). Biogas can be used for heating, cooking, energy production, or even to power cars if it is upgraded to biomethane (Atandi, E., Rahman, S. 2012). Using the modified Gompertz equation this project sought to model rates of biogas production in anaerobic systems. The Gompertz equation was first invented in 1825 by Benjamin Gompertz and later adapted into the modified Gompertz equation by Zwietering and his colleagues. The modified Gompertz equation is typically used to model bacterial growth (Tjørve, K., Tjørve, E., 2017). Factors such as potential methane yield, rate of methane production, phase delay time, and retention time are used to calculate cumulative methane yield (Recherche, L., et al., 2018). In this study, data from an experiment that looked at how the addition of iron, zinc, and zinc+2 affected cumulative methane yield were used. Using solver in excel the “um”, or rate of methane production, was calculated for each treatment group. The highest um (331.85 mLCH4g-1VS-1j-1) occurred when Zn+2 was introduced at 4mg/L to the anaerobic digester (R2=0.994). The lowest um (4.73 mLCH4g-1VS-1j-1) occurred when Zn+2 was introduced at 2g/L to the anaerobic digester (R2=0.869). This study further supports the validity of the Gompertz equation as a method of modeling rate of anaerobic digestion under different conditions.

**Poster Number:** 56

**Student Name, *Home Institution*:** Alexandra Hurd, *Macalester College*

**Project Title:** Enhancing Charge Lifetimes in Organic Solar Cells Through Less Toxic Processing

**Co-Authors:** Awwad Alotaibi, Brian Collins

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

**Abstract:** Printable and flexible solar panels are promising sources of cheap, large-scale renewable energy. Polymer inks are deposited onto sheets of plastic to form thin layers of carbon-based solar cells. Despite the efficiency of printable manufacturing, there are some limitations to these solar cells. First, toxic halogenated solvents have historically been necessary to dissolve polymers to make the ink. Additionally, charges must be separated in the cell for a certain amount of time for the cell to be efficient in its light-to-energy conversion. Many of these organic solar cells have high rates of charge recombination, which shortens their lifetimes of separation. Here, we use a transient photovoltage (TPV) technique to measure these charge lifetimes in cells made from two different organic solvents. The first solvent is toxic, halogenated dichlorobenzene (DCB) which is typically used to make organic solar cells. The other is a less toxic, non-halogenated solvent, carbon disulfide ($CS_2$). By varying the processing methods in this way, we find that cells made from $CS_2$ have longer charge lifetimes and higher efficiencies than those made with DCB. This indicates that moving forward, we may be able to decrease the toxicity of organic solar cell manufacturing and simultaneously improve the efficiency of the devices, bringing this powerful method of capturing solar energy to the forefront of sustainable design.

**Poster Number:** 57

**Student Name, *Home Institution*:** Shastine Huddleston, *Lewis-Clark State College*

**Project Title:** Thermal Desorption-Gas Chromatography-Mass Spectrometry Analysis of Volatile Organic Compounds Emitted from Compost

**Co-Authors:** Rosario Morales, Nancy A. C. Johnston

**Summer Research Program:** Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley)

**Abstract:** Volatile Organic Compounds (VOCs), substances that are easily vaporized from liquid or solid phase, make up some of the many odorous emissions that come from compost. At the Washington State University (WSU) compost facility, compost was sampled by pumping air within the pile through a cold trap apparatus and into an air sorbent tube. The samples were then analyzed via thermal Desorption-Gas Chromatography-Mass Spectrophotometry (TD-GC-MS) to quantify over 100 compounds. Terpenes and sulfides were abundant in compost samples with concentrations ranging up to 900 ppbv for Terpenes and 500 ppb for Sulfides. Most emissions were not air toxics.

**Poster Number:** 58

**Student Name, *Home Institution*:** Alexis Pleskovitch, *Allegheny College*

**Project Title:** Student Responses and Learning Gains in Physics and Your World

**Co-Authors:** Anya Guy

**Summer Research Program:** Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl)

**Abstract:** The Physics and Your World course at Washington State University aims to teach students about core ideas in physical and space science, science and engineering practices covered in the Next Generation Science Standards (NGSS), and how to use the crosscutting concepts also included in NGSS that scientists and engineers use in order to develop and refine their ideas. Learning gains from the Mechanical Waves Conceptual Survey Version 2 (MWCS2) were evaluated by looking at both normalized gain and effect size. Students took the survey at the beginning of the semester and once the class was concluded. The overall normalized gain was 0.101 and the average normalized gain for students who took both the pre and post surveys was 0.123. Questions from the MWCS2 were also grouped into categories based on content and the learning gains for each type of question were evaluated individually. Qualitative analysis of student responses on the color spectrum worksheet showed that students were able to move through the activity and some were able to justify their claims. However, many students do not back up their answers and even more do not make connections between their observations and the concepts in order to answer all parts of the question. Qualitative analysis on the worksheet questions will be used in the future to make informed changes about the alteration of curriculum. The goal of altering the worksheets in the optics and waves curriculum is to help change the way students reflect on their ideas and communicate them, and student responses to the altered worksheets in the future will be used to further develop and improve the curriculum.

**Poster Number:** 59

**Student Name, *Home Institution*:** Landon Chase, *Ohio State University*

**Project Title:** Systems Dynamic Modeling to Evaluate the Feasibility of Biochar Production in Washington State

**Co-Authors:** Manuel Garcia-Pérez, Lina Martínez Valencia, Valentina Sierra Jimenez

**Summer Research Program:** Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski)

**Abstract:** Biochar is a soil amenity that can be created from taking biomass and heating at high temperatures with the absence of oxygen, this process being known as pyrolysis. There are many benefits of biochar such as carbon sequestration, increased soil fertility, better water retention and many more. Some research has been done on ways to increase biochar production by incentives to decrease cost. With this being said, this work will focus on finding methods that will make the production of biochar cost efficient which is important If we want it to be implemented. Through the use of technoeconomic analysis and systems modeling, the supply chain and production of biochar was manipulated to help find ways to increase profits and find suitable locations for the production at preexisting biomass plant. Using modeling systems such as ASPEN and STELLA we were able to simulate the supply chain of biochar. With this model we found that it would in fact be cost efficient to build this biochar facilities. More work is being done to see where it would be most profitable to build these facilities, and where it would be most logical to add biochar producing equipment into preexisting biomass factories. This work will help increase the likelihood of biochar becoming a more prominent use of soil amenities and help to reduce greenhouse gas effect via soil carbon sequestration.

**Poster Number:** 60

**Student Name, *Home Institution*:** Steven Hernandez, *California State University San Marcos*

**Project Title:** Tilt and Bowing of High Velocity Projectiles

**Co-Authors:** James Hawreliak, Nate Arganbright, Kurt Zimmerman

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

**Abstract:** Preparations for this short time scale impact experiment were extremely careful and precise (micron scale) in order to achieve a high level of accuracy. Shock physics experiments such as these help us understand the properties of matter at uniquely extreme conditions, which is characteristic of several natural and man-made environments. Applications from these experiments vary from safe and efficient use of energetic materials to the understanding of other planets in the universe.

A two-stage light gas gun was used for the experiments. Copper impactors and target pieces were lapped to create a near uniform smooth and flat surface, while impactors were also polished to create a scratch-free and specular surface. Projectiles and targets were fully assembled with a variety of mechanical and optical equipment. Connected probes gave the impact times of four different points on the target surface allowing us to calculate a well estimated tilt and bowing.

Projectile velocity was increased in three experiments with a low of 13,283 mph and a high of 16,699 mph. Initial analysis revealed bowing values between 10-15 microns (deviations at the center of the impactor) and tilt angles between 7-10 milliradians. Bowing values are reproducible because they're caused by the stresses applied to the projectile when accelerated, while tilt is a stochastic process because of the unknown twisting and turning of the projectile inside the barrel of the gun.

**Poster Number:** 61

**Student Name, *Home Institution*:** Richard Castro, *Washington State University*

**Project Title:** Wearable Computing

**Co-Authors:** Ramesh Sah, Hassan Ghasemzadeh

**Summer Research Program:** Wearable Computing (Hassan Ghasemzadeh)

**Abstract:** Our daily lives produce stress for different reasons. Each of us knows when we are stressed and usually know why as well but how do we make a machine understand that? Our goal is to build a system which can detects stress in real time in daily living conditions. To answer that question, we aim to develop an app that can run on smartphones and do stress classification. We need to be able to differentiate normal circumstances and stressful ones. Data received from the Empatica E4 wristband will be used to train machine learning models. These models will be reconfigured as more data is fed in to get better accuracy on classifying stress. The trained models will be deployed on smartphones. During the summer, I built the infrastructure to communicate with the Empatica E4 wristband via Bluetooth and store the received sensor data for further analysis. The application will be run continuously in the background to be able to get a full reading. All this will let us help a machine detect stress which can be used in numerous other situations.

| # | Name (*Home Institution*) | Project Title | Program |
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| 8 | Sienna Alicea (*North Central College*) | Improving Satellite Imagery-based Estimates of Crop Residue Cover in the Pacific Northwest by Integrating Moisture Dependency Effects | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |
| 48 | Arelis Baez Rosario (*University of Massachusetts, Boston)* , Vince Ferrizzi (*Lebanon Valley College*), Kelsey Heard (*Morehead State University*) | Measuring the Effect of Professional Development for Best Practices in Crafting Exam Questions | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 49 | Arelis Baez Rosario (*University of Massachusetts, Boston)* , Vince Ferrizzi (*Lebanon Valley College*), Kelsey Heard (*Morehead State University*) | Exploring the Effects of Task Framing on Student Learning Following the Integration of the Argumentation For Learning Framework | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 54 | Ashly Bailey (*University of Louisville*) | Sea-level Rise Forces Adaptation Measures on King County and Quileute Reservation: Federal Funding for Climate Change May Be an Environmental Justice Issue | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 33 | Brian Bauer (*Siena College*) | Searching for Equilibration of Quantum Turbulence | Waves in the Universe and Technology (Brian Collins) |
| 51 | Carson Beyers (*Illinois College*) | Domain Hypothesis of Self-healing in Disperse Orange 11 Dye-doped PMMA | Waves in the Universe and Technology (Brian Collins) |
| 35 | William Bieker (*Western Washington University*) | Raspberry Color Analysis of 10 New Varieties of Berry | Phenomics Big Data Management (Sindhuja Sankaran) |
| 9 | Steven Binder (*The University of Georgia*) | XLINX Satellite Communication System | Phenomics Big Data Management (Sindhuja Sankaran) |
| 7 | Sasha Campana (*Randolph-Macon College*) | A Comparison of Variable and Spectroscopically Selected Active Galactic Nuclei in Dwarf Galaxies | Waves in the Universe and Technology (Brian Collins) |
| 10 | Kayden Cantrell (*Willamette University*) | COVID-era Teaching Tools: An Assessment of Learning Gains Across In-person, Online, and Hybrid Formats of a Developmental Biology CURE | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 61 | Richard Castro (*Washington State University*) | Wearable Computing | Wearable Computing (Hassan Ghasemzadeh) |
| 37 | Daniel Chaidez (*Cal Poly Humboldt*) | Dynamic Modeling of the Marginal Costs of Sunburn Prevention Methods in Apple Orchards | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 59 | Landon Chase (*Ohio State University*) | Systems Dynamic Modeling to Evaluate the Feasibility of Biochar Production in Washington State | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 22 | Leilani Concepcion (*Washington State University*) | Testing the Effect of Hydroxycinnamates on the Immune Response of Rice Plants | Plant Biofuels and Functional Genomics REU (Laura Bartley) |
| 28 | Tommy Conway (*Washington State University*) | Using Molecular Techniques to Investigate the "Green Bridge" Effect in a Dryland Wheat System | Improving Crop Resiliency: Agriculture in Changing Climate (Matthew Peck and Andrei Smertenko) |

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| 26 | Grace Cooper (*Gonzaga University*) | Effectiveness of Azotobacter Mutant AvFM2 at Rhizosphere Colonization and Ammonium Secretion for Plant Growth Optimization | Plant Cell Biology and Biochemistry (Andrei Smertenko) |
| 24 | Zachary Cunningham (*Lewis-Clark State College*) | Sustaining Oil Production in Response to Climate Change | Plant Cell Biology and Biochemistry (Andrei Smertenko) |
| 3 | Nhu-Y Do (*Bellevue College*) | Enumeration and Confirmation of Bacillus cereus in Cooked Rice Noodles Stored at Different Temperatures | Sustainable High-value Horticulture and Processing (Doug Collins) |
| 1 | Dakota Donaldson (*Frostburg State University*) | Transport Mechanics of Microplastic Fibers in a Porous Media Model | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |
| 38 | Breana Downs (*Pacific Lutheran University*) | Protein Solubility's Correlation with Direct Expansion During Twin-Screw Extrusion Processing | Sustainable High-value Horticulture and Processing (Doug Collins) |
| 32 | Sofia Franzluebbers (*University of Guelph*) | Fruit Firmness Assessment for High Quality Sweet Cherries | Sustainable High-value Horticulture and Processing (Doug Collins) |
| 17 | Brandt Geist (*Cornell University*) | Evaluating the Streamflow Augmentation Potential of Partially Leasing Agricultural Water Rights via Deficit Irrigation under Future Climate Change Scenarios | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 13 | Alex Heinrich (*Washington State University*) | Rubidium Repolarization by Hyperpolarized Xenon | Waves in the Universe and Technology (Brian Collins) |
| 60 | Steven Hernandez (*California State University San Marcos*) | Tilt and Bowing of High Velocity Projectiles | Waves in the Universe and Technology (Brian Collins) |
| 41 | Kevin Hernandez-Ramos (*Wenatchee Valley College*) | Role of Image Ortho-rectification on Crop Vegetative Indices | Phenomics Big Data Management (Sindhuja Sankaran) |
| 57 | Shastine Huddleston (*Lewis-Clark State College*) | Thermal Desorption-Gas Chromatography-Mass Spectrometry Analysis of Volatile Organic Compounds Emitted from Compost | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |
| 55 | Olivia Hunt (*Skidmore College*) | Utilization of the Modified Gompertz Equation to Model Rate of Anaerobic Digestion | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 56 | Alexandra Hurd (*Macalester College*) | Enhancing Charge Lifetimes in Organic Solar Cells Through Less Toxic Processing | Waves in the Universe and Technology (Brian Collins) |
| 5 | Sandra Illescas (*California State University Northridge*) | Examining the Impacts of a CURE in an Undergraduate Introductory Biology Course for Minoritized Groups | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 47 | Guadalupe Iniguez (*Heritage Univeristy*) | Genome-wide Association Studies Used to Find Correlations Between Phenotypic Traits of Wheat Plants | Phenomics Big Data Management (Sindhuja Sankaran) |
| 31 | Tessa Irvine (*Allegheny College*) | Responding to Drought Conditions in the Roza Irrigation District | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 50 | Maahi Jaiswal (*Mount Holyoke College*) | Antimicrobial Resistance in Foodborne Pathogens | Sustainable High-value Horticulture and Processing (Doug Collins) |
| 6 | Duncan Jurayj (*Brown University*) | Modeling the Impact of Cropping Systems on Irrigation Reliability | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 2 | Jared Kelnhofer (*Washington State University*) | Self-supervised Vs LSTM Approach to EEG Emotion Detection Tasks | Wearable Computing (Hassan Ghasemzadeh) |

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| 15 | Aengus Kennedy (*Tufts University* ) | Developing Phenomics Tools for Pea Breeding | Phenomics Big Data Management (Sindhuja Sankaran) |
| 45 | Olivia Laske (*Macalester College* ) | Aperture-matched Spectroscopy and Photometry of 132 Early-type Galaxies | Waves in the Universe and Technology (Brian Collins) |
| 44 | Malachi Ledbetter (*Washington State University* ) | Soil and Water Quality for Root Health and Management Verticillium Wilt of Potato | Sustainable High-value Horticulture and Processing (Doug Collins) |
| 19 | Alexander Lewis (*Loyola University Chicago* ) | Off-Resonant Optical Pumping in Rb-Xe Mixtures | Waves in the Universe and Technology (Brian Collins) |
| 12 | Andrew Liu (*University of Pittsburgh* ) | Validation of Enterococcus Faecium NRRL B-2354 as a Surrogate of Listeria Monocytogenes During Sanitizer Intervention in Simulated Water | Sustainable High-value Horticulture and Processing (Doug Collins) |
| 20 | Lourdes Loera (*Arizona State University* ) | Evaluating the Transport of the Antibiotic Resistance Gene NPTII in Saturated Soil | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |
| 39 | Jennifer Lopez (*Grinnell College* ) | Analysis of Kapitza-Dirac Scattering of a Rb-87 Bose-Einstein Condensate | Waves in the Universe and Technology (Brian Collins) |
| 42 | Madeline Lorquet (*Rockland Community College* ) | Bridging Equity Gaps in General Chemistry with a Novel Prep Chem Class | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 43 | Giselle Malloy (*University of Connecticut* ) | The Role of Floodplain Restoration in Ellensburg, Washington Managed Aquifer Recharge from Overbank Floods. | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 34 | Rosario Morales (*Lewis-Clark State College* ) | Headspace-Gas Chromatography Analysis of Volatile Organic Compounds from Compost | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |
| 23 | Carissa Morrison (*Eastern Washington University* ) | Examining the Regulation of Alpha-amylase During Grain Germination, a First Step Towards Controlling Preharvest Sprouting in Wheat. | Plant Cell Biology and Biochemistry (Andrei Smertenko) |
| 11 | Sara Murillo (*The University of Texas at Austin* ) | Integrating Pumped Storage Hydropower with Renewable Energy Sources to Improve Electric Grid Reliability and Financial Stability | Stakeholder Informed Modeling of Innovations in the FEW (Julie Padowski) |
| 4 | Nhan H. Nguyen (*Washington State University* ) | Quantifying Superficial Scald in Granny Smith Apple Using Image Segmentation Techniques and a Convolutional Neural Network | Phenomics Big Data Management (Sindhuja Sankaran) |
| 14 | Rowan Orlijan-Rhyne (*Swarthmore College* ) | Modeling Crop Residue's Effect on Sugarcane Soil Moisture | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |
| 53 | Elijah Persson-Gordon (*Michigan State University* ) | Using Images to Detect Herbicide Injury | Phenomics Big Data Management (Sindhuja Sankaran) |
| 58 | Alexis Pleskovitch (*Allegheny College* ) | Student Responses and Learning Gains in Physics and Your World | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 29 | Edwin Polanco (*University of Massachusetts Boston* ) | Automated Image Processing of Pear Rootstock Seedling Vigor Using PlantCV | Phenomics Big Data Management (Sindhuja Sankaran) |
| 46 | Joshua Pridemore (*St. Mary's University* ) | Experimentation and Numerical Simulation of Microplastic Fiber Transport Behaviors in Porous Media | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |

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| 30 | Emma Stacey (*Georgia State University* ) | Health Education through Arts-based Learning (HEAL): Examining Systems Thinking and the Impact of Out of School Contexts Within an Afterschool Science Program | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 21 | Scottie Teichmer (*Lewis-Clark State College* ) | Testing for a New Immunity Trigger in Rice: Luminol Hrp Assay to Test for Ros Response to Elicitor Hydroxycinnamates Ferulic Acid and P-coumaric Acid in Rice Leaf | Plant Biofuels and Functional Genomics REU (Laura Bartley) |
| 18 | Daviti Vardishvili (*Washington State University* ) | Supporting ornamental, flower, and bulb crop productions in the Pacific Northwest through applied research | Sustainable High-value Horticulture and Processing (Doug Collins) |
| 27 | Bethlehem Yohannes (*Eastern Washington University* ), Hunter Whitlock (*Innovation High School* ) | Effects of MACET on Microtubule Dynamics | Plant Cell Biology and Biochemistry (Andrei Smertenko) |
| 25 | Dasha Winterer (*Washington State University* ) | Impacts of Nitrogen Fixing Bacteria on Plant Growth and Morphology in Soils of the Palouse | Plant Cell Biology and Biochemistry (Andrei Smertenko) |
| 52 | Li Wright (*Washington State University* ) | Evaluating Microbial Sources of Greenhouse Gas Emissions in Compost | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |
| 16 | Cleve Young (*University of Nebraska-Lincoln* ) | A Development CURE for Vision and Change: Do Cures Advance Learning of Key Competencies and Extend Scientific Thinking From the Classroom Into Their Lives? | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 36 | Braelyn Young (*West Virginia University* ) | Health Education through Arts-based Learning (HEAL): Examining Systems Thinking and the Impact of Out of School Contexts Within an Afterschool Science Program | Research in Interdisciplinary STEM Education (RISE) (Erika Offerdahl) |
| 40 | Matthew Zaragoza (*University of Virginia* ) | A Climate Change Impact Projection for Heat Damage of Blueberries | Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest (Shelley Pressley) |

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**Summer Research Symposium 2022**

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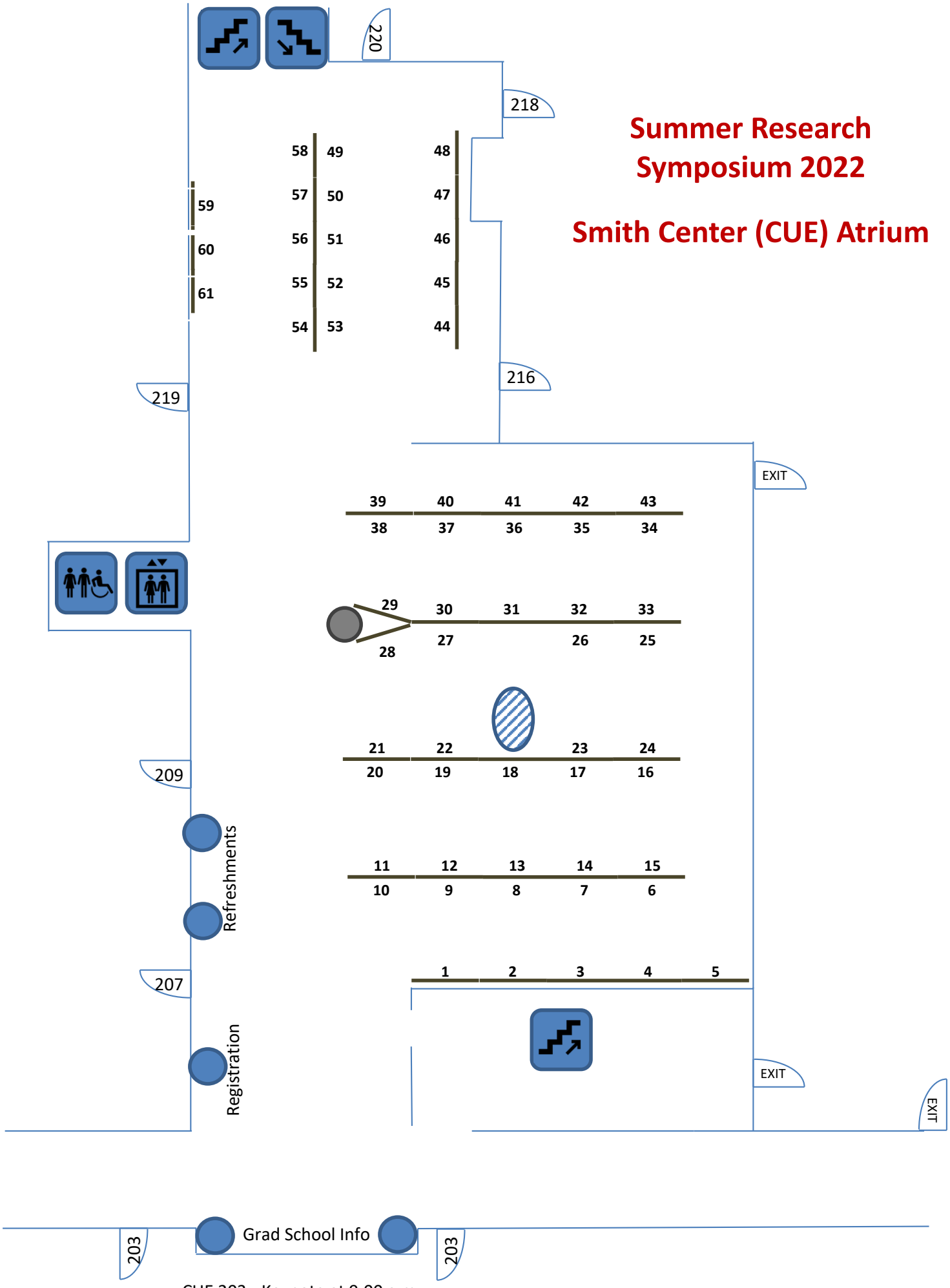


CUE 203 - Keynote at 9:00 a.m.