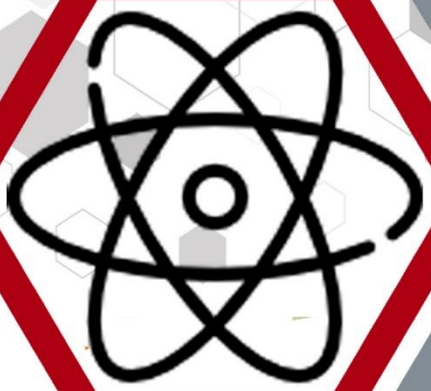
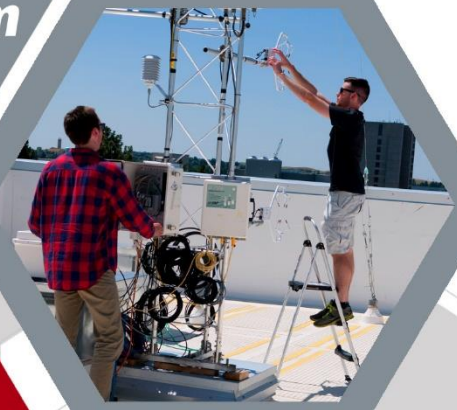
WASHINGTON STATE UNIVERSITY

SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM 2018



Friday, Aug. 3
10 a.m. to 1 p.m.
Smith CUE Atrium

Keynote Speaker:
Michael P. Wolcott
9 a.m. - CUE 203



Office of
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Presenters by Location

#	Full Name	Program	Poster Name
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17	Paolo Coronel	Research Opportunities for Native Undergraduate Students	**Sequencing MLO Genes of Different *Vitis vinifera* Cultivars**
18	Arani Cuevas-Sanchez	Wes Dowd	**Thermal Preference Assay of *Tigriopus californicus* Acclimated to Constant and Fluctuating Temperatures**
19	Saul De La Pena	Thomas Okita	**Investigating the Role of a Pho1 Domain in Rice Plants**
20	Jillian Denison	Atmospheric Chemistry REU	**Using Biochar to Reduce Compost Odor**
21	Zac Dockins	Research Opportunities for Native Undergraduate Students	**Characterization of the silk1 Mutation**
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37	Nhu Huynh and Abigail Holder	Gerontechnology (GSUR)	**Comparing Functional Abilities Between MCI and Healthy Older Adults Using the Night Out Task**
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#	Full Name	Program	Poster Name
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#	Full Name	Program	Poster Name
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56	Autumn Miller	Wes Dowd	**Effects of Thermal Acclimation on Temperature-dependent Activity Levels of the Splashpool Copepod *Tigriopus californicus***
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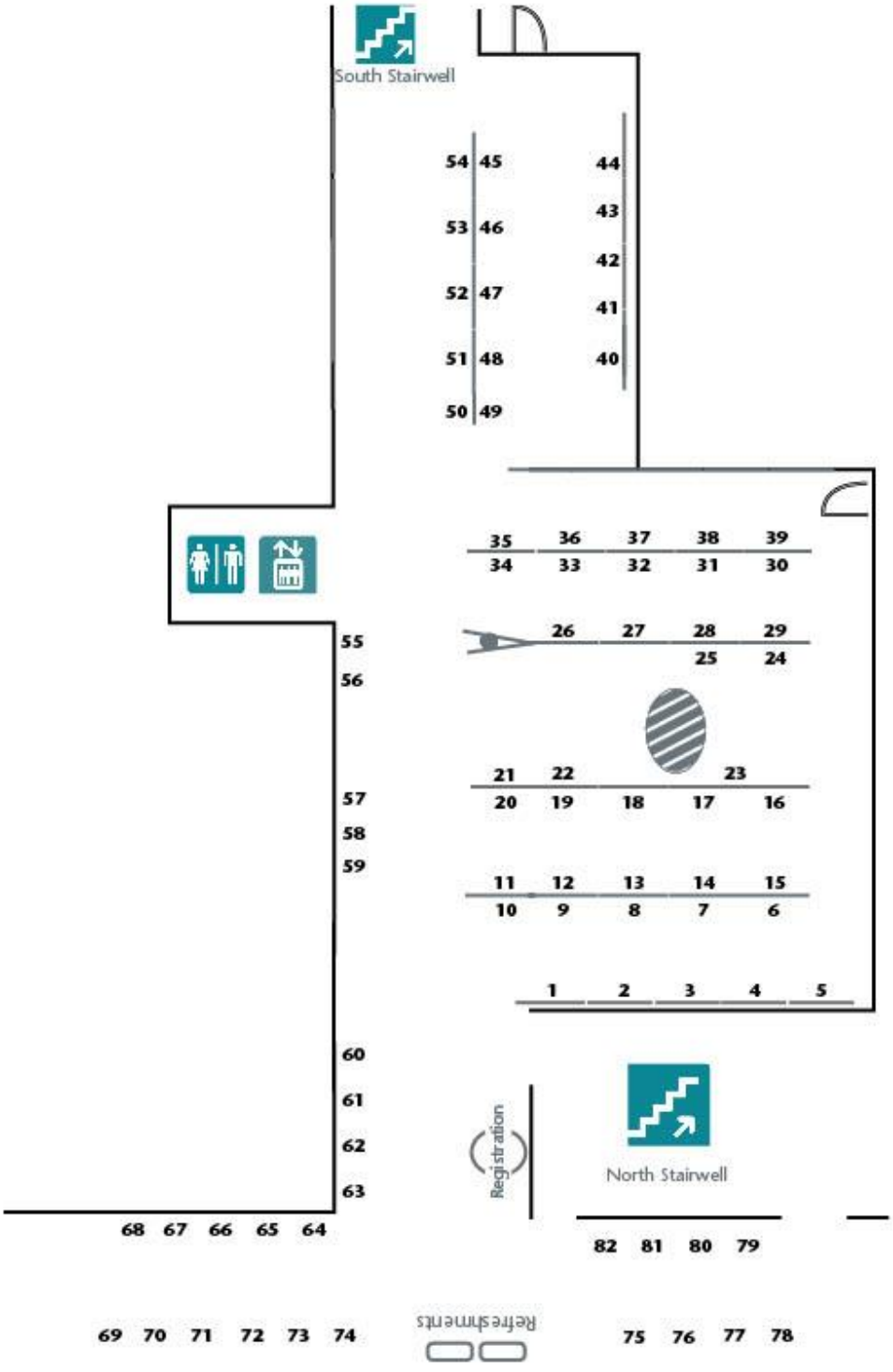
Event Floor Plan



Poster: **1**	Tissue Usage and Freezing Techniques For Rat and Human Cardiac Muscle	Poster: **1**

Undergraduate Researcher: Keinan B. Agonias

Program: Research Opportunities for Native Undergraduate Students

Co-authors: David C. Dewitt, Peter O. Awinda, and Bertrand C.W. Tanner

Home Institution, Major, Class Standing: The University of Hawaii at Hilo, Biology, Junior

Abstract:

The structural and functional relationships of muscle are important due to the highly specific organization of proteins within the cells and tissue. The organization and function of proteins in cardiac muscle tissue may change with diseases, as we have seen in preliminary studies using human tissue donors and heart failure patients that were immediately frozen in liquid nitrogen. We investigated multiple freezing techniques on fresh rat left ventricle and human septum to determine the best approach to minimize freezing artifacts and limit structural tissue damage. Establishing the best technique for optimal cellular, molecular, and pathological evaluations of the tissue will benefit future studies in our laboratory. The rat tissue was treated three ways: frozen using isopentane (2-methylbutane) cooled to -145ºC, frozen directly into liquid nitrogen, and placed directly into a -80ºC freezer. As a secondary control group, we also thawed the samples frozen directly into liquid nitrogen and placed directly into the freezer, then refrozen them isopentane. Tissue was sectioned on a cryostat, fixed on slides, and stained using Haematoxylin and Eosin (H&E) to look at the cellular structure of the cardiac tissue. The human heart tissue (which was originally frozen in liquid nitrogen) was prepared in a similar fashion as the rat tissues. These histological results reveal that freezing the tissues in isopentane showed the least amount of freeze-damage artifact, and preserved the structural organization better than the other techniques. Additionally, we found that refreezing thawed tissue samples in isopentane increased freeze-damage artifacts and appears to further deteriorate structural organization of the cardiac tissue. These findings indicate that freezing fresh tissue in isopentane at -145ºC is the most appropriate technique to minimize freezing artifacts and limit structural tissue damage, which should benefit the viability and accuracy of future experiments assessing human cardiac function in donors and heart failure patients.

Poster: **2**	Synthesis of Naphthalene Diesters for the Development of PEN Plastics	Poster: **2**

Undergraduate Researcher: Roman Amorati

Program: Bioplastics & Biocomposites

Co-authors: Huangchao Yu and George Kraus

Home Institution, Major, Class Standing: The Ohio State University, Chemical Engineering, Senior

Abstract:

Polyethylene naphthalate (PEN) is a polyester seen as a possible competitor to polyethylene terephthalate (PET), due to its similar but improved thermal and mechanical properties. However, the current feedstocks of 2,6-naphthalenedicarboxylic acid (2,6-NDA) and dimethyl-2,6-naphthalenedicarboxylate (2,6-NDC) monomers are expensive in comparison to PET monomers, limiting the use in the market. This study introduces new, bio-based, and scalable methods of synthesis for naphthalene diester derivatives from methyl coumalate, which can be obtained naturally from malic acid. Two successfully synthesized diesters, dimethyl 2,7-naphthalenedicarboxylate (2,7-NDC) and 1,5-dimethoxy-2,6-naphthalenedicarboxylate (m-2,6-NDC), in comparison to 2,6-NDA/NDC, offer a reduced cost of synthesis, and potentially similar or improved thermal and optical properties.

Poster: **3**	2-Dimensional Immunoassay of Prostate Cancer Exosomes for Early Detection Blood Test	Poster: **3**

Undergraduate Researcher: Evan Anderson

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Shuang Guo and Wen-ji Dong

Home Institution, Major, Class Standing: Washington State University, Chemical Engineering, Senior

Abstract:

Traditional blood tests used in cancer detection target either the cells themselves or easily identifiable proteins which are released during cellular necrosis. Both of these approaches carry the significant downside of being ineffective until high cell counts are present in the blood, typically occurring after the cancer has metastasized. Often, the detection window of such tests takes place too late in a cancer's progression for easy treatment. The use of exosomes, which are emitted in large numbers and at all stages of cancer development is therefore appealing in blood tests aimed at initial detection. This study seeks to demonstrate the viability of an exosome-based 2-dimensional Lateral Flow Immunoassay (LFIA) for yes/no identification of prostate cancer's presence and analysis of cell behavior through expressed proteins. Our test chip makes use of antibody-printed nitrocellulose paper to electrophorese and immobilize target exosomes. Mechanical oscillation is then used to lyse the exosomes, allowing the contents to be run in a perpendicular, protein electrophoresis. Isotachophoretic pre-concentration and chemical post treatment are employed to increase the sensitivity of both electrophoresis phases. The data collected exhibits a 100 fold concentration increase in the exosome sample and 900 fold increase for the released protein can be achieved through isotachophoresis. Chemical post-treatment improves test sensitivity by a more meager factor of 3, and antibody capture was found to bind approximately 50% of mobile exosomes, allowing lower detection threshold when compared to other LFIAs. Further research will examine filtration of whole blood through the nitrocellulose paper, simultaneous capture of different exosome species, and whether mechanical lysis of the exosomes can be conducted without disturbing the system. Results thus far indicate that a 2-dimensional exosome LFIA is a likely candidate for a fast and inexpensive blood test for prostate cancer while maintaining lower detection threshold than conventional approaches.

Poster: **4**	Examination and Quantification of *Rhizobium leguminosarum* Exopolysaccharide Characteristics and Their Relation to Host Specificity	Poster: **4**

Undergraduate Researcher: Amanda Antoch

Program: Maren L. Friesen

Co-author: Maren L. Friesen

Home Institution, Major, Class Standing: Washington State University, Data Analytics, Junior

Abstract:

Trifolium species form a mutualistic relationship with the nitrogen fixing soil bacterium *Rhizobium leguminosarum*. Symbiosis is dependent on the adhesion of rhizobium via carbohydrates and proteins imbedded in the outer membrane, to root hairs covered in cell receptors. A specific polysaccharide signal from the rhizobium known as a Nod factor induces the formation of nodules. Within these nodules, the rhizobium begin to fix atmospheric nitrogen for the plant and receive carbon and other resources in return. The Nod factor genes play a role in host specificity, a mechanism through which rhizobium differentiate between potential hosts based on the signals exchanged with the roots and establish the mutualistic relationship. However, it is possible that the host also is able to identify bacteria by the exopolysaccharides (sugars) they exude or present. The exopolysaccharides are significant in cell adhesion to the root hairs, demonstrating a role in the host's partner choice. Thus, if multiple rhizobia strains which occupy the same host species exhibit similar exopolysaccharide characteristics, then it could indicate the use of exopolysaccharides as a mechanism of partner choice and host specificity. Multiple tests were conducted to determine chemical composition and overall quantity of polysaccharides, as well as exopolysaccharide properties such as viscosity and adherence. Isolation techniques were used to separate exopolysaccharides from the exterior of the cells prior to conducting colorimetric assays to determine quantities of EPS and general concentration of carbohydrates present. Using these data, rhizobia strains will be grouped into operational taxonomic units (OTUs) to establish the relationship between host association and rhizobial exopolysaccharides.

Poster: **5**	Impact of Biochar on Tomato Biomass	Poster: **5**

Undergraduate Researcher: Paula Aubrey

Program: Plant Genomics and Biotechnology

Co-authors: Daylen Isaac and Amit Dhingra

Home Institution, Major, Class Standing: University of Idaho, Dietetics, Junior

Abstract:

Biochar is created through the process of pyrolysis. Pyrolysis is the process in which materials are heated to high temperatures in low oxygen levels. The conversion of the material to biochar results in a substance high in nutrients and carbon. Biochar produced from crop wastes or manure materials have greater nutrient contents than woody materials, and as such not all biochars are created equal in their nutrient availability to plants. When applied to soil, biochar has been shown to increase soil fertility, carbon content, and water holding capacity. Crops grown in an organic setting tend to have up to 35% yield deficits when compared to conventional methods. Previous biochar studies have attempted to determine whether the use of biochar can overcome the yield loss typically found in organic settings. 'Oregon Spring' tomatoes were grown under greenhouse conditions using two biochar sources. Previous studies demonstrated tomato plants grown in biochar amended soils exhibit greater biomass and yields compared to tomato plants grown in conventional non-biochar amended soil. Our study aims to determine if two biochar sources contribute to differential root and shoot biomass of the 'Oregon Spring' cultivar. Dry biomass of roots and shoots were measured at three time points during the six-week time period of our study. Tomato plants were fertigated with organic fertilizer biweekly. We hypothesized: (1) the addition of biochar will increase overall biomass, (2) there will be observable biomass differences between treatment groups at varying time points. Our data suggests discrete biochars have differing growth effects on the 'Oregon Spring' cultivar.

Poster: **6**	Increasing the Interfacial Bonding in Agave Fiber-polypropylene Biocomposites to Improve Mechanical Properties	Poster: **6**

Undergraduate Researcher: Shelby Bicknell

Program: Bioplastics & Biocomposites

Co-authors: Cindu Annandarajah, David Grewell, Reza Montazami, and Hana Gouto

Home Institution, Major, Class Standing: Pittsburg State University,
Plastics Engineering Technology, Senior

Abstract:

Biocomposites are a growing area of research as the need to decrease our carbon footprint increases. Natural fillers are commonly used in composites and have advantages over other types of reinforcing materials. Blue-agave fiber is the byproduct of tequila manufacturers. By using this fiber, less petroleum-based polymers will be used and the product will be lighter and economically advantageous. Polypropylene has various uses, but a key application of this plastic lies in the automotive industry. Common automotive parts molded out of polypropylene include bumpers, chemical tanks, cable insulations, gas cans and carpet fibers. By creating a practical agave fiber-polypropylene composite, greater fuel efficiency will be achieved. In this project, various agave fiber loading levels, drying times, and number of fiber wash-cycles were studied in order to improve interfacial bonding between the fiber and matrix polymer. The bond between the fiber and plastic is weak due to the hydrophilic natural of the agave and hydrophobic nature of the polypropylene. The substituents repel each other, and in turn, deteriorate their mechanical properties. It was found increasing the fiber loading level increased stiffness but reduced elongation. The fibers that were washed three times had better mechanical properties than the fibers that only underwent one wash cycle. Additionally, the odor was improved in the fibers washed three times because these fibers had less sugars. The pellets that dried for 8 hours prior to injection molding performed better than the pellets that dried for 4 hours. The material that dried for 16 and 32 hours had improved properties from the 8-hour dry time material, but not significantly.

Poster: **7**	Developing sustainable barrier materials based on polysaccharide poly-electrolyte complexes for improved food packaging	Poster: **7**

Undergraduate Researcher: Samuel Bigbee-Hansen

Program: Bioplastics & Biocomposites

Co-authors: Tuhua Zhong, Nathaniel Wallin, and Michael Wolcott

Home Institution, Major, Class Standing: Washington State University, Materials Science and Engineering, Senior

Abstract:

The oceans of the world are full of petroleum based non degradable plastics. A source of this plastic is packaging films that make packages difficult to completely recycle. Biodegradable, bio based barrier materials such as polysaccharide nanofibers have shown promise to be a green alternative to synthetic barrier materials such as polypropylene (PP) or ethylene-vinyl alcohol copolymer (EVOH). However their barrier performance is still inferior, especially in environments of high humidity. The main focus of this research is to develop competitive sustainable barrier materials out of polysaccharide polyelectrolyte complexes (PPC) that have enhanced barrier performance of polysaccharide based nanomaterials. The two polysaccharide's used in this project are chitin and cellulose, which are modified to have opposite charges from one another. The chitin is positively charged by chemically reacting the chitin in solution with NaOH to deacetylate the hydroxide groups that hang off of chitin. The negatively charged cellulose is prepared by using a TEMPO-oxidation treatment to carboxylate the similar hydroxide groups off of the cellulose. Both chitin and cellulose are run through a high pressure homogenizer separately to reduce fiber size and then mixed together. The surface charge of these polysaccharide's can be altered by changing the reaction conditions, such as time of the run and concentration of the active reagents. The effort currently is to create a water stable PPC, to further investigate the effect of parameters such as ph, mass ratios, blending techniques etc. Further research will tabulate the performance of the PPC against air, water and oil. Ultimately evaluating the economic feasibility of the PPC for use in food packaging as a barrier material.

Poster: **8**	Machine Learning for Efficient Genome Assembly Construction: A Ranking-based Approach	Poster: **8**

Undergraduate Researcher: Marcus Blaisdell

Program: Smart Environments

Co-author: Janardhan Rao Doppa

Home Institution, Major, Class Standing: Washington State University, Computer Science, Junior

Abstract:

The genome is a blueprint to build a complete organism. By determining the specific gene variations of a specific organism, we can learn how it does what it does and even customize treatments that it will respond to better than generic ones that are designed to affect multiple variations. Genome assembly is achieved by processing data from multiple reads from a sequencing process that produce large amounts of data. The sequencing process produces many random errors. Methods such as FastEtch gene assembly process the data with no prior knowledge and use the hashing method CountMin sketch to filter the random errors from the frequently occurring, high-quality protein strings (k-mers) to construct a De Bruijn graph that is used to assemble the complete genome. Using Machine Learning (ML) and a training set of known genes of a family, a model can be constructed that can be applied to an unknown gene to predict the relevant k-mers. Adding a ranking function to the learning process biases the model towards predicting a ranked list of relevant k-mers over irrelevant then use them to construct the De Bruijn graph. The machine learning models leverage prior knowledge learned from known genes to produce high-quality lists of relevant k-mers to assemble the genome. Preliminary results show that machine learning can be used to predict relevant k-mers with an 80% success rate. The use of learning by ranking machine learning applied to genome assembly can produce high-quality results using less computing time and memory than traditional, non-ML processes. The next step in this work is to modify the ranking ML model to optimize for the application specific F1 score.

Poster: **9**	Examination of the Binding Interaction Between Piperine and the Regulatory Light Chain of Myosin	Poster: **9**

Undergraduate Researcher: Matthew Burroughs

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Dmitri Tolkatchev and Alla Kostyukova

Home Institution, Major, Class Standing: North Carolina State University, Chemical and Biomolecular Engineering, Senior

Abstract:

Routine exercise is an important component of maintaining a healthy lifestyle. Unfortunately, for individuals struggling with physical handicaps (obesity, type II diabetes, etc.), engaging in demanding physical activity is unrealistic. Thermogenesis in skeletal muscle tissue contributes significantly to basal metabolic rate. Recent research has demonstrated the existence of a dichotomy in the relaxed state of myosin muscle protein: the super-relaxed state (SRX) and the disordered-relaxed state (DRX). The difference between SRX and DRX is characterized by an increase in the rate of ATP-ase activity in DRX, indicative of a higher level of energy consumption. Piperine, an alkaloid found in black pepper, has been shown to be effective in destabilizing myosin from SRX to DRX. Understanding where and how piperine interacts with myosin is of interest to the medical field, as this information can be used by pharmaceutical companies to design a weight loss supplement for bed-ridden individuals.

Previous studies in the Kostyukova lab have identified that the binding interface of piperine and myosin is localized in the myosin neck region, close to or within the regulatory light chain (RLC) subunit. A recombinant myosin fragment, containing RLC and an RLC-binding heavy chain fragment, was coexpressed in a Rosetta 2 (DE3) strain of *Escherichia coli*. This protein complex was purified through a Ni-NTA agarose purification procedure. Circular dichroism analysis confirmed the structural integrity of the protein and the destabilizing effect of the piperine additive. To obtain information on the interaction site of piperine and myosin, an *E. coli* culture was grown in ^{15}N-labeled minimal medium. This produced a uniformly ^{15}N-labeled protein amenable for study by 2-dimensional nuclear magnetic resonance spectroscopy (2D-NMR). Results from 2D-NMR aided in further localization of the interaction site. Future work on this project will focus on achieving conclusive evidence for the localization of the specific piperine binding site.

Poster: **10**	Autonomous Docking for the TurtleBot3	Poster: **10**

Undergraduate Researcher: Tristan Call

Program: Gerontechnology (GSUR)

Co-authors: Sepehr Nesaei and Christopher Pereyda

Home Institution, Major, Class Standing: Gonzaga, Engineering, Freshman

Abstract:

Robots are increasingly being turned to as an avenue to assist the elderly in various activities of daily living (ADLs) in addition to nurses because of slow growth in the quantity of nursing professionals and the rapidly increasing numbers of elderly adults. The robot TurtleBot3 is a prime platform from which to perform research into methods of assisting the elderly, due to its relative inexpensiveness, ease of use, and highly adaptable configuration. However, the TurtleBot3 lacks the ability to charge itself. This is a requirement for robots which will need to undergo long term use in the homes of people with cognitive decline, who frequently have difficulties completing routine tasks. To make the TurtleBot3 more capable of serving as a research platform, we have designed a docking station that the robot can automatically travel to and charge from. We also developed the code needed to direct the robot to the docking station when it requires charging, utilizing infrared sensors for precision guidance. These efforts will allow for TurtleBot3s to be deployed for longer than a few hours in people's homes and without manual supervision from researchers. With this dock research groups will be able to carry out extended studies in participant's home environments without direct oversight, vastly reducing hours, increasing ecological validity, and increasing data collection. In the future, similar technology may allow the deployment of robotic systems on a large scale to assist people with staying healthy, staying out of nursing homes, and maintaining their quality of life.

Poster: **11**	Determining Temperature Dependence of Ranavirus on Viral Replication and Cell Growth	Poster: **11**

Undergraduate Researcher: Brendalis Camacho

Program: Erica Crespi

Co-author: –

Home Institution, Major, Class Standing: Rochester Institute of Technology, Biomedical Sciences, Senior

Abstract:

Ranaviruses are large, double-stranded DNA viruses that are responsible for mass die-offs of amphibians, fish and select reptiles across the globe . These die-offs are generally observed in the warmer months of summer for amphibians and fish. While it has yet to be determined how varying temperature ranges play a role in the transmission of ranavirus, this research aims to test temperature dependence on ranavirus to discover how varying temperatures play a role in viral replication. By determining temperature dependence of ranavirus, optimal temperature ranges for viral replication can be determined, which can further elucidate virulence of ranavirus. We hypothesize that as temperature increases, ranavirus replication will increase consistent with the metabolic theory of ecology. We are culturing fathead minnow (FHM) cells and inoculating with ranavirus at 5 different temperatures in ranges 10-30°C. By understanding how temperature affects ranavirus replication and transmission, we can better predict ranavirus persistence and mortality events as climate continues to change.

Poster: **12**	Bio-manufacturing Scaffolds for Articular Cartilage and Osteoarthritis Treatment	Poster: **12**

Undergraduate Researcher: Monika Cewe

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Paige Ford and Arda Gozen

Home Institution, Major, Class Standing: Washington State University, Chemical Engineering, Junior

Abstract:

Osteoarthritis (OA) is a debilitating chronic disease that causes the degradation of articular cartilage in the knee. OA affects over 30 million adults in the United States, and currently has limited treatments and therapies--majority of which are invasive. Current treatments such as arthroscopy, cartilage repair, osteotomy, and knee arthroplasty have been beneficial, however, these procedures can result in severe pain and articular cartilage damage. As a result, there is a significant need to advance OA treatment to be less invasive and closer to replicating native tissue. This project implements tissue engineering, which aims to regenerate, improve, and repair injured or diseased articular cartilage. The hypothesis is: by using 3D bioprinting, precise scaffolds can be made to mimic collagen structure for aiding in the culture of chondrocytes. Scaffolds are beneficial for this purpose because they provide the structure to develop the desired shape for chondrocytes. The purpose of this study was to optimize printing protocols for bioprinting in order to obtain an ideal scaffold structure. In this case, the ideal scaffold structure must have the smallest pore size and smallest pore-to-pore distance to recreate native cartilage with proper morphological structure and mechanical properties. Various bio-ink compositions were tested using a wide range of printing parameters such as pressure, speed, infill density and temperature, as input variables. The bioinks that have been tested include a sodium alginate and cellulose nanofibril solution, methacrylated gelatin, and a hyaluronic acid and gelatin solution. Thus far, printing at reduced pressures and speeds produces the thinnest lines, and therefore the best print resolution.

Poster: **13**	Personalized Human Activity Recognition: An Active Semi-Supervised Learning Approach	Poster: **13**

Undergraduate Researcher: Sunny Chiu

Program: Smart Environments

Co-authors: Ramyar Saeedi and Assefaw Gebremedhin

Home Institution, Major, Class Standing: Colorado College, Computer Science, Senior

Abstract:

Physical activity monitoring is crucial for fitness evaluation, gait analysis, and patient monitoring. Wearable motion sensors, commonly used for human activity recognition (HAR), allow continuous, remote monitoring of physical activities. Supervised machine learning algorithms form the core intelligence of embedded software in wearable systems. These models utilize training data to construct the HAR computational model. However, the accuracy of HAR models decreases when sensor data, generated during personalized exercises or tasks, may be too specific or inadequate to be used as training data for another, new subject. Moreover, even for the same subject, the activity patterns may change over time. Retraining the machine learning algorithms for a new subject requires collecting sufficient amount of labeled training data, a process that is expensive and sometimes impractical.

The aim of this project is to design algorithms for personalized HAR systems by keeping subjects in the loop. Our goal is to minimize the number of queries needed from annotators. To this end, we propose a graph-based semi-supervised learning approach that utilizes the inherent clustering present in the unlabeled data from the new subject and the training data from other subjects. In the graph-based formulation, the data points are represented by nodes while edges capture the similarity between the nodes they connect. We compute a spectrum of the Laplacian matrix of a graph to define graph signal frequencies that capture activity class membership of nodes. The approach retrieves the most informative node from the Laplacian matrix, acting as a frequency baseline, to propagate labels used for creating a personalized activity classifier. We evaluated the efficacy of the approach using a public dataset. The results indicate HAR accuracy of over 87% by labeling, on average, only 14% of the originally unlabeled data from a new subject.

Poster: **14**	Digital Memory Notebook Dashboard	Poster: **14**

Undergraduate Researcher: Jacob Cillay and Atsuyo Shimizu

Program: Smart Environments

Co-author: Lawrence Holder

Home Institution, Major, Class Standing: Pitzer College, Computer Science, Sophomore

Abstract:

The Digital Memory Notebook (DMN) is an application built for the elderly and cognitively impaired living in a smart home environment to assist them with their daily lives. It has features such as creating to-do lists, scheduling events on their calendar, and documenting note and journal entries. All user interactions with the app and within their smart homes are recorded and stored in a database. Our project entails gathering data from the DMN database, analyzing it as necessary, and displaying the information in a presentable and understandable manner. The dashboard is intended to summarize users' interactions with the app over time and to help caregivers grasp the condition and well-being of their patients. It currently consists of data that categorizes and breaks down user interactions by type, counts the number of interactions with specific attributes, and calculates time spent for specific activities. It will also contain information relating to the Smart-Home-in-a-Box (SHiB) data. This data is accompanied by visual displays to further illustrate relationships in the data. Our goal is that the real-time updates to the dashboard are informative enough for the caregivers so that they can remotely observe any positive and/or negative changes with their patients.

Poster: **15**	Routine Change Detection Using Apple Watches	Poster: **15**

Undergraduate Researcher: Jason Conci

Program: Gerontechnology (GSUR)

Co-authors: Chance DeSmet, Diane Cook, and Gina Sprint

Home Institution, Major, Class Standing: Gonzaga University, Computer Science, Senior

Abstract:

Approximately 80% of older adults in the United States manage at least one chronic health disease (He et al., 2005). These diseases, left unmanaged, lead to additional comorbid diseases, diminished quality of life, loss of independence, significant health care costs, and morbidity (CDC, 2013). Research evidence links physical activity, nutrition, medication adherence, and sleep quality to chronic disease prevention (Aldana et al., 2006). Given the aging of the population, increasing rates of chronic disease, and a diminishing number of healthcare professionals to meet demand, development of effective and sustainable models of health behavior change are essential for improving public health across one's lifespan (Dexter et al., 2010).

A significant limitation in behavioral health change research is the lack of sensitive measures for detecting daily behavioral changes. Traditional measures include self-report, direct observation, and biophysiologic measures; however, these measures are often unreliable, inefficient, expensive, or ineffective for measuring short-term change in a patient's behavior.

Sensors, paired with the aforementioned methods, may increase sensitivity for measuring daily behavioral change. Being low-cost and unobtrusive, sensors can be used in both laboratory and real-life contexts, capturing abnormalities and changes in daily activity patterns (Steele et al., 2003) that may escape other methods. Apple Watches, in particular, provide an opportunity to assess daily activity changes in a more broad scope than other approaches, because they provide information on a more persistent basis than stationary motion-tracking alternatives. The current study aimed to determine if machine learning-driven behavior change detection methods (BCD) applied to Apple Watch sensor data are capable of capturing changes in daily activities of participants enrolled in a behavioral change intervention. We hypothesize that the behavior change across an intervention can be captured using Apple Watch data and that the change can be quantified and analyzed using BCD.

Poster: **16**	Screening Nodule-associated Bacteria for Plant Growth Promoting Properties	Poster: **16**

Undergraduate Researcher: Tommy Conway

Program: Maren Friesen

Co-author: –

Home Institution, Major, Class Standing: Washington State University, Biology, Sophomore

Abstract:

In legumes, modified root structures known as nodules are the loci of a symbiotic mutualism, in which the host plant exchanges carbon-rich compounds with rhizobia (a type of bacteria) in return for fixed nitrogen. Thus, these microbes play a key role in the growth and development of the host. However, other bacteria have also been isolated from *Trifolium* nodules collected from a Bodega Bay (CA) field site. The microbes are not rhizobia, and do not necessarily perform nitrogen fixation for the plant. It is unknown if they provide any benefits to the host at all. In an effort to reveal possible functions for the host, a co-inoculation experiment is performed on *Trifolium barbigerum* plants. In this experiment, 9 strains of mystery microbes are each co-inoculated with a single rhizobium strain. Three weeks after inoculation, dry shoot and root biomass, shoot height, and number of nodules are measured. Each inoculation group is then compared to the negative control (no mystery microbes). If an inoculation group displays significantly higher growth, it is classified as a PGPR (plant-growth-promoting-rhizobacteria) which may then be further investigated to determine the nature of its promotive properties. As the practice of biofertilization expands in the agricultural industry, this methodology may provide farmers with an ability to maximize crop yields in an environmentally sustainable manner; the first step in developing effective biofertilizer mixtures is identifying bacterial strains that stimulate growth, which can be accomplished by preliminary screening of candidates as performed in this experiment.

Poster: **17**	Sequencing MLO Genes of Different *Vitis vinifera* Cultivars	Poster: **17**

Undergraduate Researcher: Paola Coronel

Program: Research Opportunities for Native Undergraduate Students

Co-authors: Ryan Christian, Richard Sharpe, and Amit Dhingra

Home Institution, Major, Class Standing: St. John's University, Toxicology, Senior

Abstract:

Powdery mildew is a fungal pathogen that infects a variety of commercially important crop plants. The fungus primarily grows on the surface of leaves and can inhibit photosynthesis and interfere with stomatal regulation. Ultimately, this could lead to a reduction of crop yield. In California, the grape industry is heavily impacted by powdery mildew. It has been estimated fungicide application cost the industry approximately $189 million in 2011. Furthermore, powdery mildew fungicide makes up 74% of all grape pesticide treatment; therefore, posing a significant environmental burden. Genes in the *Mildew Locus O* (MLO) superfamily, particularly membranes of phylogenetic clade V, act as powdery mildew susceptibility factors; inactivation of said genes could lead to powdery mildew resistance. Sequencing of the grape genome and physiological studies have revealed the genes VvMLO11, 7, 6, 9 and others as potential candidates for mildew susceptibility. In this project, alleles from these genes will be sequenced from nine cultivars important to the Washington State wine industry. Because the mildew susceptibility is hypothesized to be imparted by the coding regions, cDNA pools were generated for each cultivar. Various methods of RNA extraction were utilized to obtain optimal results; however, cetrimonium bromide (CTAB) with 2% polyvinylpyrrolidone (PVP) proved to be most effective. The extracted mRNA will then be synthesized into cDNA. The cDNA will be amplified through a PCR. The genetic information will then be transformed into bacterial plasmids for sequencing and long-term storage. This project will allow for further research in understanding the function of the MLO genes in *Vitis vinifera*; through this, gene editing could be utilized to develop powdery mildew resistance.

Poster: **18**	Thermal Preference Assay of *Tigriopus californicus* Acclimated to Constant and Fluctuating Temperatures	Poster: **18**

Undergraduate Researcher: Arani Cuevas-Sanchez

Program: Wes Dowd

Co-authors: Autumn Miller and Wes Dowd

Home Institution, Major, Class Standing: Portland State University, General Science, Senior

Abstract:

Our knowledge of behavioral patterns of organisms in the lab was primarily developed under constant conditions, but for most organisms conditions are always fluctuating. Splash-zone copepods (*Tigriopus californicus*) experience a variety of environmental fluctuations including changes in salinity, temperature, pH, and dissolved oxygen. In this study, we developed a method for assaying the thermal preference of individual copepods, and we used this method to examine the effects of acclimation to constant and cycling temperatures on behavior. Egg mass bearing females (n=48) were subjected to one of four temperature treatments for two weeks: 15º C, 19º C, 23º C and one treatment oscillating between 15-23º C. Females were assayed for thermal preference with the order of females being randomized across treatments. Preference was assayed in an annular chamber. A thermal gradient range from 10.49ºC to 30.07°C was created across the chamber by cooling one end and heating the other end. The movements of each female were tracked for 30 minutes using the animal tracker video analysis software plugin in ImageJ. The animal's position within the annular chamber in each frame was used to estimate the body temperature. Initial *ad hoc* observations suggest a preference for cool water; our statistical analyses will address whether the mean and/or the variation in preferred body temperature shifts with thermal acclimation. Ongoing research will aim to understand the survivability and plasticity of offspring from these females. Future experiments will also involve the manipulation of other variables. With changes in marine environments being inevitable our understanding of organisms response to climate-induced changes will help determine possible adverse effects on this species and others.

Poster: **19**	Investigating the Role of a Pho1 Domain in Rice Plants	Poster: **19**

Undergraduate Researcher: Saul De La Pena

Program: Thomas Okita

Co-author: –

Home Institution, Major, Class Standing: California State University Los Angeles, Biochemistry, Senior

Abstract:

Pho1 (plastidial starch phosphorylase) plays a significant role in initiating starch synthesis and during the maturation of the starch granule in developing rice seeds. A unique feature of the plastidial starch phosphorylase is the presence of a non-catalytic L80 domain of unknown function. To further identify the function of the L80 region, transgenic rice plants are made by transfection of mature seeds using agrobacteria with a CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) system to knockout the genes that encode for Pho1 and its L80 region. The transgenic seeds are then cultured and selected for a period of 4 months in which the selected seeds grow into embryonic callus and undergo further selection for the development of transgenic rice plants. To ensure that the rice plants DNA (deoxyribonucleic acid) is transgenic, a PCR (polymerase chain reaction) is done using gene specific primers.

Poster: **20**	Using Biochar to Reduce Compost Odor	Poster: **20**

Undergraduate Researcher: Jillian Denison

Program: Atmospheric Chemistry REU

Co-authors: Neda Khosravi and B.T. Jobson

Home Institution, Major, Class Standing: Rochester Institute of Technology, Chemistry, Sophomore

Abstract:

Large scale commercial composting facilities must deal with complaints of odor from surrounding communities and neighborhoods. The use of biochar, plant-based charcoal, is being studied as a potential compost additive and other studies have shown that biochar helps increase plant growth and yield in certain crops. This project, funded by the State of Washington Department of Ecology, looked at the effects of varying percentages of biochar within compost piles on gaseous emissions of ammonia and volatile organic compounds that might cause odor. Twelve compost piles were made, 3 piles of each 0%, 2.5%, 5%, and 10% biochar. Piles were sampled a total of six times over 31 days, collecting temperatures, ambient conditions, and air samples. Air samples were analyzed using gas chromatography mass spectrometry (GC-MS) to identify and quantitate compounds. There is great interest in sulfur and nitrogen containing compounds because they tend to have very low odor thresholds. Preliminary analysis shows that the addition of biochar to the compost reduced the amount of sulfur and nitrogen containing compounds, such as dimethyl disulfide, pyridine, and 5-methyl iso thiazole, that were emitted from the piles, which could correlate to a reduction in odor.

Poster: **21**	Characterization of the silk1 Mutation	Poster: **21**

Undergraduate Researcher: Zac Dockins

Program: Research Opportunities for Native Undergraduate Students

Co-authors: Matt Marcec and Kiwamu Tanaka

Home Institution, Major, Class Standing: Boise State University, Health Sciences, Sophomore

Abstract:

The *silent knight 1* mutation (*silk1*) is a mutation within the *Arabidopsis thaliana* plant. The mutation cannot produce a calcium signature, which causes the plant to be smaller and more susceptible to disease. Calcium signatures are used as a response to stimuli within the plant and are important in plant growth and development. While the gene that causes this mutation is still unknown, once it is discovered it will be highly useful for diagnostics and breeding resistant plants.

To better understand the *silk1* mutation, I have grown the plant in several different temperatures in order to determine if the mutation is conditional. In every grouping, six sets of plants were planted: three sets of Wild Type as a control, and three sets of the mutation. The plants were grown in 19, 22, and 25°C growth chambers and given eight hours of light every day. Before being planted into soil, the hypocotyl, cotyledon, and root of each plant were measured at five and seven days. After being put into the soil, the rosettes of each plant were measured weekly. The Wild Type plants and *silk1* mutation were directly compared to one another. When the plants were large enough, they were infiltrated with pathogens in order to test and compare their susceptibility. The pathogen used was *Pseudomonas syringe*, a hemibiotroph.

After 4 groups of the plants were grown, the data showed that *silk1* plants grew at a closer rate to Wild Type plants at lower temperatures, and as temperatures increased, the size difference in *silk1* and Wild Type plants increased as well. The results of the *Pseudomonas syringe* assay were inconclusive, and the assay will be repeated.

Characterizing this mutant will provide a better understanding of the gene once it is discovered.

Poster: **22**	Financial Capacity in a Community Dwelling Sample: Correlations Between Performance-based and Self-report Measures	Poster: **22**

Undergraduate Researcher: Colleen Donahue

Program: Gerontechnology (GSUR)

Co-authors: Catherine Sumida, Alyssa Weakley, and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: Gonzaga, Psychology/Biology, Senior

Abstract:

Objectives: Financial management behavior is shifting toward technology-based tools (e.g., online banking, credit cards). However, current clinic assessments do not always match the financial management tools individuals report using in the real-world environment, leading to potential overestimation or underestimations of everyday financial management abilities. This study examined relationships between performance-based financial management tasks and self-reported everyday financial management behavior.

Method: Eighty-one community-dwelling older adults completed two performance-based measures [University of California, San Diego Performance Screening Assessment (UPSA), Observable Task of Daily Living, Revised (OTDL-R)] and self-report Likert ratings (1=never; 5=always) of financial behaviors (paying bills, paying bills with check, online banking, automatic payment). Spearman correlations examined the relationship between the UPSA and OTDL-R financial capacity subtests (i.e., counting change, writing and preparing a check for mailing, identifying bill information and balancing a checkbook) and self-reports of financial behavior as well as an aggregate measure (i.e., sum of the three bill method measures).

Results: Higher self-report ratings of needing help with bill payments related to poorer UPSA counting change subtask performance. Participants who self-reported higher engagement in online banking behaviors performed better on the OTDL-R bill payment subtask. Finally, self-report of more frequent use of online checking and automatic bill payments was associated with higher performance on the UPSA bill test.

Discussion: Individuals who reported needing less help with bill paying and using more online banking and checking performed significantly better on counting change and bill paying tasks, respectively. These results suggest that reported online banking engagement may indicate preserved financial capacity. Future research should examine self-reported financial capacity across financial management tools, including online banking tasks.

Poster: **23**	Dual-ionophore Ion-selective Electrode Optimization Factorial Design	Poster: **23**

Undergraduate Researcher: Samantha Draves

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Olivia Reynolds and Bernard Van Wie

Home Institution, Major, Class Standing: The College of Wooster,
Biochemistry and Molecular Biology, Junior

Abstract:

Ion-Selective Electrodes are on the rise for their uses in biomedical applications as both accurate and efficient tools for diagnosis of acute and serious medical conditions. Ion-Selective Electrodes can sense ions and their permeability to membranes by using ion carriers such as ionophores and monitoring the membrane potential. Infectious proteins or cells can coat the membrane surface, which limits the amount of ion exchange across the membrane. The dual ionophore ion selective electrodes (di-ISE) with the greatest sensitivity to changes in ion concentration will likely have the best capability for detecting low protein concentrations or the earliest stages of infections.

We completed an optimization of di-ISE components via a factorial design experiment, manipulating the membrane concentration of valinomycin (1×10^{-4} - 1 weight percent) and sodium ionophores (1×10^{-4} - 1 weight percent) and the concentration of the sodium chloride filling solution (0 – 1 M). In the experiments, we utilized a wye connector piece for each electrode that was connected to one valinomycin and one sodium membrane with a silver tip that plugs into a circuit board that measures potential and sends data to a computer. We simulated complete coating of the potassium carrying side of the di-ISE by removing that membrane from solution and washing it with deionized water. This allowed for membrane potential to be compared when both membranes were in solution versus when only the sodium carrying membrane was in solution at various concentrations of potassium chloride from 1×10^{-4} - 0.1 M. Initial analysis using the software "R" showed valinomycin, sodium ionophore and sodium chloride on their own as well as the valinomycin squared term significantly affect voltage changes. Future work will explore optimal membrane components and its capacity to detect proteins present.

Poster: **24**	Assessing Energy Efficiency of Mechanical Pretreatment of Lignocellulosic Biomass in a Pilot-Scale Vibratory Mill for Clean Cellulosic Sugar Production	Poster: **24**

Undergraduate Researcher: Moira Duya

Program: Northwest Advanced Renewables Alliance SURE

Co-authors: Tuhua Zhong, Mohammadali Azadfar, and Michael P. Wolcott

Home Institution, Major, Class Standing: New York University,
Chemical and Biomolecular Engineering, Junior

Abstract:

Lignocellulosic biomass, abundant and readily available in nature, can be converted to bioethanol through enzymatic hydrolysis and subsequent fermentation processes. However, the recalcitrance of lignocellulosic biomass due to cellulose crystalline structure and lignin-carbohydrate complex prevents the enzymes from accessing the cellulose, which results in low digestibility and low sugar yield. Mechanical pretreatment is often used to disrupt the recalcitrant structure, and increase the enzymatic accessibility and digestibility. A disadvantage of such a pretreatment is its high energy input, which is a barrier to commercializing mechanical pretreatment. In this study, we seek to develop an energy-efficient mechanical pretreatment process, through optimizing grinding parameters in a pilot-scale VibroKinetic Mill. Grinding parameters that were investigated included the grinding medium, the particle size of the feedstock, the grinding medium to biomass weight ratio, and the milling time. The preliminary results revealed that the energy consumption and physicochemical properties of the ground wood particles varied depending on the combination of grinding parameters. The energy consumption ranged from 0.098 ~ 2.89 kWh/kg OD biomass for the resulting wood particles with particle size of 106 m ~ 24.1 m, and crystallinity index of 47% ~ 7%. The ongoing effort is to produce clean cellulosic sugar through enzymatic hydrolysis and calculate energy efficiency based on the total sugar yield divided by the energy consumption, and finally determine optimal grinding parameters to produce amorphized hydrolysable biomass with lowest energy input for desirable sugar yield.

Poster: **25**	Soil Quality Improvements with Biochar and Compost	Poster: **25**

Undergraduate Researcher: Taylor Enns

Program: Food Systems Program

Co-authors: Doug Collins, Nate Stacey, Steven Seefeldt, David Gang, and Naomi DuBois

Home Institution, Major, Class Standing: Pierce Community College, Associates of Science, Freshman

Abstract:

With increased industrialization and fossil fuel consumption, atmospheric carbon dioxide concentrations have risen dramatically since the mid-nineteenth century and climate change threatens agriculture and natural ecosystems. While most solutions strive to decrease current emissions, greenhouse gases can also be sequestered from the atmosphere. Biochar, or charcoal, is produced from the thermal conservation of plant matter and can be stored in soil to remove carbon dioxide from the atmosphere. Additionally, biochar can increase the water holding capacity of the soil and decrease bulk density. In this study, we investigated soil quality following addition of soil amendments and nitrogen fertilizer in a split-plot field experiment with nitrogen as the main plot, amendment as the subplot and potatoes as the crop. Amendments included: biochar alone, compost alone, compost made with biochar (co-compost), biochar and compost field applied, and no amendment. Biochar was applied at 10 Mg ha^{-1} and all amendments were applied at the same rate of organic carbon (8.75 Mg ha^{-1}). We analyzed soil bulk density, total carbon, total nitrogen, particulate organic matter carbon and nitrogen, and mid-season nitrate and ammonia. The co-compost and compost treatments significantly changed bulk density (6.6 % decrease) relative to the no amendment control. Soil carbon and mid-season nitrogen availability analyses are underway. This study will demonstrate the magnitude of soil quality improvements and carbon sequestration with biochar and compost applied alone or in combination, providing producers and regulators important guidance.

Poster: **26**	Nitrogen Trichloride Detection in Indoor Pool Air using Proton Transfer Reaction Mass Spectrometry	Poster: **26**

Undergraduate Researcher: Anna Feerick

Program: Atmospheric Chemistry REU

Co-authors: Yibo Huangfu and B. T. Jobson

Home Institution, Major, Class Standing: University of Maryland- Baltimore County, Chemistry, Junior

Abstract:

The purpose of this study is to accurately identify the concentration of nitrogen trichloride (NCl_3) in indoor swimming pool environments using Proton Transfer Reaction Mass Spectrometry (PTR-MS). NCl_3 is a chloramine compound that forms from the reaction of HOCl and NH_3. It is a disinfection by-product that has been correlated to increased cases of asthma in swimmers. The amount of NCl_3 produced is dependent on the number of swimmers, the amount of NH_3/urea released, the air change rate of the building, the amount of sunlight, and the concentration of HOCl in the water. In this work known concentrations of NH_2Cl, $NHCl_2$, and NCl_3 were synthesized and stock solutions quantified by UV/VIS spectrometry. Stock solutions were then used to make test gas mixtures for determining the PTR-MS response factors for these compounds. Test gas mixtures were made by calculating gas phase concentrations from stock solution concentrations and the Henry Law coefficient of the chloramines. Preliminary results have confirmed the PTR-MS's ability to measure NCl_3. The continuous PTR-MS measurement method would thus be valuable for better determining exposures of NCl_3 by swimmers and pool workers. Further research will include testing the PTR-MS in an indoor pool environment and determining the NCl_3 concentration in the air.

Poster: **27**	The Effect of Tablet Reading in a Reclined Trunk Position on Neck Muscle Strain	Poster: **27**

Undergraduate Researcher: Leah Fisher

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Kaitlin M. Gallagher and Anita N. Vasavada

Home Institution, Major, Class Standing: Wichita State University, Biomedical Engineering, Junior

Abstract:

Overly flexed head and neck postures during tablet use are linked to significant neck pain. With the trunk upright, the position of the head in front of the body leads to higher loads on the spine. It has been shown that tablet use in reclined trunk postures is associated with less discomfort than upright postures. The goal of this study was to quantitatively compare the strains on neck muscles in different postures. Our collaborators at the University of Arkansas took x-rays of subjects in neutral and fully flexed postures and while reading a tablet in upright, semi-reclined and reclined trunk postures. They found that both reclined positions involved more flexion in the lower neck than upright and that the forward posture of the head with respect to the trunk decreased between neutral and reclined positions. Our hypothesis, influenced by these results, was that reclined postures would have lower muscle strains than upright postures. We built a musculoskeletal model and used x-ray measurements to create subject specific models that represented each subject's posture and bone geometry. We then used the models to estimate the musculotendon lengths of relevant cervical muscles and calculated the muscle strain with respect to neutral for each muscle in each posture. The average muscle strain in the upright postures was less than in the reclined postures, contrary to our hypothesis. Preliminary results indicate that on average, muscles experience 61% more strain in full flexion than the other postures. Initial findings suggest that of the muscles we studied, the multifidus muscles, which are located deep in the neck, tend to have the greatest strain values in all of the postures.

Poster: **28**	Synergistic Antibacterial Activity of Manuka Honey and Garlic Extract (Allicin) Against *Streptococcus mutans*	Poster: **28**

Undergraduate Researcher: Darby Fox

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-author: Nehal Abu-Lail

Home Institution, Major, Class Standing: Washington State University, Microbiology, Junior

Abstract:

Recently, the threat of antibiotic resistance has become a reality. In response, current research aims at identifying potential alternatives to traditional antibiotics. Research supports the claim that both Manuka Honey and the Garlic Extract, Allicin, can act as powerful antibacterials. Honey's hyperosmolarity and hydrogen peroxide activity as well as Allicin's high sulphuric content may be responsible for inhibiting bacterial growth. Motivated by their potential efficacy as antibacterials, the biofilms of Streptococcus Mutans UA159 were treated with 18+ Manuka Honey, Allicin extracted from Garlic, and a combination of the two at a variety of concentrations. To check their efficacy, a growth curve, membrane permeability assay, biofilm assay, and a colony forming unit (CFU) experiment were performed. During the biofilm assay and the CFU experiments, the biofilms were grown and fed for 4 days, and were then treated every 2 days for a series of 4 days with the appropriate dose of the natural antibiotic. On the 4th, 6th, and 8th days of growth, the pH was measured and both a biofilm assay and a CFU experiment were conducted. These experiments are still ongoing. If the CFU count was found to be lower once a biofilm was treated compared to the control, then the treatment is considered successful in partially killing the pathogen. If it is found that certain treatments appear to be more capable of disrupting biofilms than others as evident from higher permeabilities, then it can be concluded that the mechanism of action for the antibiotic against the biofilm occurs via disturbing the biofilm structure. By the conclusion of this research, it is expected that a dose, application treatment and a length of treatment for effective destruction of S. mutans biofilms would have been identified.

Poster: **29**	Modification of Cellulose-derived Polymeric Solution with Photoresponsive Organic Dyes for Packaging Films	Poster: **29**

Undergraduate Researcher: Andrew Freiburger

Program: Bioplastics & Biocomposites

Co-authors: Mohammadali Azadfar and Michael Wolcott

Home Institution, Major, Class Standing: Grand Valley State University, Chemistry, Senior

Abstract:

Oxygen is a major determinant of food shelf life because it contributes to the oxidation of lipids, and is essential for the growth of food-spoiling aerobic microorganisms. Oxygen scavenging systems are one method of slowing or inhibiting such consequences of oxygen. This study describes an oxygen scavenging approach to improve the oxidative stability of edible oils – specifically extra virgin olive oil – through the use of an ethyl cellulose-based oxygen scavenging film that contains photo-responsive organic dyes: eosin Y/B and curcumin. The film utilizes photo-excitation to convert ground-state oxygen, triplet oxygen, to highly reactive singlet oxygen, which is adsorbed by the film. Here we show how the presence of organic dyes and organic oxygen scavenging agents determine the oxidative stability of commercially available extra virgin olive oil. It was found that a buildup of concentration series of ethyl cellulose-eosin-curcumin-ascorbic acid in ethyl acetate-ethanol solvent results in a homogenous polymeric solution suitable for casting. The olive oil was then stored in an LED illuminated box and a Fluorescence illuminated fume hood in sealed Petri dishes containing developed films at room temperature for 72 hours. Using chemical analytical techniques – GC-MS and liquid-state ^{1}H NMR – we present evidence that the developed film is significantly capable of protecting extra virgin olive oil against visible light.

Poster: **30**	Robotic Activity Support (RAS): Attitudes and Future Directions	Poster: **30**

Undergraduate Researcher: Justin Frow

Program: Gerontechnology (GSUR)

Co-authors: Nisha Raghunath, Christopher Pereyda, Diane Cook, and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: Washington State University, Psychology/Neuroscience, Senior

Abstract:

To preserve older adults' autonomy there has been a recent push to design robots that assist with everyday activities of daily living (ADLs). When designing such robots, it is important to make them useful, reliable, and appealing to an aging population. To evaluate attitudes towards robotic assistance and future research directions with older adults, undergraduate students interacted with a robot within a smart home environment and then completed a battery of questionnaires to evaluate the RAS system. The system recognized the steps and actions involved in three scripted everyday activities (preparing to walk a dog, taking medication with food and water, and watering plants) and automatically intervened and assisted when an error occurred. Participants were directed to make a variety of specific errors (e.g. forgetting to take their medicine) when completing tasks. Once the system detected the error, the robot approached the participant who would then be guided through an intercom system to interact with robot's tablet interface. The interface included three types of assistive prompts: take me to object, show video step, and show full video. Data revealed participants had a positive reaction (mean scores above 4 on a 1-7 Likert scale) in the domains of likeability, annoyance, habitability, cognitive demand, and system response accuracy, and a negative reaction to the speed of the system. Feedback showed participants thought watching a video of the missed step was the easiest to imitate and would be most helpful and least confusing to someone with mild cognitive impairment (MCI). Positive ratings of the robot's friendliness, helpfulness and usefulness were associated with how much participants thought an older adult would enjoy the robot in their home. These findings give insight into how assistive robotic technology should be designed to be most helpful with ADLs.

Poster: **31**	Characterizing the Binding of Phosphates on Nitrogen-Functionalized Biochars: A Combined Experimental and Theoretical Study	Poster: **31**

Undergraduate Researcher: Aidan Garcia

Program: Jean-Sabin McEwen

Co-authors: Michael Ayiania, Alyssa Hensley, Kyle Groden, Jean-Sabin McEwen, and Manuel Garcia-Perez

Home Institution, Major, Class Standing: Washington State University, Chemical Engineering, Senior

Abstract:

The scale and intensity of human agriculture often has dire impacts on the surrounding environment, such as the eutrophication of local waters by fertilizer contamination. Phosphate's dramatic enhancement of plant growth plays a key role in these processes, and as such its adsorption and sequestration have been studied extensively. Biochars are a natural choice of adsorbent due to their easy production from agricultural byproducts and potential for re-use as a soil amendment. This study aims to contribute to the field by experimentally and theoretically characterizing the adsorption of phosphate on nitrogen functionalized biochars. Nitrogen doped chars were produced, characterized, and tested for phosphate binding ability. Meanwhile, corresponding density functional theory (DFT) calculations were performed for phosphate species on common functional groups within the char. These simulations were used to assess and verify the thermodynamics, pH effects, and stoichiometry of the binding. The result is a thoroughly vetted model of nutrient adsorption in nitrogen doped biochars developed through synergistic computational and experimental efforts.

Poster: **32**	Separation of Disease Biomarkers from Extracellular Vesicles by Microfluidic Isotachophoresis	Poster: **32**

Undergraduate Researcher: Elizabeth Gomez

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Daniel Molina and Cornelius F. Ivory

Home Institution, Major, Class Standing: Texas Tech University, Chemical Engineering, Junior

Abstract:

Exosomes are extracellular vesicles (EVs), ranging from 50-100 nm in size, that are excreted by endocytosis and contain vital information for intercellular communication. Previous research indicates that EVs from diseased cells carry biomarkers which could be used for disease diagnosis. However, current isolation methods of diseased biomarkers can be costly, time consuming and invasive.

Electrophoretic techniques may be a viable alternative for rapid concentration and isolation of these biomarkers at very low physiological concentrations. Specifically, isotachophoresis (ITP) has the prospect of utilizing various mobilities of charged particles within an applied electric field to isolate bands of concentrated EV fractions from very low-abundance samples. Analysis of these fractions may allow for further identification and quantification of the biomarkers in the exosomes, thus providing a means for rapid diagnosis of myriad diseases, e.g., leukemia.

In order to test the ability of ITP to fractionate exosomes quickly, a straight microfluidic channel was constructed from PMMA and double-coated with amino-poly (ethylene glycol) to improve separation efficiency. After loading the channel with a pair of fluorescent-tagged EV samples between leading and trailing buffers, an electric field of 100 V was applied along the 3 cm microchannel to drive the separation and the concentrated bands were observed from a Leica Brightfield fluorescence microscope.

COMSOL Multiphysics®, a commercial computer simulation package, was utilized to model band separation and movement throughout the microfluidic channel. This 3D representation, employing Nernst-Planck equation, will be used as evidence to support experimental findings.

ITP's separation of particles based on their charge mobility will allow for diseased biomarkers carried in EVs to be identified and analyzed for further disease diagnostics. This new methodology would allow for early disease detection and routine testing for at-risk patients by sampling common biological fluids containing disease specific biomarkers.

Poster: **33**	Towards Biobased ABS Plastic	Poster: **33**

Undergraduate Researcher: Zachary Gotto

Program: Bioplastics & Biocomposites

Co-authors: Dr. Eric Cochran, Baker Kuehl, and Sharan Raman

Home Institution, Major, Class Standing: University of Wisconsin Platteville: Research done at Iowa State University, Engineering Physics, Senior

Abstract:

In today's world, we are surrounded by plastics and use it in every facet. Common plastics such as ABS and Polyethylene derivatives, though incredibly useful and versatile, are still produced through petroleum byproducts. ABS, specifically, is used in a range of applications such as LEGOs and pipes because of its useful mechanical and chemical properties such as corrosive resistance and its machinability. The downside to ABS is its longevity. When it has outlived its life cycle, it does not degrade quickly as the bacteria that naturally break things down do not interact with the plastic which hurts the environment. The aim of this project is to use poly L-Lactic Acid (PLLA) as a bio-based replacement for ABS. Natural PLLA plastic has similar properties to ABS and is also a thermoplastic like ABS but is quite brittle. To fix that, we are copolymerizing PLLA with Poly n-Butyl Acrylate (PnBA) to keep the properties of the PLLA while reducing its brittleness as PnBA is a more ductile and elastic material. These materials by themselves will usually phase-separate which is undesirable. To prevent phase-separation, a compatibilizer is used; in our case, it is a poly L-Lactic Acid – poly n-Butyl Acrylate (PLLA-PnBA) diblock which is created through an ATRP reaction. ATRP or atomic transfer radical polymerization is used as it is an easily controllable reaction that can be repeated. Though the downside is the use of transition metals such as copper I and II. Once the PLLA-nBA block is created, solvent blending is used to mix the diblock together with commercial PLLA and PnBA. The resulting product is then tested using rheology and other mechanical tests such as tension and torsion.

Poster: **34**	Efficacy of Bio-based Plastics with Natural Insecticides	Poster: **34**

Undergraduate Researcher: Hana Gouto

Program: Bioplastics & Biocomposites

Co-authors: Cindu Annandarajah and Chunhui Xiang

Home Institution, Major, Class Standing: University of Tennessee at Knoxville, Chemical Engineering, Junior

Abstract:

The goal of this project is to develop bio-based plastics with natural insectides for single use protective garments. Synthetic insecticides create an adaptation to environmental changes causing less resistance to insect-borne diseases such as the West Nile, Yellow fever, and Zika virus. The chemicals present in synthetic insecticides pose various environmental and health threats, thus driving the need for alternative methods. This project focuses on the use of natural insecticides, containing 2-pyrone, with the functionality of bio-based plastic poly(lactic acid) (PLA). PLA is a compostable and biodegradable polymer derived from natural resources like corn starch or sugarcane. This thermoplastic can replace the standard petroleum-based polymers, while maintaining mechanical and physical properties. In this study, pure PLA pellets were mixed thoroughly with 2 different natural insecticides, then spun into fibers through extrusion. The mechanical properties of the single PLA fibers compounded with the two insecticides were measured with a tensile tester and compared with industry-produced PLA fibers from NatureWorks. The average linear density of PLA with insecticide was collected to determine the tenacity of the fibers. Thermogravimetric Analysis (TGA) was conducted to evaluate the degradation temperature of the two natural insecticide samples. The efficacy of the insect repellency of the developed PLA with natural insectides was evaluated.

Poster: **35**	Using Amine-based CO_2 Capture and Conversion to Produce Formic Acid	Poster: **35**

Undergraduate Researcher: Kristian Gubsch

Program: Hongfei Lin

Co-authors: Hongfei Lin and Yao Yao

Home Institution, Major, Class Standing: Washington State University, Chemical Engineering, Junior

Abstract:

Global climate change is one of the most significant threats to the future existence of life as we know it on Earth. Increased CO_2 emissions contribute greatly to this change in our environment so it is very important to develop more sustainable technology that limits the overall anthropic carbon footprint. One of these emerging sustainable technologies is CO_2 capture and conversion which is an efficient way to both reduce emissions as well as stimulate the economy. The main focus of the research conducted this summer is improving the overall efficiency of the conversion of CO_2 to calcium formate. This project is significant in helping limit CO_2 emissions because the process, once efficient, can be used as an incentive for corporations with large amounts of CO_2 emissions to capture and convert these emissions to valuable chemicals, such as calcium formate, which will benefit both the environment and their business. Furthermore, every chemical used in this process is environmentally-safe. Calcium formate has many practical applications including the use as a cement additive, livestock feed preservative, a de-icing agent, and flue-gas desulfurizer. The goal of this research project is to separate formic acid from the reaction solution, produced from the reaction of CO_2 and H_2 with a palladium on activated carbon catalyst, then convert the formic acid to other useful chemicals such as calcium formate or methyl formate. The yield of the formic acid can be determined using high-performance liquid chromatography (HPLC) and the percent yield is dependent on variables in the reaction including time, temperature, pressure, stir rate, and dosage of the catalyst. Through the experimental adjustment of these dependent variables, a combination may be found that will convert CO_2 to formic acid, and ultimately calcium formate, at an overall rate close to one hundred percent.

Poster: **36**	Discrepancies Between Self-Report and Objective Observation of Meal Preparation in Community-Dwelling Older Adults	Poster: **36**

Undergraduate Researcher: Nicole Henriksen

Program: Gerontechnology (GSUR)

Co-authors: Lisa Chudoba and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: Washington State University, Psychology, Junior

Abstract:

Objective: Instrumental activities of daily living (IADLs), such as meal preparation, involve complex cognitive abilities and allow individuals to maintain independence. Subtle deficits in IADLs, which may be too subtle to be noticeable by the patient themselves, have been noted in early stages of cognitive decline. Deficits in self-report of IADL skills have also been associated with poorer functional outcomes. The current study aimed to investigate the ability of community-dwelling older adults to accurately self-report behaviors related to the IADL of meal preparation. **Method:** Participants were 36 older adults age 50+. Participants filled out a questionnaire assessing cooking behaviors and prepared a light lunch in their own homes where an observer assessed their cooking behaviors. Behaviors of interest included: keeping an organized kitchen, getting out all items before preparing a meal, and cleaning while cooking. Discrepancies between self-report and observed behavior were analyzed using Chi-square analyses. **Results:** Results indicated that participants accurately reported their kitchen organization, but significantly overestimated cleaning while cooking ($X^2 = 29.59$, $p < .001$) and getting items out prior to preparing a meal ($X^2 = 4.13$, $p = .04$) compared to observed behavior. Additional analyses are being conducted to further understand differences between participants who accurately self-reported cooking behaviors and those that overestimated cooking behaviors. Relationships between the cooking behaviors of interest and variables such as quality of life, dysexecutive functioning, cognitive testing scores, and performance-based assessment scores are also being examined. Implication of the study for self-report of meal preparation behaviors will be discussed.

Poster: **37**	Comparing Functional Abilities Between MCI and Healthy Older Adults Using the Night Out Task	Poster: **37**

Undergraduate Researcher: Abigail Holder and Nhu Huynh

Program: Gerontechnology (GSUR)

Co-authors: Abigail Holder, Reanne Cunningham, and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: Washington State University, Neuroscience and Psychology, Senior

Abstract:

The world's population is aging and the number of older adults living with mild cognitive impairment (MCI) is increasing. Cognitive changes that accompany MCI can negatively impact the ability to complete everyday tasks. Capturing these changes in a clinic can be challenging as current neuropsychological tests tend to be highly structured while many everyday activities are complex and variable. The aim of this study is to ascertain how MCI impacts performance on everyday activities using the Night Out Task (NOT). The NOT is an open-ended, ill-structured naturalistic assessment that mimics everyday activities and is administered in a laboratory setting. Participants are required to complete 8 tasks in preparation for a "night out", (i.e., gathering money for movie tickets, preparing tea). Participants are observed and scored on measures that capture task accuracy, time, error-types, and approach processes.

The sample in this study consisted of 9 participants with mild cognitive impairment (Ageμ=61.44, Edμ=17.0, 66.7% female) and 18 age, education, and gender matched healthy older adults (HOA) (Ageμ=61.89, Edμ=16.94, 66.7% female). T-tests were performed to determine group differences on NOT variables. Results indicated the MCI group performed more poorly on NOT accuracy and efficiency measures, including Task Accuracy (t=2.49, sig=.036), Sequencing (t=-2.88, sig=.008), and number of Total Errors (t= 2.12, sig= .044). There were no significant group differences in total time to complete the NOT. Process approach variables revealed that the MCI group spent significantly greater time pre-planning (t=2.26, sig=.032) and engaging in mid-task planning (t=2.09, sig=.046), while HOAs demonstrated more multi-tasking (t=-2.41, sig=.023) and self-monitoring (i.e., double-checking; t=-3.02, sig=.006) behaviors. Despite an increase in pre- and mid-task planning, individuals with MCI were less accurate and efficient when compared to healthy controls in NOT performances. Moreover, participants with MCI demonstrated reduced self-monitoring skills, which are important for accurate completion of complex everyday activities.

Poster: **38**	Washington State University Fermentation: Building Extension Resources to Support Washington Fermentation Industries	Poster: **38**

Undergraduate Researcher: Amy Johnson

Program: Food Systems Program

Co-author: Bri Ewing

Home Institution, Major, Class Standing: Washington State University, Intended Integrated Strategic Communication, Junior

Abstract:

Prompted by the continual growth in popularity, Washington State's fermentation industry has displayed a distinct need for more resources for both existing and hopeful industry professionals alike. Because of this, the concept of creating a website dedicated to all things fermentation was created. Over the course of the internship careful thought was placed into creating the WSU Fermentation website, utilizing WSU's existing interface with WordPress. Pages were to include: information on various alcoholic and lactic acid fermentation products, profiles offeatured fermenters, a quarterlynewsletter, instructional videos, and upcoming workshops and events. Instructional videos such as measuring titratable acidity in cider, were filmed, edited, and published. Infographics were designed and placed on webpages to improve user experience and convey scientific knowledge. To record and better the reach of the website, analytics were logged. Video views were also tracked. Website users were given a comment section to suggest edits or ask questions. Upon completion of the WSU Fermentation website, traffic has steadily increased as the word continues to spread. To conclude, this website has set Washington State University one step closer to be the go-to hub for fermenters in Washington State and beyond. As time progresses, the website will continue to thrive as more resources are added and the reach is extended further across the globe.

Poster: **39**	Wet Air Oxidation of Phenol	Poster: **39**

Undergraduate Researcher: Kayleigh Johnson

Program: Northwest Advanced Renewables Alliance SURE

Co-authors: Iva Jovanovic Tews and Manuel Garcia Perez

Home Institution, Major, Class Standing: University of Arkansas at Pine Bluff, Physics, Sophomore

Abstract:

Phenol is a highly toxic chemical that is very common in oil, gas, and chemical manufacturing. Due to the toxicity of phenol, any aqueous solution that is contaminated with it, has to be properly treated and disposed of.

The objective of this research is to determine if wet air oxidation is an efficient way to treat waste water contaminated by phenol. Applying compressed oxygen to the phenol contaminated water in a closed batch system under pressure and high temperature contributes to the break down of phenol into components: carbon dioxide (CO_2), water (H_2O) , and other small organic acids.

If complete oxidation is achieved, the aqueous waste can then be further treated with established biological methods found in most wastewater industries. Chemical Oxygen Demand (COD) will be measures in order to evaluate if the complete breakdown of phenol has occurred. High pressure liquid chromatography will also be utilized to assess the composition of the final products after oxidation.

Our experimental technique uses 28 ml stainless steel batch reactors operated at a span of temperatures and residence times. The experimental matrix will help to identify the most effective process conditions for complete oxidation of the phenol solution. The temperatures span from 180-250^oC in intervals of 10^oC. The gases were tested were nitrogen (N_2) and oxygen (O_2). The time durations included 5, 10, 15, 20, 30, and 45-minute intervals. These conditions were all tested under a pressure of 120 psi of the tested gases.

Poster: **40**	Bias Correction for the AIRPACT-5 Model	Poster: **40**

Undergraduate Researcher: Nicole June

Program: Atmospheric Chemistry REU

Co-authors: Joseph Vaughan, Yunha Lee, and Brian Lamb

Home Institution, Major, Class Standing: The Pennsylvania State University, Meteorology and Atmospheric Sciences, Junior

Abstract:

Air quality models are needed to inform the public of potential health concerns that result when there is a high concentration of pollutants, such as $PM_{2.5}$, in the atmosphere. The AIRPACT-5 system runs daily to predict concentrations of various pollutants throughout the Pacific Northwest. Through comparison with surface $PM_{2.5}$ measurements, we know that the forecasts have bias, which varies in magnitude during the year, and peaks during wildfire season mainly due to the underprediction of $PM_{2.5}$. This project explores multiple methods to correct the model biases. We used model results and observations at state and local air quality monitoring sites within the AIRPACT domain for the entirety of 2017. These data were limited to sites that observed $PM_{2.5}$ and reported data for the entire year. We reviewed three post-process bias-correction methods including: a subtraction of a rolling mean of the bias, a multiplicative ratio technique, and the Kalman Filter technique. The Kalman Filter is a recursive technique that predicts the future bias based on recent past bias. Previous studies have used this technique to reduce bias of air quality models. In their application to the AIRPACT system, we found that all of the post-processing methods reduce the bias at monitoring stations, including during the wildfire season. These results suggest that a bias-correction method can be usefully interpolated to each grid cell in the domain of the model. Further work is needed to evaluate interpolation methods to better improve the accuracy of AIRPACT forecasts, especially in areas where observation sites are sparse.

Poster: **41**	Dynamic Robot Placement in Smart Environments	Poster: **41**

Undergraduate Researcher: Daylan Kelting, Julia Maliauka and Brittany Manuel

Program: Smart Environments

Co-authors: Christopher Pereyda, Aaron Crandall, and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: California State University, Channel Islands, Computer Science, Senior

Abstract:

A combination of increased lifespans and falling birth rates has led to a serious burden on senior care organizations. As a result, in-home nursing services have become prohibitively expensive for many seniors as they age. Robotic assistance for the elderly is a promising solution, allowing people to age in-place more effectively without the need for a dedicated nurse. Robotic assistants are able to perform a variety of functions to assist the user from reminder of daily activities to meal and medication delivery. One problem in human robot interaction is the question of where the robot should be when no help is needed. In order to be effective, the robot must be close enough so that it can deliver help in a timely manner while also being out of the way. Here, we describe an algorithm that uses real-time smart home data and a floor plan to choose locations for the robot to idle in real time, as residents occupy the living space. We evaluate our algorithm using both historical data and an informal preliminary survey. {begin projected results} Our historical data analysis shows that our algorithm chooses a location that is is always less than {insert} seconds from users. Our survey study shows the algorithm performs similarly to human placement. {end projected results} This work will allow home and medical robots to live more harmoniously with humans by being closer to assist users when they are in need.

Poster: **42**	Determining Organic Herbicide Performance Using Canopeo Digital Analysis	Poster: **42**

Undergraduate Researcher: Gus Kendrick

Program: Food Systems Program

Co-authors: Aaron Appleby

Home Institution, Major, Class Standing: Washington State University, Environmental Science, Junior

Abstract:

The production model of organic agriculture typically includes benefits of sustainability, crop diversity, crop nutrient levels, and economic viability when compared to conventional agricultural methods. However, the organic model is criticized for its lack of easily viable weed and pest management options. Certified organic herbicides were hypothesized as a solution, if their effectiveness could be demonstrated against several different weed species, without exceeding economic viability, due to the generally high cost of organic herbicides. Four OMRI registered herbicides, each consisting of different active ingredient(s), were chosen for a study conducted over three certified organic farms in the state of Washington. Visual observation was compared to the digital image analysis tool Canopeo for precision and efficiency as methods for measuring weed burn down/ground cover percentage. An additional greenhouse study will be conducted later to determine herbicide efficacy with factors such as weed species, weed growth stages, and herbicide concentration, further contributing to possible methods of increasing herbicide viability in organic agriculture. The results of this research will be presented to agricultural entities at the various local, state, and national levels. This information will hopefully provide additional, effective weed management practices to reduce the strain on converting from a conventional to an organic agricultural model, where producers may also enjoy increased sustainability and economic productivity.

Poster: **43**	Synergistic Effects of Crosslinking Treatments on Therapeutic Laden Hydrogels	Poster: **43**

Undergraduate Researcher: Joshua Kernan and Terreill Robertson

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Alia Mallah, Mahmoud Amr, Haneen Abusharkh, Juana Mendenhall, Arda Gozen, Bernie VanWie, and Nehal Abu-Lail

Home Institution, Major, Class Standing: Washington State University, Mechanical Engineering, Junior

Abstract:

Osteoarthritis (OA) is a degenerative disease that affects approximately 31 million Americans. OA is characterized by articular cartilage (AC) deterioration. AC is unable to regenerate due to its low cellular density and the lack of blood flow. Today, knee replacement surgery, marrow stimulation and mosaicplasty are some treatments used to alleviate OA. However, these treatments do not effectively restore the tissue properties nor function. Therefore, innovative tissue implants are being developed as a long-term solution to OA. To make such implants, chondrocytes are grown on 3D printed scaffolds that guide the growth of cells. A scaffold must mimic the mechanical properties of the native tissue and be biocompatible and biodegradable as the tissue grows. Hydrogels can resemble the viscoelasticity of native AC. In this experiment, a tricomponent hydrogel was tested for a scaffold. The hydrogel was made of alginic acid sodium salt powder, gelatin from porcine skin and gum arabic from acacia tree mixed at a ratio of 1:2:1 and crosslinked by refrigeration, $CaCl_2$, and N-hydroxysuccinimide (NHS)-EDC (1-Ethyl-3-(3-dimethylaminopropyl)-carbodiimide) respectively. To study the cytotoxicity of crosslinking, bovine chondrocytes (bAChs) were seeded in a micromass culture in triplicates, and the viability of the cells was tested using Alamar Blue and compared to a negative control with no crosslinking. To test the hydrogel potential as an externally seeded scaffold, hydrogel discs crosslinked and without crosslinking were seeded with bAChs and cultured for 14 days. The chondrocytes cultured on hydrogels will be tested using histology to test glycosaminoglycans (GAG) and collagen qualitatively, biochemical analysis to quantify GAG, collagen and DNA, and cell count for viability. In our experiment, we expect improved cartilage properties when culturing chondrocytes on a 3D hydrogel scaffold. This will be reflected by an increase in collagen and glycosaminoglycan (GAG) contents.

Poster: **44**	Phenomic Predictions' Insight into Environmental and Genetic Significance	Poster: **44**

Undergraduate Researcher: Rafi Khaled

Program: Smart Environments

Co-author: Lawrence Holder

Home Institution, Major, Class Standing: Vassar College, Computer Science, Junior

Abstract:

We analyzed machine learning methods for phenotypic predictions as a function of environmental and genetic features; a successful learning algorithm is also good at ranking the importance of these features that result in certain yields or growth rates. How we approached pre-processing the data was sometimes as significant in several testing metrics as the chosen algorithm. For example: using k-means clustering to divide latitude and longitude into regions; binary encoding the genetic variation of crops instead of using one-hot vector; reducing three features for month, date, and year into one representing the season; time shifting data to encode historical information; and many more methods were used to allow learning to proceed more efficiently and accurately. We were able to get average Root Mean Squared Error (RMSE) of 9% for a diverse dataset provided by the Syngenta company, and RMSE of 2% for smaller time series data. Related works have used Random Forests to outperform Multiple Linear Regressions and other machine learning methods, but we have found Gradient Boosted Machine to do better than these other methods with our processing techniques, including better than some deep neural networks.

Poster: **45**	Gleaning Network and Its Impacts in Two Rural Counties	Poster: **45**

Undergraduate Researcher: Mirah Khalid

Program: Food Systems Program

Co-authors: Laura Lewis, Clea Rome, and Joseph Sharkey

Home Institution, Major, Class Standing: Virginia Tech, Food Science and Technology, Junior

Abstract:

The practice of gleaning dates back thousands of years, when farms would allow excess crops to be harvested by the food-insecure in the community. In the past few years, WSU Clallam and Jefferson Counties Extension offices have established a gleaning program that connects farmers with an overabundance of produce to a rescue network, saving hundreds of pounds of food from being wasted. This study examines the impacts of the gleaning network in Clallam County and Jefferson County, Washington, on those who glean, organizational recipients of gleaned produce, and the farms and property owners that host gleans. An anonymous survey was created to target four different categories: gleaners, organizational recipients, farms, and property owners. Each category completed a survey tailored to their role. The participants provided demographics information, such as age, ethnicity/race, and gender identification. Additional questions in the survey aimed to determine the benefits of joining the network, if reason for participation changed over time, the perceived effectiveness of the program, and the strengths and weaknesses of the network. The survey is formatted on the Qualtrics platform and was distributed through email and on paper to the Clallam and Jefferson Counties gleaning database. Preliminary data indicates older property owners and a middle to older-aged population of gleaners. Expected results include involvement in the gleaning network for access to free, fresh, and healthy food, and contributing to the community. This research may be expanded to compare Clallam County and Jefferson County's gleaning networks with large-scale food rescues.

Poster: **46**	Quantifying Particulate Matter Emissions from Wheat Conveyance using a Carbon Dioxide Tracer	Poster: **46**

Undergraduate Researcher: Kristina Koh

Program: Atmospheric Chemistry REU

Co-authors: Anna Potapova and Candis Claiborn

Home Institution, Major, Class Standing: Emory University, Chemistry (B.S) and Engineering Sciences (B.S), Junior

Abstract:

As Washington State's large supply of wheat is transported from farms to storage elevators, it emits fine particulate matter ($PM_{2.5}$). $PM_{2.5}$ impacts air quality and may trigger diverse health problems. During storage and handling, the harvested wheat is moved by truck to a storage facility, where it is held in grain elevators or stored in large wheat piles until it can be loaded onto rail cars and transported to markets. In the grain storage yard, wheat stored in the wheat piles is transferred to the elevators via conveyor belts prior to being loaded onto trains. The wheat is dropped from one belt to another, creating visible dust plumes. Our experiment determined the emission rate of $PM_{2.5}$ from this drop point using carbon dioxide as a tracer gas. The tracer gas was released at the drop point and both $PM_{2.5}$ and CO_2 analyzers were deployed upwind and downwind from it. Downwind data were collected from six trials in three varying distances from the drop point. The Tracer Ratio method was used to determine the $PM_{2.5}$ emission rate. Knowing the CO_2 release rate and concentrations of both CO_2 and $PM_{2.5}$, we were able to determine the emission rates of $PM_{2.5}$. The $PM_{2.5}/CO_2$ ratio was found through summation plots. The $PM_{2.5}$ emission rate was calculated using the formula, $Q(PM_{2.5}) = [C(PM_{2.5})/C(CO_2)] \cdot Q(CO_2)$ where Q is the emission rate (g/hr) and C is the concentration (g/m^3). The regression slope from the summation plot gave a $PM_{2.5}$ to CO_2 concentration ratio of 0.0013. The calculated $PM_{2.5}$ emission rate was 4.9 g/hour. Further research is needed to determine whether this rate complies to EPA's Air Pollution Emission Factors (AP-42).

Poster: **47**	Exploring the Potential of Machine Learning for Ozone Prediction in Tri-Cities Washington	Poster: **47**

Undergraduate Researcher: Ryan Lamastro

Program: Atmospheric Chemistry REU

Co-authors: Kai Fan and Yunha Lee

Home Institution, Major, Class Standing: SUNY New Paltz, Environmental Geochemical Science, Senior

Abstract:

Ozone is one of the major air pollutants that causes a hazard for public health and the environment. The Environmental Protection Agency (EPA) has set the National Ambient Air Quality Standard (NAAQS) to be 70 ppbv for annual fourth highest daily maximum 8-hour concentration, averaged over 3 years. Air-quality forecasting for the Pacific Northwest (AIRPACT) struggles to predict the ozone concentration in Tri-Cities in Washington. This study aims to better predict ozone in Tri-Cities using Machine Learning (ML) based modeling approaches with available observation datasets: meteorological measurements from Pasco and Hermiston airports and O_3 and PM2.5 measurements from Hermiston and Kennewick air quality index sites. Instead of providing data from individual site as a separate input, we used the average across the sites and performed four different preprocessing methods. After that, several feature selections are used to select which meteorological variables are the most valuable for the prediction of ozone. Those variables are then used to train a linear regression model and random forest model. With the trained model, we determined the accuracy of O_3 predictions from those ML models. We find that random forest works best for ozone prediction, while linear regression tends to have a lower correlation with observations and tends to underestimate ozone at higher concentrations. Unlike the linear model, random forest model predicts O_3 reasonably within the wide range of concentrations. Moreover, our random forest model predicts O_3 better than AIRPACT predictions. Our study demonstrates a ML model as a promising air quality prediction tool. As a future work, we will explore the accuracy of ML-based air quality model in other regions.

Poster: **48**	Characterizing Post-Wildfire Mulch Leachates: Implications for Source Water Quality	Poster: **48**

Undergraduate Researcher: Noah Leibnitz

Program: Northwest Advanced Renewables Alliance SURE

Co-authors: Elizabeth Kittisack and Amanda Hohner

Home Institution, Major, Class Standing: University of Puget Sound, Physics, Sophomore

Abstract:

For communities reliant upon forested watersheds for drinking water, increased rates of erosion following wildfires often create drinking water treatment challenges. To minimize sediment fluxes into source waters, several different types of mulch are often applied to burned areas. While such post-wildfire mulches have proven to be effective in reducing erosion, little is known about the effects the mulches may have on downstream drinking water quality and treatment. These parameters serve as indicators of the natural organic matter leached from the mulches and the overall water quality. Initial data suggested there was no meaningful relationship between any of the mulch types or concentrations, and pH; however, longer leaching periods primarily resulted in lower pH values. The straw mulches generally exhibited higher absorbance than the wood mulch, with the 48-hour, 8 g/L, short-strand mulch having the highest overall absorbance. Increased mulch concentrations resulted in increased absorbance, DOC, and TDN measurements. Similarly, although less definitively, longer leaching periods resulted in higher absorbance, DOC, and TDN. Preliminary data suggests that increased mulch concentration and leaching period results in increased organic matter leached into solution and lower water quality, particularly for straw mulch. Further testing will include ammonia and other inorganic nitrogen measurements, as well as specific ultraviolet absorbance calculations at 254nm. Continued analysis is expected to support earlier observed relationships, which suggest that straw mulch is more likely than wood mulch to contribute to source water quality degradation.

Poster: **49**	Expansion Characterization of Whole and Split Faba Beans during Twin-screw Extrusion	Poster: **49**

Undergraduate Researcher: Katy Lobeda

Program: Food Systems Program

Co-authors: Girish Ganjyal, Pichmony Ek, and Bon-Jae Gu

Home Institution, Major, Class Standing: Virginia Tech, Food Science and Technology, Junior

Abstract:

Extrusion characteristics of whole and split faba beans, *Vicia faba L.*, was studied. Moisture content of the flours was varied between 14, 16, and 18% (w.b.) and the screw speed was varied between 150, 200, and 250 rpm. Two dies with diameters of 2-mm and 3-mm were used. Rest of the processing parameters were kept constant. Physical properties including, expansion ratio, bulk density, water solubility index (WSI), and water absorption index (WAI) of the extrudates were measured. The system parameters (SME, pressure, and motor torque) and physical properties (expansion ratio, density, WAI, and WSI) will be subject to regression analysis to determine how moisture content, screw speed, and die diameter affect the extrusion.

Poster: **50**	Knock out of the Phosphoglycerate Dehydrogenase Gene in Arabidopsis Influences Photosynthetic Performance	Poster: **50**

Undergraduate Researcher: Maximiliano Madrigal

Program: Henning Kunz

Co-authors: Ricarda Hoehner, Moritz Kraemer, and Hans-Henning Kunz

Home Institution, Major, Class Standing: Washington state university, Genetics and cell Biology, Sophomore

Abstract:

Photosynthesis is the biological process that occurs amongst others in chloroplasts of plant leaves. It supports all life on earth, by using sunlight to turn carbon dioxide and water into sugars, O_2 and, other organic material. Photosynthesis can be split into two different stages, light dependent reaction and the Calvin–Benson cycle. In the Calvin–Benson cycle, RuBisCo binds CO_2 to produce sugars. But RuBisCo can also bind O_2 leading to the production of toxic products which recycling in a process called photorespiration is accompanied by significant carbon and energy losses. But Photorespiration is also the major pathway to produce the amino acid Serine (Ser). An alternative pathway for Ser synthesis is the Phosphoserine pathway in which phosphoglycerate dehydrogenase (*pgdh*) oxidizes 3-Phosphoglycerate (3-PGA) to 3-Phosphohydroxypyruvic acid (3-PHP). *Arabidopsis* expresses 3 PGDH isoforms, whereas we are investigating on of which, *pgdh-3*. Two independent loss-of-function lines with t-DNA insertions in different loci of the *pgdh-3* gene (At3g19480), were isolated. In both of these lines photosynthesis was less efficient and heat dissipation, measured as non-photochemical quenching (NPQ), increased. Here we want to show that *pgdh-3* is expressed in Arabidopsis leaves. To prove this, we took advantage of the Gus reporter system. Our results show that *pgdh-3* is highly expressed in leaves and that knocking out the *pgdh-3* gene causes photosynthesis to be less efficient. More research is needed to determine the exact feedback process that leads to this down-regulation of photosynthesis in order to find factors that lead to better understand the process of Photosynthesis.

Poster: **51**	Reinforcing Regenerated Fibers Manufactured from Cotton Waste Using Cellulose Nanofibers	Poster: **51**

Undergraduate Researcher: Gloria Martinez

Program: Northwest Advanced Renewables Alliance SURE

Co-authors: Hang Liu, Tian Liu, and Shu Yan

Home Institution, Major, Class Standing: Santiago Canyon, Engineering, Sophomore

Abstract:

Ninety-five percent of post-consumer cotton waste ends up in landfills or is disposed of by incineration. This is a great waste of natural cellulose resources, and these disposal methods also produce greenhouse gases and other toxic chemicals that pose a threat to our environment and ourselves. Recycling cotton waste by dissolving and regenerating cellulose fibers is an ideal way to solve this issue. However, the traditional cellulose solvents are either toxic or expensive, which limit their application in cotton waste recycling. Recently, some alkali solvent systems were found to be able to dissolve cotton as a cheap and green alternative. Regenerated fibers have been successfully produced using these solvent systems from cotton waste. Cellulose nanofibers (CNF) are known with their excellent mechanical properties and have been widely researched for composite material reinforcement. However, reinforcing regenerated cellulose fibers using CNF has not been reported. In this study, the effects of CNF on reinforcing regenerated fibers made from cotton waste are investigated. These include how CNF influence solution preparation, solution properties, fiber spinning process, and fiber properties.

Poster: **52**	Predicting Emotion Based On Biological Signal Inputs Using Machine Learning	Poster: **52**

Undergraduate Researcher: Lucia Martisovitsova

Program: Smart Environments

Co-authors: Mona Ghandi and Salikh Bagaveyev

Home Institution, Major, Class Standing: University of Central Florida, Computer Science, Junior

Abstract:

Compassionate spaces are architectural environments which have the potential to change their design and built structure according to inhabitants' thoughts and feelings. These spaces have several applications in the medical field, where they can empower people with physical challenges to regain control over their environments. One such compassionate space involves a configurable wall which can change shape based off of a user's emotional state.

In this project, for the purpose of coordinating a configurable wall's movements with a user's emotions, we developed a method to predict a user's emotions based off of collected biological data. Using the Empatica E4 wristband, we collected skin temperature, heart beat, heart beat variability (HBV), and galvanic skin response (GSR) in both live and recorded sessions. Data associating these biological signals with participants' emotional responses was collected by having a participant watch audiovisual recordings which could evoke a variety of emotions. This data was then utilized in a random forest-based machine learning algorithm which could make predictions based off of live new data. A relationship between biological data and emotion was starting to be established, with the algorithm garnering somewhat accurate outputs. Future work would involve gathering a larger dataset and experimenting with other machine learning algorithms in order to optimize accuracy.

Poster: **53**	Predicting Transitions Between Activities to Customize Tutorial Videos	Poster: **53**

Undergraduate Researcher: Timothy McAleer

Program: Smart Environments

Co-author: Larry Holder

Home Institution, Major, Class Standing: University of Washington, Math, Junior

Abstract:

The purpose of this project is to tailor instructional videos of multi-step tasks for the individual, showing them only the steps that they missed. For instance, if the individual is planning on walking their dog, but forgot the step of grabbing the leash, the video would show only that step, rather than show the complete tutorial for walking the dog. This will be used for people with degrading cognitive abilities, who might forget certain steps of everyday activities. We are investigating two solutions to this task. One is to manually design rules for automatically detecting the transitions in the videos. The second is to use Machine Learning to train a model that can perform the transition detection task based on patterns in the sensor data. The manual method has had limited success (with an average of 3.45 seconds off the actual transition times for three videos with three different activities). We will compare this performance to the Machine Learning models across several different experimental settings.

Poster: **54**	Expanding Why Not Queries in Data Graphs	Poster: **54**

Undergraduate Researcher: Evan McElheny

Program: Smart Environments

Co-authors: Yinghui Wu, Mohammad Hossein Namaki, and Xin Zhang

Home Institution, Major, Class Standing: Marist, Computer Science, Senior

Abstract:

New ideas have surfaced to find tangible results in large heterogeneous data graphs. However, when a query does not return expected results and users are left with nodes 'missing', unless they have extended knowledge of the database there is little explanation on how to modify a query to include missing results. We present a fast algorithm for modifying query Q to Q' on a data graph to include missing nodes into a new result. This approach stems from the heuristic that the nodes that will be added to the tree will be added through the closest path. We find the nodes that have a shortest path through a missing node to the original result. Then, we modify the query to include the neighbor nodes that hit the most missing nodes in their path and are the closest.

Poster: **55**	Biobased Transparent Waterborne UV Absorbing Coating	Poster: **55**

Undergraduate Researcher: Ana Miller

Program: Bioplastics & Biocomposites

Co-authors: Yifan Li, Emily Olson, and Shan Jiang

Home Institution, Major, Class Standing: Iowa State University, Materials Engineering, Senior

Abstract:

An estimated 25-50% of food is wasted globally, producing high levels of methane in landfills as well as economic loss. One contributor is food degradation caused by ultraviolet radiation. Degradation occurs when photosensitizers become electronically excited and oxidation ensues. Limiting UV exposure can reduce the amount of food waste and therefore curtail economic loss and prevent greenhouse gas emissions. In this study, Zinc Oxide nanoparticles were formulated with biobased polymers into transparent UV blocking coatings for food packaging to prevent oxidation of the product while still maintaining transparency. We tested different biobased polymers and formulation conditions, and discovered that coatings formulated with 2-hydroxyethyl cellulose (HEC) showed superior UV blocking performance. However, films made with 2-hydroxyethyl starch (HES) did not exhibit sufficient UV blocking. With the optimized coating formulation, the resulting less than two micron thick film had a transmittance of 75% at a wavelength of 600 nm (visible range), 6% at 357nm (UV-A range), and 0% at UV-B and UV-C range. Scanning electron microscopy further revealed a complex network structure formed by ZnO nanoparticles, which may be accounted for the improved UV blocking performance and high transparency.

Poster: **56**	Effects of Thermal Acclimation on Temperature-dependent Activity Levels of the Splashpool Copepod *Tigriopus californicus*	Poster: **56**

Undergraduate Researcher: Autumn Miller

Program: Wes Dowd

Co-authors: Arani Cuevas-Sanchez, and Wes Dowd

Home Institution, Major, Class Standing: Washington State University, Biology, Sophomore

Abstract:

Although environmental conditions are constantly shifting, relatively little is known regarding how physiology adjusts to fluctuating conditions. The copepod, *Tigriopus californicus*, is abundant in intertidal splash zones along the west coast. They are unique in their ability to adapt to a wide spectrum of environmental conditions. Water pH, temperature, dissolved oxygen, and salinity all change over the day-night cycle in their splashpool habitat. We developed a novel, high-throughput, microplate-based assay for quantifying activity patterns of individual copepods at a range of temperatures simulating the daily cycle in a tidepool. We then applied this method to analyze the effects of fluctuating and constant temperature acclimation on these activity patterns. The copepods were gathered from Friday Harbor, Washington and were acclimated to four different temperature regimes over a two-week period: 19, 23, 15, and a cycling 15-23°C. A temperature-controlled TECAN plate-reader was used to analyze the activity of copepods by counting the number of times an infrared light beam was disrupted by the animal over a six-minute period. This measurement was repeated for each individual at temperatures ranging from 18 to 36°C. A python program is then used to analyze the data. Ongoing research aims to analyze the plasticity of offspring when acclimated to constant or fluctuating conditions throughout development. These results will have implications regarding climate change and ecosystems adapting to this variation.

Poster: **57**	This Is the Way the World Ends, Not with a Bang but with a Whimper from Degenerative Joint Pain	Poster: **57**

Undergraduate Researcher: Geoffrey Morse and Trey Reppe

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: A. Mallah, M. Amr, H. Abusharkh, J. Mendenhall, B. J. Vanwie, and N. I. Abu-Lail

Home Institution, Major, Class Standing: WSU, Chemical engineering, Senior

Abstract:

Osteoarthritis (OA), which is a disease that marks the degeneration of articulating cartilage (AC), is caused by various factors including injury, obesity and age. Engineered AC can be grown in the laboratory using a cell source, a bioreactor, and growth factors, but this faces many problems, such as the acquisition of chondrocytes, AC cells, from patients. When isolated from patient, these cells are often inflamed. To induce the growth of healthy AC, these cells can be treated with nutraceuticals to reduce the effects of reactive oxygen species (ROS) which contribute to inflammation. We hypothesize that the use of nutraceuticals on inflamed chondrocytes will reduce the expression of inflammatory markers and increase the expression of chondrogenic markers such as collagen and glycosaminoglycans (GAGs). To test this, bovine articular chondrocytes (bACH) were seeded in micromass cultures into 144 wells in triplicate on day zero. Inflammation was induced by applying interleukin 1 beta (IL1β) for 2 hours on day one. The cells will then be treated with each of four nutraceuticals separately in chondrogenic media, including vitamin C, vitamin E, gallic acid and catechin hydrate for 21 days and compared to a negative control of nutraceutical-free medium. After day 21 of treatment, cells will be tested for chondrogenic and inflammatory markers to determine which nutraceutical reduced inflammation the most. The characterization of the grown tissue includes histology to qualitatively determine GAG and collagen, Griess (NOS) assay to determine level of inflammation, and biochemical analysis to quantify the total GAG and total collagen produced. Samples will also be prepared to be tested for mRNA expression of collagen 2 and aggrecan. We expect to see an increase in chondrogenic markers and reduction of inflammatory markers versus the negative control.

Poster: **58**	Effects of Social Cues on the Termination of Migration in a Facultative Migrant, the Pine Siskin	Poster: **58**

Undergraduate Researcher: Guillermo Navarro and Hilary Zuñiga

Program: Heather E. Watts

Co-authors: Ashley R. Robart and Heather E. Watts

Home Institution, Major, Class Standing: Washington State University, Animal Science, Senior

Abstract:

Most of what we know about migration comes from studies of obligate migrants. Much less information is known about the cues that regulate facultative migration, and we know particularly little about what triggers the termination of migration (i.e., settlement). In this study we tested whether the presence of a conspecific stimulated settlement in migratory pine siskins (*Spinus pinus*). Pine siskins are facultative migrants that can be used to study migratory behavior in captivity. Birds in a spring migratory state were either housed individually as the control group or paired with a non-migratory pine siskin. Birds were video recorded repeatedly before and after pairing occurred. Behavioral data were collected from videos using scanned sampling and a pine siskin ethogram in order to quantify nocturnal migratory restlessness, our indicator of migratory behavior. We will compare rates of migratory restlessness between paired and control birds. If paired birds show a reduction in migratory restlessness compared to controls, this would indicate that the presence of a conspecific stimulated settlement. On the other hand, if paired and control birds show similar levels of migratory restlessness, this would suggest no effect of our manipulation on settlement behavior. We expect the results of this study to advance the understanding of facultative migration, the role of social cues in migration, and the process of settlement.

Poster: **59**	The Effects of Diffuse Radiation on Ecosystem Carbon Uptake and Stomatal Behavior	Poster: **59**

Undergraduate Researcher: Kidus Negesse

Program: Atmospheric Chemistry REU

Co-authors: Heping Liu, Justine Missik, Zhongming Gao and Andy Suyker

Home Institution, Major, Class Standing: Harvard University, Physics, Sophomore

Abstract:

Net ecosystem production depends heavily on the nature of the radiation transferred through the atmosphere. Cloud coverage and aerosols increase the diffuse fraction of radiation, which has been suggested to increase carbon uptake by enhancing penetration of radiation into the canopy. We investigate the effects of diffuse radiation on ecosystem carbon uptake and stomatal behavior in forests and croplands. The forest sites include a mix of deciduous and coniferous trees; the cropland sites consist of maize and soybean and are either irrigated or naturally rainfed. Grouping ecosystem flux data by incoming photosynthetic photon flux density, we analyzed the relationship between the diffuse fraction of radiation and gross primary production (GPP), water use efficiency (WUE), intrinsic water use efficiency (iWUE), and light use efficiency (LUE). For both forest and cropland sites, GPP, WUE, and LUE increased with a higher fraction of diffuse radiation. We will run regressions of ecosystem production, stomatal conductance, and evapotranspiration against important environmental parameters to better isolate the effects of diffuse radiation. In addition, we will investigate the extent to which GPP, evapotranspiration, and stomatal conductance each controls the response of WUE and iWUE to enhanced diffuse radiation.

Poster: **60**	Identification of Vaccinium Hybrids Using SSR Markers	Poster: **60**

Undergraduate Researcher: Grant Nelson

Program: Plant Genomics and Biotechnology

Co-authors: Nathan Tarlyn, Ryan Christian, and Amit Dhingra

Home Institution, Major, Class Standing: Washington State University, Genetics and Cell Biology, Senior

Abstract:

Vaccinium species have been widely cultivated for hundreds of years, with varieties such as blueberries and cranberries representing a significant portion of the commercial markets for fruit. In 2016, Washington State lead the United States in blueberry production, with over 120 million pounds grown in the state. In 2017, the total yield was anticipated to increase further, beyond 132 million pounds. However, while blueberries produce a significant market, one variety of vaccinium is considered to have better taste; the huckleberry is often considered to be a tastier and more nutritious fruit. The berry has remained undomesticated through the years due to poor berry yields and the fastidious nature of the plant. While the native species are resistant to cultivation, little has been previously done to develop a new species for growing. Our lab then has begun to work with the objective of developing a new hybrid species of blueberry and huckleberry to with the beneficial characteristics of both. We have cross bred seven species of blueberry with two species of huckleberry to develop an F_1 population of hybrid offspring utilizing honeybees. Due to the long development time of these plants, we will be unable to observe phenotypic changes for some time, and as a result we have begun genotyping the offspring. By identifying genotypic patterns with SSRs (short sequence repeats), we can locate plants with both huckleberry and blueberry DNA within our population, and select these individuals for growth and future phenotypic selection.

Poster: **61**	Expression of RNA-Binding Proteins in Rice Seedlings under Salt Stress	Poster: **61**

Undergraduate Researcher: Thu-Lan Nguyen

Program: Thomas Okita

Co-authors: Li Tian and Thomas W. Okita

Home Institution, Major, Class Standing: California State University, Los Angeles, Biochemistry, Senior

Abstract:

RNA-binding proteins (RBPs) play key roles in post-transcriptional gene regulation processes, including pre-mRNA processing, mRNA transport, localization and decay. Emerging evidences suggest that RBPs are involved in the cellular response to external stress. To identify the RBPs involved in stress response in rice plants, expression of several RBPs in rice seedlings under salt stress conditions were examined. Seedlings were collected after 1, 2, 8, and 24 hours of salt stress treatment with 0 mM, 100 mM, 200 mM, or 300 mM NaCl supplemented with nutrition buffer. Immunoblot analyses were conducted to determine the changes of RBP expression that occur as a result of the stress treatments. Overall, this research will aid in understanding which RBPs play roles in gene regulation during salt stress.

Poster: **62**	The Effect of Multi-strain Rhizobia Inoculations on the Salt Stress Response of *Medicago polymorpha*	Poster: **62**

Undergraduate Researcher: Cassidy Peru

Program: Maren Friesen

Co-author: Maren L. Friesen

Home Institution, Major, Class Standing: Washington State University, Biochemistry, Sophomore

Abstract:

Rhizobia are soil inhabiting bacteria that form mutualistic relationships with legumes by fixing nitrogen, making it available for plant use. Because rhizobia are applied managed plant systems, multiple investigations have explored additional effects of single-strain rhizobia inoculations on plants. These investigations demonstrate that rhizobia are also beneficial because they aid in defending the host against herbivory and stress. However, it is unlikely that only a single rhizobia strain would inhabit a plant's nodules; it is far more likely that multiple strains would colonize roots simultaneously as it is known that diverse rhizobia colonize in the same plant, typically in different nodules. To address this deficiency, we explored the effect of single versus multi-strain inoculations on the plant's stress response to salinity. *Medicago polymorpha* plants inoculated with single or multi-strain inoculums will be treated with 200mM NaCl solution at 3 weeks of age. At time periods of 0, 24, and 48 hours after salt treatment, the plants will be flash frozen and analyzed for salicylic acid (SA) in the leaf tissue and hydrogen peroxide (H2O2) content in the roots. Since multiple genotypes of bacteria may buffer plant stress more effectively, we predict that plants inoculated with multiple strains of rhizobia will produce more SA and H2O2 when exposed to salinity, indicating more protection against stress. These results can be applied to managed plant systems to determine if leguminous crops should be inoculated with single or multiple strains of rhizobia in order to achieve the most protection against stress.

Poster: **63**	Consumer-safe Bioplastic Blister Packaging	Poster: **63**

Undergraduate Researcher: Lexington Peterson

Program: Bioplastics & Biocomposites

Co-authors: David Grewell and Mitchel Michel

Home Institution, Major, Class Standing: Pittsburg State University, Plastics Engineering Technology and Polymer Chemistry, Sophomore

Abstract:

Blister packaging is a type of packaging where plastic is custom molded to fit neatly around a product and is welded around the edges. They are typically composed of petrochemicals, polymers derived from petroleum oil, due to their low cost, abundance, elasticity, aesthetics, fatigue resistance, and impact-resistance. While petrochemicals are convenient, there are alternative materials that are safer for consumer usage and are biodegradable/compostable. Bioplastics are derived from renewable resources such as natural feedstocks, are cost competitive with petrochemicals, and have the potential to be just as reliable and safer for consumers in blister packaging applications. Consumers have a history of injuring themselves with a cutting device while trying to pry through blister packages or on the sharp plastic itself while trying to get to a product. In this research, bioplastic mixtures are extruded under the same temperatures to ensure they all retain the same thermal histories with a uniform blend and are also pelletized. The pellets are then split to be injection molded into dog bones and extruded into film. The dog bones are tensile tested to highlight each mixtures' modulus, maximum strength, and elongation. Two specimens at a time are cut from the film, conjoined in a weld, and tensile tested to observe the weld strength of a theoretical blister pack composed of that bioplastic mixture. The purpose of this research is to discover a combination of bioplastics that will retain the favored characteristics of current blister package compositions and to determine which of various welds have the most appropriate shear strength for a consumer to open a package's seal safely.

Poster: **64**	Biofilm Reduction on Wounds With Electrochemical Scaffold	Poster: **64**

Undergraduate Researcher: Maria Predtechenskaya

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Gretchen Tibbits and Haluk Beyenal

Home Institution, Major, Class Standing: Arizona State University, Microbiology, Junior

Abstract:

A major contributor to chronic wounds are biofilms. Biofilms, which are films containing bacterial colonies, lead to antibiotic resistance of bacteria and the need for complex treatments. Biofilms on wounds are known to reduce the wound healing rate significantly. Previous research shows that an electrochemically conductive scaffold with a three-electrode system, called an "e-scaffold," can decrease viable bacteria in biofilms in in-vitro conditions. This solution is an alternative to antibiotics: the e-scaffold electrochemically oxidizes water to produce a low concentration of hydrogen peroxide during a 24-hour treatment period of the biofilm, causing oxidative stress and killing bacterial cells. This reaction is given by the following equation: O_2 (oxygen) + $2H^+ + 2e^- \rightarrow H_2O_2$ (hydrogen peroxide). Research has been done to modify the design of the previous e-scaffold to fit a wound on a mouse model in order to test the effectiveness of the e-scaffold killing ability in-vivo. We have hypothesized that with a smaller design, the e-scaffold will still reduce the viable cells in a biofilm. The new design has been tested in-vitro on a commonly found bacteria in wounds: *Acinetobacter baumannii* strain. The treatment's effectiveness is shown by a logarithmic reduction in cells. The next step is to prove that the in-vitro e-scaffold can be implemented in in-vivo mouse wound experiments with similar results. The cell reduction results will add momentum to the creation of an electrochemical scaffold that can reduce biofilms on infected human wounds, greatly aiding patients suffering from chronic wounds.

Poster: **65**	Nanobiocatalysts in Non-invasive Diabetes Detection	Poster: **65**

Undergraduate Researcher: Joshua Recinos

Program: Engineering Tools for Disease Diagnostics and Treatment

Co-authors: Tanzila Islam, Alla Kostyukova, and Su Ha

Home Institution, Major, Class Standing: University of California, Riverside, Chemical Engineering, Senior

Abstract:

The advancement of glucose biosensors has been realized with the developments in technology and techniques pertaining to biocatalysis and electrochemistry. In this project, an enzymatic glucose biosensor electrode was constructed with glucose oxidase (GOx) and its glucose sensing performance was studied. Due to the large separation distance from the active site of the GOx to its electrode surface, direct electron transfer (DET) is absent between GOx and its electrode. To facilitate DET and enhance the glucose detection efficiency, one of our goals was to minimize the structure of GOx to bring the active site of the enzyme closer to its surface without significant damage to the conformation of the enzyme. To minimize the GOx crystal structure (PDB: 1CF3) *in silico*, the software Chimera was used to remove parts of the GOx secondary structure that are not critical to the active site, thereby improving the electrochemical activity of GOx. To ensure the enzyme's structural conformation is conserved after structural minimization, Molecular Dynamics Simulation was performed and compared with actual GOx structure.

We also developed a GOx-based glucose sensor electrode by entrapping commercial GOx in graphitized mesoporous carbon (GMC) and crosslinking the enzyme with glutaraldehyde to improve the enzyme's stability. The GOx entrapped in GMC was then localized onto a glassy carbon electrode with 5% nafion and the sensor was analyzed through a glucose sensing test at 0.72 V (vs Ag/AgCl). A commercialized glucose sensor for diabetic patients is expected to have a linear range detection of more than 7.0 mM glucose in the blood. The studied glucose sensor reached a linear range detection of 2.0 mM glucose solution. The goal was to improve the linear range detection of the GOx-based glucose sensor by changing parameters in the immobilization technique and analyzing their corresponding trends.

Poster: **66**	Validation of the Complete Chloroplast Genome Sequence for Multiple Rosaceae Fruit Trees	Poster: **66**

Undergraduate Researcher: Angel Rivera

Program: Plant Genomics and Biotechnology

Co-authors: Richard Sharpe, Bruce Williamson Benavides, and Amit Dhinrga

Home Institution, Major, Class Standing: Department of Horticulture, Washington State University, Pullman, WA - 99164, Genetics, Senior

Abstract:

Availability of chloroplast genome sequences is important to determine evolutionary relationships among individuals. Chloroplast sequence information has also translational applications such as protection of plants from biotic and abiotic stress, and development of vaccines and biopharmaceuticals. In this study, complete chloroplast genome sequence will be determined for 17 cultivars from the Rosaceae family. The 17 chloroplast genomes include one *Malus domestica* (apple), one *Pyrus domestica* (pear), one *Prunus avium* (cherry) and 14 *Prunus dulcis* (almond) cultivars. Chloroplast genomes consist of four main regions: a Large Single Copy (LSC), Small Single Copy (SSC) and two Inverted Repeat regions (IRA and IRB). These four main regions have been previously sequenced and assembled in our lab using next generation sequencing technologies and bioinformatics. An alignment tool, BLAST, identifies assembled contiguous sequences (contigs) predicted to belong to chloroplast genomes. LSC, SSC and IR sections, when abundant sequence data is available, enables a complete chloroplast genome to be assembled from three contigs due to assembler specific algorithms. MEGA6 alignment software was used to identify overlapping section regions of sequences to predict directionality of the chloroplast genomes. These overlapping regions will be verified using Polymerase Chain Reaction (PCR). Amplified regions, amplicons, will be sequenced using Sanger sequencing technology. Sequencing of the overlapping regions will allow us to validate the predicted chloroplast genome sequences obtained via bioinformatics. So far, the sequences that form parts of the LSC, SSC, and IR have been identified for all species and cultivars. We expect that our sequencing technique will allows us to obtain complete chloroplast genome sequences by using DNA extracted from whole plant tissue.

Poster: **67**	Modeling the Reaction Mechanism of Carbon Monoxide Oxidation on a Clean and an Oxidized Cu(110) Surface: A Density Functional Theory Study	Poster: **67**

Undergraduate Researcher: Danelle Roan

Program: Jean-Sabin McEwen

Co-authors: Kyle Groden and Jean-Sabin McEwen

Home Institution, Major, Class Standing: Washington State University, Chemical Engineering, Senior

Abstract:

Carbon monoxide (CO) oxidation is a very important reaction used in automobile emissions control due to the need to convert incompletely combusted CO into a less directly toxic product, CO_2. It also plays a role in other chemical processes such as the water gas shift reaction, which produces hydrogen gas, an important component of fuel cells. By theoretically modeling a catalytic surface for this reaction, we can work to fundamentally develop a catalyst that lowers the reaction temperature necessary for carbon monoxide oxidation. This can potentially address challenges faced by low-temperature combustion engines. It is known experimentally that the oxidation of carbon monoxide takes place on a clean Cu(110) surface, though there has not been any theoretical study of the mechanistic path. Using density functional theory implemented in the Vienna *ab initio* Simulation Package (VASP), we can map out the reaction pathway for oxidation over this relatively simple surface. Once well-defined, we can begin to characterize the reaction over isolated metal dopants incorporated into the Cu(110) surface as well as over an oxidized Cu(110) surface. As both types of systems have recently shown great potential in reactivity compared to traditional catalysts, this work will provide needed insights toward the design of new “single-site” catalysts that can be utilized in the chemical and automobile industries.

Poster: **68**	Development of a Rooftop Air Quality Sensor Unit to Detect Temporal Changes in Air Quality Throughout the Spokane University District	Poster: **68**

Undergraduate Researcher: Yoni Rodriguez

Program: Atmospheric Chemistry REU

Co-authors: Jon Thompson, Marissa Anne Grubbs, Patrick O'Keeffe, and Von P. Walden

Home Institution, Major, Class Standing: Washington State University, Biochemistry, Junior

Abstract:

This is an extension of my 2017 REU summer project "Lab Module to Introduce Undergraduates to Environmental Engineering." This summer project focuses on the development of Air-Quality Sensor Unit (AQSU) that will be mounted on rooftops in the University District in Spokane, WA. These AQSU's will collect real-time data-collection throughout the wildfire season in Eastern Washington. The data will also be utilized by The Elson S. Floyd College of Medicine for the "Tailoring and Testing Asthma Instruments to Detect Temporal Changes in Air Quality Related Social Media Messages" project. Each AQSU will contain a non-dispersive infrared (NDIR) K-30 sensor to detect CO_2. A Bosch Sensortec BME280 for measuring humidity/pressure/temperature; and an Alphasense OPC-N2 optical particle monitor that measures $PM_{1.0}$, $PM_{2.5}$, and PM_{10}. All sensors are wired to a Raspberry Pi3 model B (RPi3) microprocessor that automates data collection. An Adafruit Ultimate GPS Breakout is also connected to the RPi3 to ensure accurate time and location. The RPi3 operates through a Linux interface to run specific scripts written in the Python programming language. The script allows the AQSU's to transmit data to a cloud-based data-base in real-time using Amazon Web Services. This network will provide information regarding temperature, pressure, humidity, CO_2, and particulate matter concentration. The data will be analyzed by WSU Paccar atmospheric researchers and members of The Urbanova Project. The Urbanova Project is a combined effort to develop Spokane into a sustainable city that utilizes smart city technologies and applications to improve infrastructure, public safety, energy, transportation and waste management. Along with a focus on educating the public on their air-quality as well as allow researchers to study the health impacts of various concentrations of particulate matter.

Poster: **69**	Evaluating Artificial Intelligence Tests for Consistency in Distinguishing Degrees of Intelligence	Poster: **69**

Undergraduate Researcher: Jordan Roth

Program: Smart Environments

Co-authors: Larry Holder and Christopher Pereyda

Home Institution, Major, Class Standing: Kansas State University, Computer Science, Senior

Abstract:

The lack of a standard test to assess intelligence in artificial intelligence (AI) programs causes a tremendous difficulty in measuring the level of intelligence of a program. The identification of multiple features which correlate with intelligence across multiple AI tests will provide a solid foundation for creating a gold standard test for detecting different degrees of intelligence. A common approach is to use a single AI test to evaluate the intelligence of a program; however, only a limited amount of characteristics of intelligence can be found in a single AI test, ultimately rendering the test of little use when examining multiple programs. Pooling together a mixture of AI tests is used to provide a better evaluation of the degree of intelligence of a program. Using multiple tests proves effective in the ability to individually extract a key feature of intelligence, while keeping a single test from growing too complex. As a result, more features of intelligence can be extracted out of the data and evaluated to determine a standard level of intelligence for a program. The features directly connected with identifying different levels of intelligence are derived from using three types of programs: simple algorithms without AI, a variety of AI programs, and alterations to the AI programs making them more or less intelligent. This approach is used to determine characteristics of intelligence in programs using AI and marginalize the features found in simple algorithms. Then, alterations of the AI programs are used to find how these traits of intelligence change when an AI program becomes more or less intelligent. A consequence of identifying properties which strictly correlate with intelligence will lead to a gold standard test which will assist the progress of building more intelligent programs as we continue our progression towards general intelligence.

Poster: **70**	Identifying Anomalies in Power Grid Sensor Data Using LSTM Neural Networks	Poster: **70**

Undergraduate Researcher: Caroline Rublein

Program: Smart Environments

Co-authors: Anurag Srivastava, Vignesh Krishnan, and Armina Foroutan

Home Institution, Major, Class Standing: Lock Haven University, Computer Science, Senior

Abstract:

Phasor Measurement Units (PMUs) are one of the sensors that measure the current and voltage in electric power grids for situational awareness and decision support. Constantly monitoring this data is important in identifying and interpreting different possible anomalies. These anomalies can be grouped into three categories: event data, bad data, and missing data. While event data indicates a legitimate event happening to the system, bad and missing data usually result from imperfections in the sensor or supporting cyber systems and should be filtered out for accurate analysis.

In this work, we applied machine learning, specifically Long Short-Term Memory (LSTM) networks, to identify the anomalous data. LSTM networks use a combination of all previous data to predict future values, with older inputs fading into a smaller proportion to impact the prediction over time. While LSTM networks are usually trained using labeled data, we used autoencoders to train the data without labels since the normal PMU data could center around any value. Autoencoders generate their own unsupervised encodings of data to train larger networks. The developed LSTM network will be integrated into an ensemble detection method previously developed by the co-authors, in which a compilation of different algorithms and statistical methods were used to detect anomalies. Future work will include differentiating between event and bad/missing data after the anomalies are identified.

Poster: **71**	Classification of Local Climate Zones in Spokane, WA for use in the Weather Research and Forecasting (WRF) Model	Poster: **71**

Undergraduate Researcher: Alexander Schmies

Program: Atmospheric Chemistry REU

Co-authors: Ana Carla Fernandez Valdes and Yunha Lee

Home Institution, Major, Class Standing: University of Minnesota, Physics, Senior

Abstract:

Urban land use impacts local climate in numerous ways that have the potential to be harmful to human health and the environment. These include the urban heat island (UHI) effect, an abundance of impervious surfaces, and changes in wind flow patterns. Effective land classification systems are a necessary component of research concerning land use and climate. However, several methods used for urban land use classification rely upon vague classification definitions and/or are not easily applicable to a variety of cities, especially those in developing nations.The World Urban Database and Access Portal Tools project (WUDAPT) recognized such issues and proposed the Local Climate Zone (LCZ) classification system as a standardized method for urban land use classification. The LCZ system contains seventeen local climate zone classifications defined by quantitative and qualitative factors regarding urban form and function. In this study, an LCZ map was created for Spokane, WA and the surrounding communities using the method outlined by WUDAPT. Using Google Earth Pro, training areas for each LCZ present in the region of interest were identified. Next, the training areas and LANDSAT 8 imagery were used to create a LCZ map in Saga GIS via a random forest classifier. The LCZ data and 2016 National Land Cover Dataset (NLCD) will be used for high-resolution urban modeling based on the Weather Research Forecast (WRF) model. The results produced by both datasets will be compared to observations and the accuracy of the LCZ data will be assessed.

Poster: **72**	Possible Routes of Bacterial Contamination in Shelved Fresh-produce at the Retail Level	Poster: **72**

Undergraduate Researcher: Lasata Shrestha

Program: Food Systems Program

Co-authors: Aleksandra Checinska Sielaff and Stephanie Smith

Home Institution, Major, Class Standing: Troy University, Biomedical Science/ Pre-medicine, Senior

Abstract:

Fresh produce has been linked to various microbiological food-borne outbreaks. Contamination during production, handling, transportation, and storage of produce has a contributing factor in outbreaks. In this study, we investigated the possible routes of microbial contamination of shelved fresh produce at the retail level (grocery stores, co-ops, etc.). Approximately 100 cm^2 of selected produce shelving units were swabbed with sterile pre-moistened cotton swabs to obtain microbiological samples. Mister (spray) water samples were collected in a sterile container during regularly scheduled misting events. Appropriate dilutions of collected samples were made and further plated on tryptic soy agar and various selective and differential media to determine microbial load in both types of samples. The samples were tested for total aerobic counts, *Salmonella* spp., *E. coli*, *E. coli* O157, coliforms and *Listeria* spp. Furthermore, isolates from the selective media for *Listeria* were randomly picked for a molecular analysis (DNA extraction and PCR analysis of *Listeria*-specific genes) to differentiate between the *Listeria* species found in the samples. Mister water samples were found to contain no microbial load while the swab samples yielded various microbial loads. Generally, the locations showed (10^1 to 10^9 per 100 cm^2 for TSA). Coliforms were ubiquitous while the presence of *E. coli* and *Listeria* spp. dependent on the produce associated with the sampled area. *Salmonella* spp. on the other hand, were not detected in any samples. The dry samples, where no mister water was used, had very low microbial counts. Mister water, although microbiologically safe, acted as a vector for spreading possible contamination from produce. The results of the study show that the fresh produce introduced microorganisms of concern at the retail level, and highlights the importance of sanitation practices at the source of fresh produce as well as continuous cleaning of the shelving units where produce is stored.

Poster: **73**	Biofuel and Bioenergy Literacy and Education: Testing of a Biofuel Lesson With Elementary-aged Students Aged 5-9	Poster: **73**

Undergraduate Researcher: April Stewart

Program: Northwest Advanced Renewables Alliance SURE

Co-author: Karla Eitel

Home Institution, Major, Class Standing: Washington State University, Elementary Education, Junior

Abstract:

Biofuel is an ever growing enterprise, yet very few biofuel lessons have been created for elementary-aged children. Students aged 6-9 were surveyed for energy and biofuel literacy then a biofuel lesson was tested twice with students aged 5-9. When asked many hours after the test of the biofuel lesson what biofuel and bioenergy is, one student stated that it was something to do with solar energy and it going into plants, other students stated they couldn't remember. While drawing a diagram representing energy transfer for the creation and use of biofuels, many students drew arrows from the sun to their plant, animal, or other item they drew as an example of biofuel. Others also drew arrows from their item to the environment, one student drew an arrow from their plane to the space behind the plane. These results show that the lesson helped build a base understanding of the creation and use of biofuels, but that information was not retained for many students. This implies that elementary-aged students are able to learn about biofuels. Future work would include repetition, a tactile diagram creation, and literature about energy transfer to introduce the diagrams and concept to students.

Poster: **74**	Natural/Synthetic Fiber & Thermoplastic Hybrid Laminae for Manufacturing Molded Composite Products	Poster: **74**

Undergraduate Researcher: Edgar Varela

Program: Bioplastics & Biocomposites

Co-authors: Vikram Yadama and Hang Liu

Home Institution, Major, Class Standing: University of Colorado at Boulder, Architectural Engineering, Junior

Abstract:

Bio-composite materials using natural fibers can develop the next generation of green materials, products, and processes, adding significant sustainability to the industrial sector. Various natural fibers have been investigated with polymer matrices to produce composite materials that are competitive with plastics currently used in industry. Here we investigate the use of hemp, cotton, jute and synthetic polypropylene yarn as reinforcement to a nylon and polypropylene polymer matrix, ultimately called a natural fiber and/or synthetic fiber reinforced lamina. One goal is to determine the effect of natural fiber density and natural fiber and synthetic fiber combinations on the tensile and bending properties of our bio-composite lamina. By creating several natural fiber reinforced laminae specimens and testing them for their tensile and bending properties we will be able to determine how our laminae compare to the industry used plastics and/or composites. Eventually, we would like to research the use of our natural fiber reinforced laminae for molded manufactured product applications. This research describes our attempt at mechanically joining the natural fiber yarns with the polymer matrices and the use of the Instron machine to determine the mechanical properties of our laminae.

Poster: **75**	Investigation of the Effects of Varied Catalysts on the Product Distribution of Sugar-derived Glycerol Hydrogenolysis	Poster: **75**

Undergraduate Researcher: Jose Velasco

Program: Bioplastics & Biocomposites

Co-authors: Junna Xin, Jihuai Tan, and Ran Li

Home Institution, Major, Class Standing: University of Tennessee, Knoxville, Chemical Engineering, Junior

Abstract:

Bio-diesel production creates an abundant amount of glycerol as a byproduct. Research has shown that sugar-derived glycerol can serve as a renewable feedstock for the synthesis of higher value materials. Previous literature has analyzed the effects of different variations of platinum catalysts on glycerol hydrogenolysis. The focus of this project is to quantitatively compare the effects of catalysts that contain a bi-support complex of zirconium oxide and silicon oxide ($Pt\text{-}WO_x/ZrO_2\text{-}SiO_2$), and catalysts that only contain a zirconium oxide support ($Pt\text{-}WO_x/ZrO_2$). Weight loading of tungsten oxide was another factor that was investigated. Some of the predicted products are 1,2-propandiol, 1,3-propandiol, and 1-propanol. The catalyst was altered by varying the weight loading of tungsten oxide (WO_x) and including or excluding a silicon oxide (SO_2) modification to the zirconium oxide (ZrO_2) support. The catalytic performance was evaluated in a fixed-bed reactor. Gas chromatography (GC/FID) was used to analyze the compounds present in the product. X-ray diffraction (XRD) and Brunauer–Emmett–Teller (BET) theory were used to characterize the catalysts. The results of GC analysis revealed that a large portion of glycerol was converted into 1,2–propandiol when using the $ZrO_2\text{-}SO_2$ support complex. Reactions will be done for ZrO_2 catalysts, which are expected to have a small yield of 1,3-propandiol based on previous literature. XRD characterization will identify the tungsten dispersion on the catalyst particles, and BET analysis will determine specific surface area of the particles. The results of this project will aid in further optimizing the glycerol reaction to produce high value materials.

Poster: **76**	Vitrimerize PLA by Using a Biobased Hyperbranched Polymer as Dynamic Cross-Linker	Poster: **76**

Undergraduate Researcher: Christina Verdi

Program: Bioplastics & Biocomposites

Co-authors: Jinwen Zhang, Tuan Liu, and Zhuai Zhang

Home Institution, Major, Class Standing: North Carolina State University, Sustainable Materials and Technology, Senior

Abstract:

Vitrimer is a new class of reprocessable crosslinked polymer which has been defined as the third type of polymers besides thermosets and thermoplastics. Because vitrimer combines the advantages of both thermosets and thermoplastics, it may have many potential applications. In this work, we developed a new vitrimer system based on polylactic acid (PLA) using a hyperbranched polymers (HBP) as dynamic cross-linker. The HBP was synthesized via the polymerization of glycerol, succinic anhydride, and ethylene glycol diglycidyl ether with a molar ratio of 0.5:0.5:1. The prepared HBP was compounded with neat PLA in a mini extruder. Then, the PLA/HBP blend was put in a hot press to make the film samples. It was found that the gel content of the polymer blend increased as the increase loading of HBP. The gel was formed mainly from the transesterification reactions between PLA and HBP and the self-polymerization of HBP. In addition, all PLA/HBP blends showed improved toughness, excellent shape memory and reprocessing properties. At 200 °C, the PLA/HBP blends were able to keep their shape while the neat PLA was melted. This work demonstrates a simple method for turning PLA into a vitrimer, and the findings may set up an important framework for future design of vitrimers based on polyester based thermoplastics.

Poster: **77**	Use of Biochar for Methylene Blue Removal from Water	Poster: **77**

Undergraduate Researcher: Kennedi Weston

Program: Northwest Advanced Renewables Alliance SURE

Co-authors: Ashlie Adams, Kamu Taulelei, and Waled Suliman

Home Institution, Major, Class Standing: University of Arkansas at Pine Bluff, Chemistry, Sophomore

Abstract:

The goal of this study was to remove contaminants from aqueous phase solutions using the adsorption approach. We used Methylene Blue (MB) to mimic water contamination while biochar was the adsorbent. We conducted several isotherm and kinetic experiments to understand the adsorption behavior of the biochars that were used and their removal efficiency. The two biochars, SCOMC and COMBC, were made from agricultural biomass. The effect of pH, adsorbent doses, and contaminant concentrations were all studied in the batch of adsorption set ups. To measure the concentration of MB before and after biochar additions, a spectroscopy method was utilized to track MB concentration. Before that, all samples were agitated for 24hrs (max) at 200 rpm and then filtered using Whitman filter paper 42.The results showed that biochar removes MB up to 98% after only 5 minutes at pH 7. We can conclude that we can design biochar-based adsorbents for water filtration.

Poster: **78**	Improving Energy Literacy in Young Children Through Education	Poster: **78**

Undergraduate Researcher: William Weygint

Program: Northwest Advanced Renewables Alliance SURE

Co-author: Karla Eitel

Home Institution, Major, Class Standing: University of Idaho, Natural Resource Conservation, Senior

Abstract:

The use of renewable energy sources such as biofuels has become increasingly common, and it is important for the public to understand the differences between renewable and nonrenewable energy sources in order to make informed energy decisions in the future. Increasing energy literacy in children is a crucial step in this process. This research focuses on developing a lesson plan using building blocks to explore the differences between renewable and nonrenewable energy sources. The targeted age group is children between the ages of 3-5. The lesson was tested twice on a group of 7 students in the appropriate age group during the adventure day camp at the McCall Outdoor Science School in McCall, Idaho. The results of the research are still being assessed, but it could provide a method to build an understanding of the differences between renewable and nonrenewable energy in young children.

Poster: **79**	Evaluation of Three Numerical Weather Predictions Using the Weather Research and Forecasting Model	Poster: **79**

Undergraduate Researcher: Benjamin Yang

Program: Atmospheric Chemistry REU

Co-authors: Yunha Lee, Vikram Ravi, Joseph Vaughan, and Brian Lamb

Home Institution, Major, Class Standing: The Pennsylvania State University, Meteorology and Atmospheric Science, Junior

Abstract:

Meteorology greatly influences air quality, a complex process involving direct emissions, chemical and physical transformations, and removal of air pollutants. In order to generate accurate air quality forecasts, reliable numerical weather predictions are essential. We used model output from three variants of the Weather Research and Forecasting (WRF) model: the University of Washington's (UW) WRF-GFS with 4-km resolution, Washington State University's (WSU) WRF-Chem with 18-km resolution, and the National Oceanic and Atmospheric Administration's High-Resolution Rapid Refresh (HRRR) with 3-km resolution. Each model differs in selection of atmospheric physics options and data assimilation level. WRF-Chem is a coupled model, accounting for feedbacks between meteorology and chemistry, while both WRF-GFS and HRRR are decoupled models. We selected the 13-day evaluation period, August 28 to September 9, 2017, for model comparison because of the high wildfire activity in the Pacific Northwest during this time. MesoWest—a cooperative project led by the University of Utah, the National Weather Service, and other organizations—was our source of weather observations. Observed and predicted near-surface temperature, pressure, wind speed, wind direction, relative humidity, and precipitation were used to determine the normalized mean bias (NMB), normalized mean error (NME), root mean square error (RMSE), and coefficient of determination (R^2) at each MesoWest station and for all stations, within the WRF-GFS domain. We discuss factors that may have contributed to the biases and errors, namely resolution, coupling, and physics options. Preliminary results indicate that the WRF-Chem underperforms the other models overall during smoky days, so we expect that coupling will not be the predominant factor in model performance. This research will provide valuable information on the quality of each WRF variant and the implications for air quality forecasting.

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