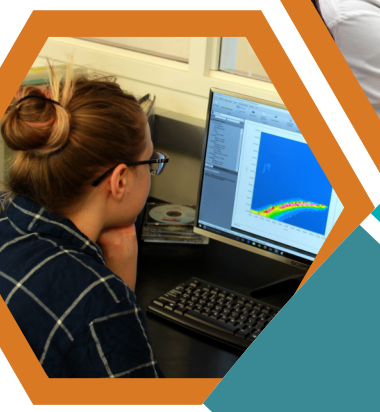
WASHINGTON STATE UNIVERSITY

SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM





Friday, Aug. 4, 2017

9 a.m.: Keynote Address, CUE 202

10 a.m.-1 p.m.: Posters, CUE Atrium

Office of
Undergraduate Education
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Presenters by Group and Location

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2	Reprocessable Thermosetting Epoxy Derived from Bio-based Lignin Feedstock	Lucas Brown
3	*E. coli* H7 Entrapment Through Calcium, Potassium, Sodium and Phosphorous-enriched Bio-char Sand Columns	Jesus Chavez
4	Using Simple Lessons to Teach Elementary Students about Energy Literacy, the Environment and Energy with a Wood Residual Biofuel Focus	Jace Hogg
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51	Fully Biodegradable Plastics with Insecticide Functionalities	Ryan Funk
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53	Bio-based Adhesives	Mason Moeller
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57	Synthesis Pathway of Glycerol Derivative Block Copolymers as a Biobased Feedstock for Pressure Sensitive Adhesives	Nicholas Van Nest
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65	Optimizing Help Tools for a Memory Notebook App	Timothy McAleer
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Group 1: Northwest Advanced Renewables Alliance (NARA)

Poster: 1	**Preliminary Investigation of Waste Cooking Oil-Based Bioasphalt and Reinforcement with Lignin-Based Epoxy**	Poster: 1

Undergraduate Researcher: Alexa Antalan

Faculty Advisor: Shelley Pressley

Co-authors: Ran Li, Junna Xin, and Jinwen Zhang

Home Institution, Major, Class Standing: Seattle Central College, Mechanical Engineering, Junior

Abstract:

Traditional asphalt binder is residue obtained during the crude petroleum refining process. Increased environmental regulations for new drilling, dwindling existing resources, modifications to the refining process that maximize the fuel quantity while minimizing asphalt residue have increased the cost of asphalt in recent years. Petroleum-based asphalt also has low resistance to rutting and cracking due to extreme temperatures. With this impact in mind, waste cooking oil (WCO)-based bioasphalt is an affordable and sustainable alternative with higher temperature resistance. Our research optimized WCO-based bioasphalt to ensure that its properties were comparable or better than the properties of petroleum-based asphalt.

Bioasphalt was created by polymerizing WCO with maleic anhydride. The reaction conditions were optimized and the properties of bioasphalt were characterized. To further improve the characteristics of this WCO-based bioasphalt, it was modified using lignin-based epoxy. Lignin is a byproduct of the pulping process in paper-making with great structural properties. When lignin-based epoxy was added to modify bioasphalt, the resulting epoxy bioasphalt is more resistant to rutting and cracking caused by extreme temperatures and normal wear. Our lignin-based epoxy was synthesized by reacting kraft lignin with epichlorohydrin. We tested the epoxy value using titration and Phosphorus-31 nuclear magnetic resonance (P NMR) spectroscopy, and the structure of the lignin-based epoxy was characterized using Fourier transform infrared (FTIR) spectroscopy. The optimized product was used for the bioasphalt modification.

The lignin-based epoxy-modified bioasphalt was characterized three ways: The curing behavior was tested using differential scanning calorimetry (DSC), the structure of the product was interpreted using FTIR, and the rheological properties were observed using a parallel-plate rheometer. Then the effects of the epoxy content on the lignin-epoxy-modified bioasphalt were studied. We expect our results to show that the epoxy-modified bioasphalt has greatly improved rheological properties and higher resistance to temperature-deformation.

Poster: 2	**Reprocessable Thermosetting Epoxy Derived from Bio-based Lignin Feedstock**	Poster: 2

Undergraduate Researcher: Lucas Brown

Faculty Advisor: Shelley Pressley

Co-authors: Cheng Hao, Tuan Liu, and Junna Xin

Home Institution, Major, Class Standing: Washington State University, Mechanical Engineer, Senior

Abstract:

Conventional thermosetting polymers are constructed by petro-based resources which are toxic and nonrenewable, and their permanent crosslinks make them difficult to be reprocessed and recycled thereby resulting in a wastage of resources. Developing renewable biobased thermosetting polymers that are repairable and recyclable will greatly advance the potential to satisfy sustainability demands. In this study, Kraft lignin, which is derived from wood, was used as a feedstock to prepare thermosetting polymers. First, Kraft lignin was chemically modified using an anhydride monomer to prepare our polycarboxylic acid (LPCA). This LPCA was then used as a curing agent to react with eugenol epoxy in different ratios. The chemical structure of the cured product is characterized by FT-IR (Fourier Transform Infrared). It was found that the crossed links after curing were mainly constructed by β-hydroxyester groups. At high temperature (190°C), a dynamic transesterification reaction due to these β-hydroxyester groups can be initiated under the existence of catalyst ($Zn(Ac)_2$). This dynamic reaction quickly increases stress relaxation in the cross-linked network, and permits recycling and repairing of the cured samples. In addition, the mechanical properties of the different lignin based epoxies were investigated. When compared to the commercial analogues, our bio-based epoxies processed similar or better properties. These innovative findings provide a feasible way to prepare renewable high performance thermosetting polymers.

Poster: 3	# *E. coli* H7 entrapment through calcium, potassium, sodium and phosphorous-enriched bio-char sand columns	Poster: 3

Undergraduate Researcher: Jesus Chavez

Faculty Advisor: Shelley Pressley

Co-authors: Elyas H Alnamnakani, Waled S Omar Suliman, Manual Garcia-Perez, and Nehal Abu-Lail

Home Institution, Major, Class Standing: Heritage University, Engineering, Sophomore

Abstract:

Bio-char is a substance made out of burning bio materials at certain temperatures for an extended amount of time. It has many uses that range from nutrient entrapment in the soil to water filtration. Due to its porous nature, bio-char can trap bacteria and other materials in its pores. It is practical in these experiments to filter water contaminated with pathogenic Escherichia coli H7 bacteria. Groundwater outbreak and waterborne diseases which cause bacterial infections are a great concern especially in third world and developing countries where advanced water filtration systems are non-existent. By successfully trapping bacteria using bio-char, economically efficient filtration systems can be implemented in needed areas where groundwater is prone to contamination. The goal of our project is to optimize the performance of a water-filtration system made of sand mixed with bio-char capable of trapping *E. coli* H7. To achieve our goal, different pine wood bio-char samples were treated with sodium, potassium, calcium, and phosphate. To make the bio-char, pinewood was burnt at 350 C at a rate of 10 C per minute in the absence of Oxygen. The different mineral treatments are expected to alter the bio-char polarity and other properties that affect its ability to capture the bacteria. In one experiment, untreated bio-char was used while another bio-char mixture treated with calcium carbonate was used. A column was used to contain the bio-char-sand mixture while a bacterial solution would be filtered through it. Although our test results are consistent throughout our trials, the different bio-char mixtures we've experimented with have shown no signs of entrapment. Anticipated results consists of ideally blocking all of the bacteria through bio-char. Ongoing efforts are focused on testing bio-char samples modified with sodium, potassium, and phosphate.

Poster: 4	**Using Simple Lessons to Teach Elementary Students about Energy Literacy, the Environment and Energy with a Wood Residual Biofuel Focus**	Poster: 4

Undergraduate Researcher: Jace Hogg

Faculty Advisor: Shelley Pressley

Co-author: Karla Eital

Home Institution, Major, Class Standing: University of Idaho, Environmental Science, Junior

Abstract:

The biggest challenge of starting young students on the path to be energy literate is being able to break down some of the bigger concepts such as energy conservation, and on a broader scale, the concept of energy itself. Not only do these activities have capture their attention, they must accurately teach them the building blocks of energy literacy. While executing this, you as the educator must be careful not to create any misconceptions, and dispel them when you come across them while interacting with the students. One goal in this series of mini-lessons is for the students to understand not only energy concepts but understand their environment, and why it is important for animals and humans alike. The mini lessons include a demonstration of basic thermodynamics using Legos, a game to identify trees/ their ideal habitats and a whiteboard activity looking more at habitats and sunlight exposure, an outdoor demonstration using Legos, fallen trees and a slash pile to briefly explain how fossil fuels are formed from decomposed plants and animals, and finally how slash piles can be used to extract energy to make biofuel. The mini lessons were tested with MOSS Adventure Day Camp students, tested with students ages 6-11. A series of follow up discussion questions provided feedback on each lesson, where a majority of the students were able to answer the questions accurately and ask relevant follow up questions.

Poster: 5	Energy Literacy for Youth: Investigating Wood Residual Biofuel	Poster: 5

Undergraduate Researcher: Trent Montsma

Faculty Advisor: Shelley Pressley

Home Institution, Major, Class Standing: Western Washington University, Energy Policy and Management, Junior

Abstract:

With an important transition away from fossil fuels underway in the energy sector it is important to educate children and also contextualize the issues pertaining to energy we face today. With the politicizing of energy sources it is important to give young people the proper information to decipher real issues and real solutions to them. Two video lessons were created as explanatory resources that explain the basic science of energy, issues facing the energy sector, and possible solutions with the NARA wood-to-wing program as a main example. Using videos as the medium for these lesson helps with the engagement of the kids and also becomes a readily available resource that can be referenced again. The first lesson explains energy on a very basic level and how it is conserved. It then applies this with explanations of how we generate and consume electricity. This provides the viewer with the baseline understanding to look into energy issues introduced in the second video. The second video focuses on why we should care about issues like carbon emissions, possible solutions and difficulties that come with different plans. The primary example of a solution is the NARA forest residual biofuel program as a carbon neutral fuel source. This gives kids an example of how to approach energy issues critically and realistically. These videos lessons were pilot tested on kids ranging from 6-11 years old where critical feedback was given.

Poster: 6	**Exploring Informal Learning Practices: Engaging K-5 Students in Learning about Woody Biomass**	Poster: 6

Undergraduate Researcher: Zakiya Jones

Faculty Advisor: Shelley Pressley

Co-author: Karla Eitel

Home Institution, Major, Class Standing: Pomona College, Math and Spanish, Sophomore

Abstract:

An important part of ensuring that children will become well informed, energy literate adults is engaging them in learning about energy at a young age. How young? Maybe as young as Kindergarten through 2nd grade. They may not be able to gain an in depth understanding of the science behind the law of conservation of energy or the mechanisms of converting a slash pile into jet fuel; however being exposed to these concepts at an early age and being aware of the possibilities of renewable energy sources and the positive impact they can have on our environment will provide a strong foundation for more indepth understanding and learning about energy as they get older. The challenge in teaching such a young age group is ensuring that they are engaged and interested in what they are learning. That was the main motivation behind creating a board game as a tool for teaching K-2nd aged kids about the basics of energy and the NARA process (you can use tree parts to fly a plane!). It is a fun, hands-on approach that will hopefully be both engaging and exciting. This monopoly-style game has the students collect units of “energy” by landing on biomass (trees) and expending “energy” by landing on spaces that represent work related to the NARA process. Collecting enough “energy” allows them to move through the main stages of the NARA process: obtaining slash piles, pretreatment, creating isobutanol, creating jet fuel, and finally flying an airplane using biofuel. The students seemed to understand how the game represented the NARA project and how the exchange of energy works, but did not get the importance of the benefits of renewable energy sources in place of nonrenewable energy sources.

Poster: 7	Pelletized Biochar Production and Characterization from Biobased Waste Textiles	Poster: 7

Undergraduate Researcher: Rosemary Nicholson

Faculty Advisor: Shelley Pressley

Co-authors: Anamaria Paiva Pinheiro Pires, Karl Englund, and Manuel Garcia-Perez

Home Institution, Major, Class Standing: The Pennsylvania State University, BioRenewable Systems, Senior

Abstract:

The presence of biobased waste textiles is an increasing problem in the current solid waste management system. However waste-textiles pose an interesting potential because of the ability to be turned into a biochar. Biochar is a stable, carbon rich biomass that could then be used as a soil application or for an alternative source of power generation. This study aims to develop processing logistics for pellet development, as well as characterize the output of the pellets. Pellets are formed by grinding feed stock material, forming pellets in pellet press with grinded material and binder, performing slow-pyrolysis with a spoon reactor, and then chemical characterization analysis. Chemical characterization analysis in this study includes calorific high heating value, Carbon-Hydrogen-Nitrogen (CHN) elemental analysis, and thermogravimetric (TGA) analysis. Preliminary results have shown that corn-starch is the leading binder due to its availability, low cost and performance in binding the pellet. Further research may include testing alternative binders, different pellet grinding and formation techniques, as well as testing the pellets structure and durability.

Group 2: Biomedicine Summer Undergraduate Research Experience

Poster: 8	**Host Pathogenesis and Innate Immune Response: Exploring, Screening, & Identifying Polymorphism that Render *Drosophila melanogaster* Susceptible to *Coxiella burnetii* Infection**	Poster: 8

Undergraduate Researcher: Efrain C. Cuellar

Faculty Advisor: Samantha Gizerian

Co-authors: Sarah A. Borgnes, Zachary P. Howard, and Alan G. Goodman

Home Institution, Major, Class Standing: University of California, Berkeley, Chabot College, & State Center Community College, Bioengineering, Sophomore

Abstract:

One of several downfalls of biological organisms is being affected by diseases since the beginning of time and both host and pathogen continue to sophisticate their interaction and intensity over years. In our society, disease affects nations, ecosystems, and economies whether it is in food, health, and technologies for example. Transmissible diseases interfacing with Anthrax between animal and people, for example, are considered dangerous between domestic, national, and global level since it has the potential of being a biological warfare agent. Other biological agents that has life threatening affects is *Coxiella burnetti*, which is the cause of Q fever and inner lining heart damage (endocarditis), causing death to humans. Both agents affect human in a dramatic way and can be made in a form of aerosol for ill distribution. As a result, many institutions are interested identifying novel approaches in quickly detecting and determining how these biological agents work and a counter approach in treating such devastation . This also requires a deep understanding of how innate immune response at each type of organism response to an infection to further create therapeutics. Something to note is that Coxiella causing infections has a single limited treated, that is antibiotics. Our group is currently addressing the knowledge gap of *Drosophilla melanogaster* being susceptible to *Coxiella burnetti* infections since their is poor literature currently. Nearly 75% of human genes that are related to disease are in Drosophila.

Poster: 9	**Hormonal Disruption of the Stress Response Alters Prefrontal Cortex Activation**	Poster: 9

Undergraduate Researcher: Franchesca Ortega

Faculty Advisor: Samantha Gizerian

Co-authors: Scott Kinlein, Marina Savenkova, and Ilia Karatsoreos

Home Institution, Major, Class Standing: New Mexico State University, Genetics and Biotechnology, Senior

Abstract:

The stress response is a physiological process that facilitates survival and adaptation. However, dysregulation of this response can be detrimental to health and has been implicated in the development of neuropsychiatric disorders such as depression, post-traumatic stress disorder, and anxiety disorders. The hypothalamic-pituitary-adrenal (HPA) axis is the primary neuroendocrine system that controls the stress response and is responsible for the production of glucocorticoids, including the major stress hormone corticosterone (CORT). This system is under tight negative feedback regulation to ensure that this response is properly engaged, efficiently regulated, and rapidly turned off when the stressor has been removed. This control is important because while short-term exposure to glucocorticoids may assist in adaptation, prolonged exposure can lead to HPA dysfunction making individuals vulnerable to future stressors. A key brain area that regulates the HPA axis negative feedback is the medial prefrontal cortex (mPFC), primarily through glucocorticoid signaling. Here we investigate whether acutely manipulating CORT levels in mice could change the response of the mPFC to stress. Previous work from our lab shows that chronic HPA disruption in mice increases neural activity measured by cfos expression in the mPFC and blocks the normal behavioral stress response. To explore the neural and behavioral effects of acute HPA disruption, adult male C57/B6 mice were injected with metyrapone, a CORT synthesis inhibitor, and subsequently stressed. Following the stressor, behavior was analyzed in an open field and brains were collected for cfos analysis. RNA was extracted from brain tissue, reverse transcribed, and quantified through qPCR. Metyrapone-treated mice showed a significant increase in cfos expression in the mPFC, although behavior was unaffected. This “mismatched” behavior and brain activity following stress may give us insight into how HPA hormones interact with the mPFC during stress to control behavior, enriching our understanding of mechanisms of stress in the brain.

Poster: 10	Self-administration of Vaporized Methamphetamine in Rats	Poster: 10

Undergraduate Researcher: Melissa Vargas

Faculty Advisor: Samantha Gizerian

Co-authors: Lydia Baxter-Porter, Janelle Lugo, Jessica A. Higginbotham, Ryan J. McLaughlin, and Rita A. Fuchs

Home Institution, Major, Class Standing: University of Central Florida, Psychology, Senior

Abstract:

Methamphetamine is a psychomotor stimulant, it is powerfully addictive, and it causes destructive effects on health, other aspects of life, and societal well-being. A primary route of methamphetamine administration is smoking, yet rodent models of intra-pulmonary methamphetamine self-administration have not been available. Accordingly, the purpose of this study was to develop one such procedure using electronic cigarette-type technology in combination with standard instrumental conditioning procedures. To this end, 14 male Sprague Dawley rats were placed into operant conditioning chambers in which they were trained to nose-poke in one operandum. Vaporized methamphetamine (100mg/ml MA), or propylene-glycol vegetable glycerol vehicle (VEH) vapor delivery occurred over 10 s with a 1-min duration before clearance. Nose-poke responses on a second operandum had no programmed consequences. Self-administration training continued for 2 hours per day, 6 days a week for 10 days, during the rat's dark cycle. Responses were then assessed under extinction conditions with no cue light or drug reinforcement. Extinction training continued until rats reached the extinction criterion (minimum of 7 sessions and at least 25 responses per session on 2 consecutive days.) At test, reinstatement of methamphetamine-seeking behavior was assessed in the response contingent presence of the cue light. We hypothesized that vaporized methamphetamine reinforcement would support the acquisition of instrumental behavior consistent with the strong abuse potential of methamphetamine in clinical populations, and a previously methamphetamine-paired conditioned stimulus would reinstate extinguished drug-seeking behavior.

Group 3: Engineering Tools for Disease Diagnostics and Treatment

Poster: 11	**Manufacturing Bio-Scaffolds for Articular Cartilage Generation and Osteoarthritis Treatment**	**Poster: 11**

Undergraduate Researcher: Alyssa Brandley

Faculty Advisor: Nehal Abu-Lail

Co-authors: Robyn Hollfelder and Arda Gozen

Home Institution, Major, Class Standing: Rowan University, Biomedical Engineering, Senior

Abstract:

The complex, depth-dependent mechanical properties of articular cartilage and the patient-specific morphology of joints substantially limit osteoarthritis treatment. Currently, joint replacement, microfracture, or mosaicplasty surgeries are performed to relieve the pain of osteoarthritis and restore functionality to the damaged joint. However, these current treatments have a 90% re-operation rate and serve as a temporary fix, not a permanent solution. Thus, there is a considerable unmet need for a more efficient and effective treatment for osteoarthritis, the number one cause of disability worldwide. Our work focuses on engineering bio-scaffolds for articular cartilage generation, a solution that employs the individual's own cells to recreate native cartilage with the proper morphology, heterogeneity, and mechanical properties.

We demonstrate that natural and synthetic polymers, such as PVCL, Sodium Carboxymethyl Cellulose, and Lubrizol 980, at varied concentrations of 10% (w/v), 15% (w/v), and 20% (w/v), allow for printable inks with the desired size/shape, porosity, pore interconnectivity, and pore geometry to provide the required tensile properties to withstand the shear forces on joints. By varying the solution concentration, deposition speed, plate distance, and pressure, we can produce a grid-like scaffold structure to be implanted in the body to promote tissue formation.

We observed that higher concentrations prevent evaporation of the hydrogel after printing, but too high of a concentration proved too viscous to be printed through 100 μm nozzles. Thus, for hydrogels above 10% (w/v), we found that pressures above 60 psi need to be used. We also found that synthetic polymers are more difficult to homogenize, creating a non-uniform scaffold, whereas natural polymers are too soft a material, and thus do not accurately mimic the superficial layer of articular cartilage.

This novel, printable hydrogel formulation and printing method has the potential for broad use as a highly reproducible technique to synthesize bio-scaffolds and create a more effective treatment for cartilage deterioration.

Poster: 12	**Molecular Malfunction: A Protein Mutation in Cardiomyocytes That Leads to Cardiomyopathy**	Poster: 12

Undergraduate Researcher: Zachary Furlow

Faculty Advisor: Nehal Abu-Lail

Co-authors: Dmitri Tolkatchev and Alla Kostyukova

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

Abstract:

Molecular interactions between striated muscle α-tropomyosin (Tpm1.1) and leiomodin 2 (Lmod2) play an important role in regulating thin filament length. The K15N mutation in tropomyosin Tpm1.1 interferes with formation of Tpm1.1/Lmod2 binding interface which results in dilated cardiomyopathy. The goal of this study is to establish, at high molecular resolution, how the K15N mutation in Tpm1.1 affects specific amino acid residue interactions between Tpm1.1 and Lmod2 and in this way define a potential molecular target for therapeutic intervention. These interactions will be studied by analysis of NMR spectra of a ^{15}N-labeled Lmod2 polypeptide fragment corresponding to the tropomyosin binding site in the full length Lmod2, in the presence and absence of mutated Tpm1.1 peptides. This work has focused on expression and purification of the ^{15}N-labeled Lmod2 peptide using a variety of protein purification techniques and generation of mutated Tpm1.1 DNA constructs via mutagenesis. To produce the Lmod2 peptide, competent Escherichia coli BL21(DE3) cells were transformed with an engineered DNA vector known to express an MFH-tagged peptide. The transformed cells were grown on a LB culture plate supplied with ampicillin. The Lmod2 fusion protein was expressed by culturing the cells in minimal growth medium containing ^{15}N-labeled ammonium sulfate. Sonication was used to break up the cells and centrifugation was used to separate the cell debris from the cell lysate, which was recovered on a Ni-NTA superflow resin (Qiagen). The ^{15}N-labeled Lmod2 peptide was released by cyanogen bromide, and the peptide was purified to homogeneity on two “orthogonal” reversed-phase HPLC columns. The nucleotide sequences of DNA constructs encoding the mutated Tpm1.1 peptides were confirmed by Sanger sequencing. The identity and purity of purified ^{15}N-labeled Lmod2 peptide and its specific binding to the wild type Tpm1.1 peptide was tested by recording a series of ^{15}N-HSQC spectra with varying concentrations of the Tpm1.1 peptide.

Poster: 13	# The Efficacy of Silver-based Commercial Treatments on *Staphylococcus aureus* Biofilms with and Without the Presence of Chloride Ions	Poster: 13

Undergraduate Researcher: Olivia Haider

Faculty Advisor: Nehal Abu-Lail

Co-authors: Mia Mae Kiamco, Hannah Zmuda, and Haluk Beyenal

Home Institution, Major, Class Standing: Montana State University - Bozeman, Chemical Engineering, Junior

Abstract:

Silver ions are present as an active agent for many silver-based wound dressings to prevent the formation of bacterial biofilms causing chronic wounds. These dressings are typically applied with sterile deionized (DI) water or without any additional moisture. Silver is known to form silver chloride (AgCl) salt when chloride is present. Wound beds, especially highly exudating wounds, contain physiological concentrations of sodium chloride (NaCl), which results in the presence of chloride ions in the wound. Thus, we performed a comparative study among silver-based commercial dressings to test this effect. Treatments were conducted in DI water, tryptic soy broth (TSB), and phosphate buffer saline solution (PBS). Commercial wound dressings – Acticoat®, Acticoat 7®, Silvadene®, and Silvasorb Sheet® – containing silver as an active agent were used to test the efficacy of silver ions on biofilms in a wound-like environment. Commercial silver-based wound dressings were tested on two-day old *Staphylococcus aureus* biofilms in TSB, PBS, and DI water to determine their efficacy with or without the presence of chloride ions. The expected result is that the presence of chlorine ions in TSB and PBS will react with the silver ions to form silver chloride and deactivate the antimicrobial properties of the silver-based treatments. Data showed that Acticoat®, Acticoat 7®, and Silvadene® completely eradicated S. aureus biofilms in DI water but not in TSB and PBS. Moreover, there appeared to be no significant effect between TSB, PBS, and DI water for the Silvasorb Sheet® treatments. This research establishes the critical effect of the presence of chloride in the efficacy of silver-based wound dressings.

Poster: 14	A Dual Ionophore Ion-selective Electrode Biosensor for the Detection of Sepsis	Poster: 14

Undergraduate Researcher: Jessica Mahinthakumar

Faculty Advisor: Nehal Abu-Lail

Co-authors: Olivia Ranft and Bernie Van Wie

Home Institution, Major, Class Standing: North Carolina State University, Chemical engineering, Senior

Abstract:

Presently there is no rapid, sensitive assay to diagnose or characterize sepsis using whole blood. Sepsis, a bacterial infection of the blood stream, has a 2-3% increase in mortality for every hour of delayed or ineffective treatment. Here we develop an electrode biosensor for a sepsis biomarker. A dual ionophore ion-selective electrode (di-ISE) biosensor functions similarly to a neuron, such that there are two opposing concentration gradients of sodium and potassium which generate an electric potential across a synthetic membrane when ion carriers are present. Our di-ISE is bicompartmental with two separate membranes, one containing Na+ ionophore and one containing K+ ionophore. The electric potential generated is a measure of the ionophore's capability of transporting ions from one side of the membrane to the other. A ligand can be positioned within the membrane to bind an analyte onto the membranesurface. The occlusion of the membrane by the analyte-ligand binding will disrupt ionophore function. It follows that we can measure the concentration of analyte in a sample by measuring the change in voltage due to the reduction in ion transport across one of the membrane compartments. This novel biosensor was shown to have a limit of detection of 10-4 M and a response time of less than 20 minutes when detecting streptavidin, a model protein. Calibrations of voltage shift due to log molar increases in analyte were conducted using saline, plasma, and whole blood samples. We show conceptually that this rapid sensor can be adapted for c-reactive protein, an excellent biomarker for sepsis which can be bound to the membrane using phosphocholine as a ligand. This sensor could potentially shave hours off the current diagnostic time, slashing the number of deaths caused by undetected sepsis

Poster: 15	Effect of Ampicillin and Natural Antibiotics on Biofilm Formation of Multidrug-Resistant Escherichia coli	Poster: 15

Undergraduate Researcher: Raquel Murillo

Faculty Advisor: Nehal Abu-Lail

Co-authors: Samuel Uzoechi and Nehal Abu-Lail

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

Abstract:

Escherichia coli is a Gram-negative bacterium that commonly exist in the in the healthy intestines of animals and such strains are considered harmless. The pathogenic strains have been implicated in food- and water- borne diseases such as diarrhea and different intestinal infections. The biofilm forming strains of *E. coli* have been identified to resist multiple antibiotics and are associated with increased virulence. Biofilm facilitates survival of bacteria by decreasing the diffusion rate of antibiotics across the thick biofilm-formed extracellular polymeric substrates (EPS). A total of four domestic multidrug-resistant (MDR) *E. coli* strains were chosen for this experiment based on their ability to resist ampicillin. Biofilm forming ability of the four strains was studied with a crystal violet assay at their varying minimum biofilm inhibitory concentrations (MBICs) during a 3 hours' exposure to ampicillin. Based on their abilities to form biofilms before exposure to ampicillin compared to controls all four isolates were labeled as moderate biofilm formers. When biofilms of these MDR-*E. coli* strains were investigated in the presence of ampicillin, all tested strains formed significantly more biofilm when compared to biofilms formed in the absence of ampicillin ($p < 0.001$). This finding is clinically important because bacterial infections driven by biofilm formation exhibit complex resistance to a range of currently used antibiotics. This is not the case in non-biofilm related bacterial infections. Our results indicate that *E. coli* biofilm formation in presence of antibiotics maybe one of the factors contributing to treatment failure. Evidence from various sources indicate that plant extracts can alter bacteria multiplication and efficiently kill biofilms. Therefore, our ongoing work investigates the effect of commonly used natural antibiotics on MDR-*E. coli* ability to form a biofilm. The natural antibiotics investigated include garlic oil with allicin, cranberry juice extract, turmeric curcumin with bioperine and apple cider vinegar.

Poster: 16	Microchip Isotachophoresis for Isolation of Biomarker-Bearing Extracellular Vesicles	Poster: 16

Undergraduate Researcher: Gabriel Ng

Faculty Advisor: Nehal Abu-Lail

Co-authors: Daniel Molina and Cornelius Ivory

Home Institution, Major, Class Standing: Purdue University, Biomedical Engineering, Junior

Abstract:

Prior research has implicated a key role for extracellular vesicles (EVs) in tumors for intercellular communication and tumor proliferation. EVs are membrane-encapsulated packages (~50-200 nm in diameter) by nearly all types of healthy and diseased cells which contain a host of disease-specific biomarkers. There are issues with current EV isolation techniques such as centrifugation. They are often inconsistent in separating EVs from other EV subtypes or bodily-fluid components of similar density/size. Therefore, a method for improved EV isolation will allow for earlier and accurate detection of cancers.

Isotachophoresis (ITP) is an electrophoretic technique which relies on the difference in mobilities of charged particles in an applied electric field to effectively separate and concentrate substances in a microfluidic channel. This paper describes 3D simulation and experimental confirmation using ITP to concentrate vesicles in a straight channel poly(methyl methacrylate) (PMMA) chip. Using ITP, we were able to isolate and detect specific lipids within mixed fluid quickly, accurately, and at a much lower detection limit due to the concentrating nature of ITP flow.

3D numerical simulation was conducted with COMSOL v5.3 whereby two different vesicles were separated and concentrated in migrating bands in the channel. Experimental ITP was performed in straight-channel PMMA microchips fabricated in lab with Avanti lipids and dyes Rhodamine and NBD-DOPE. Various concentrations were loaded into the channel surrounded by leading and trailing electrolytes of HCl and HEPES buffer. They were then flowed down the channel through the electric field and imaged in a fluorescent microscope to form concentration plots over time and determine the lower bound to detection. The lipids are expected to form two distinct bands migrating down the chip with a relatively low limit of detection. This would prove promising for routine tests targeting EVs in biological fluids.

Poster: 17	Enzymatic Diabetic Biosensors: Changing Protocol Parameters to Increase Sensitivity and Glucose Detection Range of Enzyme Electrode	Poster: 17

Undergraduate Researcher: Mary Roberts

Faculty Advisor: Nehal Abu-Lail

Co-author: Su Ha

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

Abstract:

Diabetes affects 29 million people in the United States and 371 million people worldwide. Advances in medical technology have provided diabetics with implantable devices called biosensors that monitor blood sugar levels and help patients maintain healthy lifestyles. One challenge associated with biosensors is how to increase both the sensitivity and glucose detection range of the enzyme electrode. This research project investigates using the enzyme, Glucose Oxidase (GOx), because it's electrochemically active toward glucose oxidation and biologically safe. In a GOx-catalyzed reaction of glucose at a specific potential, current is measured as a result of changes in glucose concentration and displayed as strong or weak signals on the biosensor. On a plot of Current vs. Glucose Concentration, the slope of the linear region indicates glucose sensitivity, and the range of the linear region indicates the glucose detection range. The goal is to increase the GOx-based enzyme electrode's sensitivity and detect glucose in a wide range of concentrations. So far, I have prepared two enzyme electrode samples following the standard protocol and run them through Cyclic Voltammetry (CV) and Sensing (Potentiostatic) tests, which provided regions where current changed significantly with glucose concentration. However, the detection ranges were too narrow for practical applications. In order to accomplish my research goal, I will adjust the important fabrication parameters for the enzyme electrode preparation processes and run the samples through CV and sensing tests. Based on the experimental performances of the GOx-based enzyme electrode samples, I will investigate and optimize the sensitivity-parameter and detection range-parameter relationships.

Poster: 18	Isolating Exosomes for Use in Disease Detection	Poster: 18

Undergraduate Researcher: Genesis Ruiz Valentín

Faculty Advisor: Nehal Abu-Lail

Co-authors: Wen-ji Dong, Shuang Guo, and Andrew Cohen

Home Institution, Major, Class Standing: University of Puerto Rico-Mayaguez, Chemical Engineering, Junior

Abstract:

Extracellular vesicles (EVs) contain biomarkers for the disease detection, especially for cancers. EVs are classified as exosomes, microvesicles and apoptotic bodies. Exosomes originate from endosomes, with diameters ranging from 40 to 100 nm. Tumor cells release exosomes at a much greater rate than normal cells. Therefore, high levels of exosomal proteins can be a good indicator of the presence of tumor cells. Exosomes need to be isolated from biological fluid before study. We used polyethylene glycol/dextran aqueous two-phase system, to isolate exosomes from human saliva. Enzyme-Linked Immunosorbent Assay (ELISA) with anti-CD63 and anti-TSG101 antibodies was employed to verify the presence of the exosomes in the solution. As a result, we obtained a linear relationship between the intensity and amount of sample which indicates the presence of certain types of EVs due to the interaction between antibodies and surface proteins. Ultimately, a transmission electron microscopy (TEM) for the isolated exosomes will be performed to verify their size and shape to make sure the EVs retrieved are, in fact, exosomes.

Poster: 19	Effects of Sit-stand Desks on Posture Measured by Wearable Sensors	Poster: 19

Undergraduate Researcher: Chandler Shannon

Faculty Advisor: Nehal Abu-Lail

Co-author: Anita Vasavada

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

Abstract:

Sit-stand desks are becoming more and more popular in the workplace. As this trend gains traction, qualitative studies are being published about increases in productivity and user satisfaction when using standing desks. However, there is little published information showing the quantitative effects of using a sit-stand desk on posture. This study aims to characterize the differences in head and trunk motion between seated and standing positions while using a desktop computer in a work environment using body worn sensors. We hypothesized that in a standing position, the head and trunk postural motion (sway) would be larger than in the sitting position. Subjects will be recruited to work with a sit-stand desk. Postural sway is measured using accelerometer and angular velocity sensors placed on the head and trunk. Subjects will work for one hour in a standing position, and one hour in a sitting position. Preliminary results from one subject show that overall, postural sway was lower while standing compared to sitting. The mean acceleration magnitude of the head in the standing posture was 18.6% smaller than in the sitting posture ($p < 0.001$), and the mean angular velocity magnitude of the head was 56.1% smaller ($p < 0.001$)., The mean acceleration magnitude of the trunk was 25.4% smaller in the standing posture ($p < 0.001$). These initial results contradict our hypothesis. These results are consistent with the idea that when the subject is sitting they have a larger base of support, and are possibly more relaxed, thus increasing head and trunk movement

Poster: 20	The Role of Nutraceuticals on Engineered Articular Cartilage in Micromass Cultures	Poster: 20

Undergraduate Researcher: Jonathan Streat

Faculty Advisor: Nehal Abu-Lail

Co-authors: Lujain Alaali, Alia Mallah, Mahmoud Amr, Juana Mendenhall, Bernard J. Van Wie, and Nehal I. Abu-Lail

Home Institution, Major, Class Standing: Morehouse College, Applied Physics/Biomedical Engineering, Junior

Abstract:

Articular cartilage (AC) is an avascular tissue with diffusion limited nutrient and oxygen transfer, affecting its ability to self-heal, resulting in osteoarthritis (OA). With over 50 million cases of osteoarthritis and 700,000 knee replacement surgeries annually in the US alone, the development of a treatment for OA is gaining importance. One of the main approaches to solving the issue is tissue engineering (TE). TE aims at engineering AC tissues in vitro with properties that closely resemble these of native cartilage. In this project, we have three goals. First, isolate chondrocytes, the main AC cell type, from human and bovine knees. Second, expand the cells in a micromass culture, isolate cells and cryo preserve them. Third, optimize the role of nutraceuticals including ascorbic acid, carvacrol, tannic acid, catechin, and alpha-tocopherol on chondrogenesis. The results of our first two goals indicate the bovine and human samples result in 60.3 and 12 million cells on average per sample, respectively. Micromass grown from the bovine chondrocytes yield typical circular morphology of cells while micromasses grown from human knee samples often show irregular phenotypes indicative of osteoarthritis. To achieve the third goal, four of the nutraceuticals will be mixed in with isolated bovine chondrocytes and the culture media under static conditions. Using a hemacytometer to count cells and utilizing collagen staining techniques, the progress of the chondrogenesis will be monitored over 14 days. Although merely in its infancy, our research is expected to advance the knowledge needed to develop artificial AC.

Group 4: Atmospheric Chemistry and Climate Change: Measurements and Modeling in the Pacific Northwest

Poster: 21	**Sensitivity Analysis of the MOSAIC-HYSPLIT Lagrangian Model for Air Quality**	**Poster: 21**

Undergraduate Researcher: Sam Anderson

Faculty Advisor: Shelley Pressley

Co-authors: Yunha Lee, Brian Lamb, and Kai Fan

Home Institution, Major, Class Standing: University of Utah, Physics & Atmospheric Science, Senior

Abstract:

Air pollution continues to be a major concern for both the public and policy makers. In response, scientists have developed techniques to model air pollutants over large time periods; however, in a developing world, each model's output will continue to change with increased emission, temperature, and other climatological variations. Atmospheric scientists have developed a popular model, which calculates the trajectory of an air parcel over time. The most well-known of these models is NOAA's Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT). Similarly, Model for Simulating Aerosol Interactions and Chemistry (MOSAIC) is used to model particulate matter on a fixed grid. Washington State University recently developed a model that integrates the HYSPLIT/MOSAIC models to simulate the chemistry and dynamics in an air parcel, giving the concentrations of pollutants along a trajectory. To further the model's efficacy, a sensitivity analysis was performed by varying input values such as temperature, mixing height, and emission amounts. Each perturbation was discovered to influence both gas and aerosol concentrations along the entire trajectory with varying degrees.

Poster: 22	Analyzing the Impact of Synoptic Weather on the Surface Energy Budget of a Large Inland Water Body	Poster: 22

Undergraduate Researcher: Justin Bonds

Faculty Advisor: Shelley Pressley

Co-authors: Raleigh Grysko, Zhongming Gao, and Heping Liu

Home Institution, Major, Class Standing: Jackson State University, Meteorology, Junior

Abstract:

A large inland water body's energy budget is a delicate system and can be subject to a variety of changing conditions. A large water body's surface energy budget consists of net radiation, latent heat, sensible heat, and terrestrial radiation. Therefore it is important to understand how the surface energy budget is impacted by varying factors. Data were collected from an eddy covariance system located within the Ross Barnett Reservoir in Ridgeland, MS. These data are being used to analyze diurnal and monthly changes in latent heat, sensible heat, and net radiation, all of which are key components of the surface energy budget. We chose data from the spring months of March and April of 2008. The reservoir is subject to many synoptic weather systems, which can impact the water's surface energy budget. Therefore, dates when frontal systems would pass through the area are of significance to this study. We expect that weather systems will negatively impact the reservoir's surface energy budget, leading to less heat and energy output than on a normal day. The primary objective of this study is to examine any direct impacts weather has on the reservoir's surface energy budget, and what other variables, such as humidity and temperature, are affected.

Poster: 23	# CO_2 Flux Bias Correction Assessment in Eddy Covariance Towers over Long Term Agricultural Sites	Poster: 23

Undergraduate Researcher: Victoria Dziekan

Faculty Advisor: Shelley Pressley

Co-authors: Eric Russell, Shelley Pressley, Patrick O'Keeffe, and Brian Lamb

Home Institution, Major, Class Standing: Washington State University, Civil and Environmental Engineering, Senior

Abstract:

During the Regional Approaches to Climate Change (REACCH) program, five eddy covariance flux towers were operated over wheat croplands to assess carbon sources and sinks annually. A systematic error in the measurement of carbon dioxide (CO_2) fluxes was identified due to high frequency air temperature fluctuations that were not captured by thermistors used in infrared gas analyzers by Campbell Scientific. CO_2 flux calculations are sensitive to not only carbon dioxide density and vertical wind speed, but also to values of water vapor density, air pressure, and air temperature. Because the instrument thermistor was slow, high frequency temperature fluctuations were not captured, thus leading to errors in carbon dioxide density and the resulting carbon dioxide fluxes.

To assess how important the potential bias in flux measurements might be for the flux data, an analysis is presented using data from recent flux tower deployments associated with the new WSU Long Term Agricultural Research (LTAR) program. This assessment consisted of two steps. First, flux results obtained using the standard REACCH data processing method were compared to flux results calculated using the new Easy Flux software implemented at the LTAR sites. This step showed that the Easy Flux software returns slightly higher carbon dioxide fluxes, but the differences were negligible with respect to the overall flux rates. The second step involved development of a linear regression between the original REACCH flux results and those obtained after the instrument bias was corrected. Results from this step will be used to assess whether significant adjustments are necessary for each of the five REACCH flux sites in terms of annual net carbon exchange.

Poster: 24	Formaldehyde and Other Air Toxics: Risk and Exposure Assessment	Poster: 24

Undergraduate Researcher: Allison Eames

Faculty Advisor: Shelley Pressley

Co-authors: Miao Wen, Yibo Huangfu, Shelley Pressley, and Thomas Jobson

Home Institution, Major, Class Standing: University of North Carolina at Chapel Hill, BSPH Environmental Health Sciences, Senior

Abstract:

Formaldehyde is a chemical emitted from industrial processes and household products like wood and adhesives. It is also a secondary product of photooxidation in the atmosphere. It is listed as a probable human carcinogen by the US Environmental Protection Agency and as a known human carcinogen by the International Agency for Research on Cancer. Acute and chronic exposure can lead to respiratory health effects and eye, nose, and throat irritation. This study aims to characterize population risk due to formaldehyde inhalation exposure both in the home and outdoors. Indoor and outdoor concentrations were measured from six homes in Pullman, WA and Richland, WA as part of an EPA Indoor Air Quality study (EPA IAQ). These were compared to three outdoor sites in the Lewiston-Clarkston Valley (LCV), a region being monitored in an air toxics study for elevated levels of formaldehyde. EPA's Integrated Risk Information System (IRIS) was used to perform risk characterization. Analysis of the homes showed a summer indoor median expected excess of 259.4-771.5 cancers per million, and outdoor data ranged from 23.7-58.8 cancers per million. The monitored sites in the LCV had median risks of 26.0, 33.8, and 42.1 cancers per million. Additionally, outdoor formaldehyde pollution in the LCV appeared to be correlated to Clearwater Pulp and Paper Mill emissions, while indoor pollution was variable and may depend on habits and products in the home.

Data analysis indicated that even in relatively polluted areas, ambient formaldehyde levels do not appear to pose a significant risk to human health as compared to indoor air. While outdoor point source pollution is regulated, indoor air pollution is not monitored for safety. Moving forward, canisters from both the EPA IAQ study and the LCV Air Toxic study are being analyzed with the goal of identifying other harmful chemicals in inhaled air.

Poster: 25	Building Smart Cities Technology to Monitor Spokane's Air Quality	Poster: 25

Undergraduate Researcher: Kristian Gubsch

Faculty Advisor: Shelley Pressley

Co-authors: Von P. Walden, Yoni Rodriguez, Patrick O'Keeffe, and Kevin Toombs

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

Abstract:

The purpose of this research project is to build a network of inexpensive air quality sensors that transmit to a cloud-based database to monitor Spokane's air quality in real-time. This project is in collaboration with the broader Urbanova project which has the goal to integrate technology to help Spokane become a more sustainable "smart" city. It is important to understand the air quality in Spokane so we can maintain healthy levels of particulate matter in the atmosphere and also educate the public on what they are breathing. These air quality sensors were built using the Raspberry Pi 3 Model B, the CO2Meter K-30 CO_2 sensor, the Adafruit BME280 temperature/pressure/humidity sensor, and the AlphaSense OPC-N2 Particle Monitor. Data was collected using automated Python scripts. There are currently three sensors that are operating in the Spokane University District that are part of Avista's Streetlight program. One of the goals of this project is to expand the sensor network as well as create mobile sensors that use Adafruit's Ultimate GPS Breakout to track location. Another goal is to store the collected data using Amazon Web Services allowing our data is both secured and easily accessible. The desired result is to have multiple working sensors that are communicating with the Amazon Web Services database so the data can be processed and analyzed in real-time. Here we show preliminary results of this research using data collected when testing sensors on the roof of the Paccar building and in the laboratory. Once the sensors are deployed in Spokane, we can begin analyzing the air quality of various locations around Spokane to help educate the public about their air quality.

Poster: 26	# Lab Module to Introduce Undergraduates to Environmental Engineering	Poster: 26

Undergraduate Researcher: Yoni Rodriguez

Faculty Advisor: Shelley Pressley

Co-authors: Kristian Gubsch, Kevin Toombs, Patrick O'Keeffe, and Von P. Walden

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

Abstract:

An interactive laboratory module is being developed to introduce undergraduate engineering students to environmental engineering as part of an introductory course. This lab module will provide students an opportunity to experience hands-on engineering, computer programming, and research development skills to design an Air-Quality Unit (AQU) for real-time data-collection. This module will encourage students to use the scientific method to create a hypothesis based upon their observations regarding their surroundings. Students will then develop an experiment with the AQU to test their hypothesis. Each AQU 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 PM1.0, PM2.5, and PM10. All sensors are wired to a Raspberry Pi3 model B (RPi3) microprocessor that automates data collection. The RPi3 transmits data via a direct on-site ethernet connection or Adafruit Fona Cellular Breakout to an Amazon Web Services database. An Adafruit Ultimate GPS Breakout is also connected to the RPi3 to ensure accurate time and location. Students operate the RPi3 through a Linux interface to run specific scripts written in the Python programming language. These AQU's are modeled after the streetlight sensor units deployed in Spokane, WA by WSU researchers for 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. An ongoing WSU REU is focused on deploying the second set of AQU's that will transmit data to a cloud-based data-base in real-time. This network will provide information regarding temperature, pressure, humidity, CO_2, and particulate matter concentration. This program will educate the public on their air-quality as well as allow researchers to study the health impacts of various concentrations of particulate matter.

Poster: 27	Microclimate Urban Air Quality Modeling Using the ENVI-met Computational Fluid Dynamics Model	Poster: 27

Undergraduate Researcher: Jilliann Peery

Faculty Advisor: Shelley Pressley

Co-author: Brian Lamb

Home Institution, Major, Class Standing: Willamette University, Physics, Junior

Abstract:

Large scale air quality models like AIRPACT are powerful tools for understanding and predicting air quality and the factors that influence it across regions on the scale of multiple states. However, the scale of these models is too large to accurately show the microclimates in urban environments, as affected by the presence and location of buildings, vegetation and air pollution from sources such as traffic and businesses. Urbanova is a program based in Spokane, Washington, whose goal is to use technology to address problems of urban life and improve infrastructure and services. For this program, WSU researchers have placed several air quality sensors in Spokane's University District to provide fine scale information on local air quality. In addition to the sensors, we have initiated an effort to develop, evaluate, and apply urban air quality models to provide an overall framework together with the sensor data to create a more complete picture of urban microclimates.

In this work, we have used a software package called ENVI-met to simulate particulate matter concentrations at the building and street scale. Roadway emissions have been estimated using local traffic count data together with available traffic emission factors for PM2.5. The results of the simulations are in the form hourly estimates of particulate matter concentrations. We compare these results with the PM sensor data for specific case study days in Spokane. Once evaluated, we hope the Spokane ENVI-met model will help identify which factors have the greatest influence on air quality and aid in developing the most effective strategies to improve and maintain air quality at the micro-scale in the University district and elsewhere.

Poster: 28	Geospatial Analysis of Census Data for Health Analyses Using the AIRPACT-5 Air Quality Forecast Model	Poster: 28

Undergraduate Researcher: Austin Pelletier

Faculty Advisor: Shelley Pressley

Co-authors: Joe Vaughan, Vikram Ravi, Yunha Lee, Brian Lamb, and Farren Herron-Thorpe

Home Institution, Major, Class Standing: Washington State University, Civil/Environmental Engineering, Senior

Abstract:

Pollutants such as airborne particulate matter have been shown to increase human risk of cardiopulmonary morbidity and mortality in cases of acute or chronic exposure. This risk increases for groups sensitive to respiratory disease such as the elderly and children. Consequently, it is important to predict and convey elevated levels of air pollution to the public, especially for populations composed of a significant fraction of at risk individuals. To accomplish this, census data were geospatially analyzed to create an overlay for the domain of the AIRPACT-5 air quality forecast model. The AIRPACT-5 forecast is designed to provide timely air quality information to the public online. AIRPACT-5 utilizes CMAQ modeling with 4 km square grid cells to calculate air pollutant concentrations within its domain in the Pacific Northwest. Census data were gathered at the tract, block group, and block scales to obtain the most accurate local scale population, age distribution, and poverty levels. Using QGIS vector geoprocessing and structured query language, the census data were dissected utilizing spatial statistics to assign values to grid cells matching the AIRPACT-5 domain. The goal of this research is to create data layers of population distributions and income distributions for the AIRPACT-5 domain as the basis for an investigation of the health impacts on at risk populations. Used along with air quality forecast results, these data layers will aid in the forecasting of localized demand for health care by addressing disease states related to multiple forms of air pollution. Furthermore, they can be utilized to analyze topics of environmental justice by addressing whether poor air quality disproportionately affects disadvantaged populations. While similar tools already exist at the national scale, focusing on the Pacific Northwest region could increase accuracy and aid in the prevention of cardiopulmonary morbidity and premature mortality.

Poster: 29	Evaluation of AIRPACT Air Quality Forecasts Against Ground-based Remote Sensing Observations	Poster: 29

Undergraduate Researcher: John Perkins

Faculty Advisor: Shelley Pressley

Co-author: Yunha Lee

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

Abstract:

The AIRPACT provides air quality forecasts over the Pacific Northwest region of the United States which are routinely evaluated against satellite observations. Satellite-based instruments measure aerosol optical depth (AOD), an indicator of the extinction of solar radiation by particulate matters (or aerosols) in an atmospheric column. Unfortunately, the satellite measurements have poor temporal and spatial coverage because of the polar orbit of satellites and the frequent cloud coverage in our area. To overcome these limitations and gain an additional dimension of data for model validation, we will use ground-based measurements, which are more continuous. The main source of ground-based AOD measurements used in this study is NASAs AERONET (AErosol RObotic NETwork) remote sensing network. We evaluate AIRPACT model predictions using the AERONET measurements, but also using surface visibility data from IMPROVE (Interagency Monitoring of Protected Visual Environment) network using nephelometer readings from 7 AERONET sites and 65 IMPROVE sites within the AIRPACT model domain. The month of August 2015 was chosen for the evaluation timeframe due to the prevalence of wildfires and therefore higher atmospheric aerosol levels during that month. We have used the following evaluation methods: statistical analysis of observed and predicted AOD time series data at the AERONET sites, and spatial distributions of model output overlaid with ground-based observation values. We find that the predicted AOD is consistently lower than observations, but otherwise captures diurnal and synoptic variability. The AIRPACT surface-level AOD will be evaluated against the IMPROVE network to find out how well the AIRPACT captures the surface AOD vs. atmospheric-column AOD. We will compare the evaluation results from surface visibility with surface aerosol mass concentrations to examine any systematic problems in aerosol optical assumptions used in the AIRPACT.

Poster: 30	Odor and Emission Analysis of Air From Marijuana Growing Facilities	Poster: 30

Undergraduate Researcher: Riley Lewis
Faculty Advisor: Shelley Pressley
Co-authors: Thomas Jobson and Miao Wen
Home Institution, Major, Class Standing: New College of Florida, Chemistry, Junior

Abstract:

With the increase in state marijuana legalization, there also comes an increase in marijuana growing operations. The Spokane Clean Air Agency has received numerous odor complaints from residents living near marijuana growing facilities in Spokane, Washington. Little is known about the environmental impact and emissions of marijuana growing operations. To further the understanding of emissions from these operations, air samples were collected from four indoor growing facilities in Spokane, WA. The samples were analyzed by gas chromatography-mass spectrometry (GC-MS) to determine the concentration of odor causing chemicals, and to calculate mass emissions rates from these facilities. In conjunction with the facility air samples, direct headspace from marijuana products were sampled in order to identify major odor constituents. The samples were analyzed for their terpene concentrations, as well as other volatile organic compounds (VOCs) and hydrocarbons that may impact air quality. Initial results indicate high concentrations of monoterpenes that have distinct odors, principally β-myrcene, followed by D-limonene, α/β-pinene, and β-Ocimene. The sesquiterpene caryophyllene was identified in the headspace samples as well. Isopropyl alcohol and acetone were very abundant as a result of their use as disinfectants. Various esters and aldehydes were also identified. While differences in plant varieties appear to yield differences in the relative amounts of monoterpenes present, for the purposes of air quality and odor modeling a generic source profile was derived from the data

Poster: 31	Method 33a Analysis	Poster: 31

Undergraduate Researcher: Matthew Roetcisoender

Faculty Advisor: Shelley Pressley

Co-author: Brian Lamb

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

Abstract:

Improving the accuracy and efficiency of methane emission detection is a vital aspect to improving safety and reducing greenhouse gas emissions where leaking natural gas infrastructure is concerned. A mobile technique known as EPA Method 33a was used to estimate methane emission rates in four locations, New York, New Jersey, Los Angeles, and Idaho in both urban and open environments. These tests were conducted during the weeks of 11/1/2016, 4/27/2015, 2/01/16, and 10/3/2016 respectively. Method 33a requires measurement of ambient methane concentrations for 5 to 15 min downwind of a source along with measured wind and turbulence data. These data are used to estimate the maximum plume concentration and the Gaussian diffusion coefficients for use in the inverse calculation. For the method evaluation, different methods for estimating these parameters were evaluated using measured leak rates or in some cases controlled methane releases. Statistical analysis comparing estimated rates to specific influencing variables was utilized to determine trends based individual factors such as temperature and mean wind speed. Linear regressions and method difference graphical tests were employed to determine the overall accuracy of Method 33a for both urban and non-urban environments.

Group 5: Smart Environments

Poster: 32	**Data Analytics for Transactive Energy Environment**	Poster: 32

Undergraduate Researcher: David Bai

Faculty Advisor: Larry Holder

Co-authors: Vignesh Krishnan, Anurag Srivastava, and Adam Hahn

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

Abstract:

Present day electric power utilities are becoming more proactive in decision-making, adjusting their strategies based on predictive views. Increased penetration of distributed energy resources at the consumer level, evolution of electric vehicles, emergence of smart buildings, and strong dependence on communication and cyber technology have drastically changed the way the smart grid function. These changes impose new operational challenges.

To address these challenges, the utilities and system operators are adopting new control strategies such as distributed and decentralized control, transactive control, demand response etc. Household smart meter adoption is also rapidly increasing. Closely monitoring electricity usage can help end-users monitor their overall consumption. Electricity providers may also give offers to customers regarding their energy behavior. Accurate renewable production and market price models may help energy producers better manage their energy portfolio to optimize their profits, etc. This leads to an enormous amount of data in the cyber-physical framework in a smart grid. Hence, robust data analytics is critical towards the optimized operation of the smart grid. This leads to increased risks of cyber-attacks under such a framework. Hence, there is a need to develop intrusion-detection mechanisms, which can identify cyber-threats and distinguish such attacks from normal changes in system operations.

By first identifying then classifying the anomalous data, we can develop a better understanding of what kind of anomalies should be considered a threat and how different types of attack vary. Previous related research into anomaly detection suggests that an ensemble-based model could perform better for more kinds of anomalies than a single statistical approach. We adapted this ensemble-based anomaly detection model to our electric grid system, feeding simulated test cases to a machine-learning algorithm to optimize the normalization of different ensemble components.

Poster: 33	Infant Pain Detection Using Fast Fourier Transformed ECG Data	Poster: 33

Undergraduate Researcher: Ji Bok

Faculty Advisor: Larry Holder

Co-authors: Robert Wood and Martin Schiavenato

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

Abstract:

Prematurely born infants' inadequacy to communicate pain is detrimental to infants because pain can permanently damage an infant's growth and development. The current method for pain detection, "pen and paper" pain scale, is subjective to the examiner and is only valid at the moment of the examination. In order to constantly monitor an infant's pain level, the STM32F Discovery board will interact with the heart rate sensor to transform the electrocardiography (ECG) data to frequency domain using fast Fourier transform. The transformed ECG data will be translated into pain index using an already trained linear network, Liblinear. The future work includes being able to interpret not only ECG data, but also the facial sensor data and the hand flex sensor data for more accuracy of the pain index.

Poster: 34	U-Net for Neural Image Classification and Regression on MRI and PET Scans	Poster: 34

Undergraduate Researcher: Carter Carlos

Faculty Advisor: Larry Holder

Co-authors: Lei Cai and Shuiwang Ji

Home Institution, Major, Class Standing: Washington University in St. Louis, Computer Science, Senior

Abstract:

MRI and PET scan images have long provided a means of identifying disease in the human brain. However, identification of minute graphical details in these images is still difficult for trained doctors. Convolutional neural networks have made classification and segmentation of images in the medical field much quicker and more accurate. Using a dataset composed of MRI and PET scans, a three block convolutional neural network takes in MRI data, and then computes the difference between the output of the network and the corresponding PET data. After training the network successfully, we can use logistic regression to predict a PET image and disease classification of MRI images that do not have corresponding PET scans. Each block of the network is composed of two convolutional layers. In the down block, the convolutions down-sample the image. The bottom block uses two convolutions that keep the data the same size, and then the up block uses two transposed convolutional layers (“deconvolutional layers”) to return an image with the same dimensions as the input. The experimental setup includes three different up-sampling techniques: standard deconvolution and two types of “pixel” deconvolution. Additionally, a skip connection similar to those introduced in Microsoft Research’s "Deep Residual Learning for Image Recognition" is used between the down block and the up block to prevent a vanishing gradient during backpropagation. The data for training and testing comes from a set of single-channel, greyscale MRI images and a collection of PET scans that correspond to about half of the MRI set. The rest of the MRI data lacks corresponding PET scans, such that the trained network may predict the PET image instead.

Poster: 35	Exploratory Keyword Search Querying Over Graphs with Quality Guarantees	Poster: 35

Undergraduate Researcher: Casey Fleck

Faculty Advisor: Larry Holder

Co-authors: Mohammad Hossain Namaki, Xin Zhang, Yinghui Wu, and Lawrence Holder

Home Institution, Major, Class Standing: Coastal Carolina University, Applied Mathematics and Computer Science, Senior

Abstract:

Real-world graphs are heterogeneous and noisy. It is usually hard for end users to formulate exact keyword queries, not to mention the quality guarantees returned by the algorithms. Since the issued query is only an approximation to the user's true information need, factors such as ambiguity, vocabulary mismatch, and lack of schema can reduce the quality of search results even with well-established keyword search algorithms. This calls for automatic query refinement schemes that aid users to obtain accurate results by reducing the ambiguity of the original query.

This project studies a keyword query refinement scheme that minimizes query ambiguity and guarantees the quality of the answers at the same time. We formulate keyword query refinement as a multi-objective optimization problem subject to a bounded loss of quality. We propose an algorithm that incrementally refines a given keyword query by exploring the promising neighbors of its answer, without re-evaluating all possible query candidates. Using real-world graphs, we experimentally verify the efficiency and effectiveness of our algorithms.

Poster: 36	**Bayesian Optimization meets Search based Optimization: A Hybrid Approach for Multi-Fidelity Optimization**	Poster: 36

Undergraduate Researcher: Ellis Hoag

Faculty Advisor: Larry Holder

Co-author: Janardhan Doppa

Home Institution, Major, Class Standing: University of Illinois at Urbana-Champaign, Computer Science, Senior

Abstract:

Many real-life problems require optimizing functions with expensive evaluations. Bayesian Optimization (BO) and Search-based Optimization (SO) are two broad families of algorithms that try to find the global optima with the goal of minimizing the number of function evaluations. A large body of existing work deals with the single-fidelity setting, where function evaluations are very expensive but accurate. However, in many applications, we have access to multiple-fidelity functions that vary in their expense (cost of evaluation) and accuracy of evaluation. One example of multi-fidelity optimization is hyper-parameter optimization of machine learning algorithms over subsets of training data with varying sizes. Unfortunately, the multi- fidelity optimization setting has received very little attention. In this work, we propose a novel hybrid approach called Multi-fidelity Bayesian Locally Oriented Global Optimization (MF-BaMLOGO), that combines the best attributes of both BO and SO methods. It employs key elements from Multi-fidelity Gaussian Process Upper Confidence Bound (MF-GP-UCB) which estimates error between different fidelities for selecting the appropriate fidelity to query; and from Bayesian Locally Oriented Global Optimization (BaMLOGO) which selects query points to balance between a quick local-scale optimization with a more effective global-scale optimization with the help of a Gaussian Process (GP) to filter out unfavorable regions. Our comprehensive experiments on multiple benchmark functions show that our MF-BaMLOGO algorithm outperforms existing single-fidelity and multi-fidelity optimization algorithms. Future work includes improving the algorithm for robustness, and performing theoretical analysis including regret bounds and rate of convergence.

Poster: 37	Improving Non-expert, Human Defined Sub-task Hierarchies	Poster: 37

Undergraduate Researcher: Daylan Kelting

Faculty Advisor: Larry Holder

Co-author: Matthew Taylor

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

Abstract:

Generating effective sub-task hierarchies efficiently is a significant, open problem in hierarchical reinforcement learning (HRL). Historically, hierarchies have either been generated by an expert human or by the learning agent concurrently with training. In the former case, a human who is familiar with HRL algorithms must learn the environment and carefully design the task hierarchy. In the latter case, the agent must spend an excessive amount of time discovering a task hierarchy that may be obvious to an untrained human eye. This work attempts to bridge the gap between these two cases by accepting a sub-optimal hierarchy defined by a non-expert human and optimizing it concurrently with training. Using transition data gathered at run-time, the algorithm converts the given task definitions into a partitioned graph and uses a partition-improvement algorithm to optimize them.

Poster: 38	HomeKit-based Sensor Network	Poster: 38

Undergraduate Researcher: Michelle Medici

Faculty Advisor: Larry Holder

Co-author: Larry Holder

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

Abstract:

Apple's HomeKit sensors allow users to collect data around their homes about certain conditions like motion, temperature, humidity, etc. Some of the devices even allow users to turn appliances on or off even if they are not in the room. This data could be used to make predictions about how the user would like their home to be, which would allow the home to be autonomous. We plan to create an app that will collect data from a few sensors set up in one room and send that data to a database. We will visualize and cluster that data over the course of a few days. We hope to find distinctive behavior that can be used to make decisions that are helpful to the people in the lab, like when should the lights be turned on or off, or when the heat should be turned on. Ultimately we would like to have an application where users do not have to set preferences. Instead the app would learn from their behavior.

Poster: 39	Generating Comments for Methods	Poster: 39

Undergraduate Researcher: Kaylee Nguyen

Faculty Advisor: Larry Holder

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

Abstract:

Documentation is not only a guide to understand a program but it also plays a significant role in the success of software maintenance. However, not all source code out there provides enough explanation about the program's operation. A program must be understood by human and machine, yet both does not speak the same language. While high programming language such as Java or C++ are compiled into binary or hexadecimal instructions for the computer to execute, programmers need to read the explanation in natural languages to understand the exact same procedure. In this project, we will implement a Java application that automatically generates comments for methods using an approach proposed in the paper "Towards automatically generating summary comments for Java methods" by researchers Giriprasad Sridhara, Emily Hill, Divya Muppaneni, Lori Pollock and K. Vijay-Shanker from University of Delaware. By identifying common patterns of the codes such as loops, method call, assignment, conditional… we will select and perform analysis on important statements, making sure that the text generated is concise and captures all the necessary information.

Poster: 40	**Deep Learning Algorithms for Human Activity Recognition: Frameworks and Algorithms Based on Convolutional LSTM Neural Networks**	Poster: 40

Undergraduate Researcher: Skyler Norgaard

Faculty Advisor: Larry Holder

Co-authors: Ramyar Saeedi and Assefaw Gebremedhin

Home Institution, Major, Class Standing: Kalamazoo College, Computer Science and Mathematics, Senior

Abstract:

Human activity recognition (HAR) plays a central role in health-care, fitness, and sport because of its potential to enable novel context-aware data processing. With the increase in abundance and popularity of wearable devices, there has been a large influx in publicly available human activity data. Analysis and interpretation of the heterogeneous and high-volume streaming data associated with HAR holds immense potential for impact. Therefore, there is a strong need to develop algorithms for robust classification of human activity data that address challenges associated with dynamic environments (e.g. different users, signal heterogeneity).

Many traditional methods for classification rely on domain knowledge and feature engineering. However, recent research has demonstrated that deep learning methods, in particular, Convolutional Layers, can learn a hierarchical representation of features from raw sensor data. Furthermore, Long Short-Term Memory (LSTM) recurrent layers have shown promise in detecting features and capturing time dependencies in human activity data. In this project, we propose a novel deep architecture that adds a notion of depth corresponding to the X, Y and Z components of sensor data. As labeled data is often sparse in the real world, we also use the architecture to explore the transfer of knowledge between different settings. Furthermore, we add an active learning submodule to the system whenever it is necessary to get feedback from users for better human activity recognition. Our active learning process considers both informativeness and representativeness of unlabeled sample data. This allows us to choose the best samples for fine-tuning the model to the new setting in which the system operates (e.g. a new user). We demonstrate the efficacy of the algorithms as well as the architecture using real human activity data collected in different contexts.

Poster: 41	Creating Power Models of Smartwatches to Extend Battery Life During Long-Term Data Collection	Poster: 41

Undergraduate Researcher: Nathan Seitz

Faculty Advisor: Larry Holder

Co-authors: Ramin Fallahzadeh and Hassan Ghasemzadeh

Home Institution, Major, Class Standing: University of Illinois at Chicago, Computer Science, Senior

Abstract:

With the increase of users and the availability of built-in sensors of smartwatches (gyroscope, accelerometer, etc.), studies of using sensor data for activity recognition are being conducted. These studies usually employ methods which require an abundance of sensor data, which necessitates long-term data collection on these devices. However, when the sensors are invoked for data collection some power is used, reducing the battery life of the device.

In effort to extend the battery life, we conducted experiments to create a power model on a Huawei Watch with Android 2.0. The same process can be used to build a power model for other Android smartwatches too. The power model is useful for helping determine what sampling parameters to use when collecting data to ensure longer battery life. Ultimately, this improvement allows for longer data collection periods and the program used to collect data will have less of a noticeable, negative impact on battery life from the user's perspective.

Group 6: Research Opportunities for Native Undergraduate Students

Poster: 42	**Rhizosphere Bacteria Suppressing Fungi in Wheat**	Poster: 42

Undergraduate Researcher: Brooke Capetillo

Faculty Advisor: Amit Dhingra and Lori Carris

Co-author: Chuntao Yin

Home Institution, Major, Class Standing: Heritage University, Environmental Studies, Junior

Abstract:

To date, only a small percentage of soil microorganisms have been characterized despite their vital role in soil processes. There are indications wheat rhizosphere soil microorganisms may naturally suppress plant diseases. Here, we identified specific culturable bacteria found in rhizosphere soil using plate-count and PCR-sequencing techniques. Soils were serially diluted and spread onto 1/10 TSA plates. The plates were incubated at room temperature between 24-72 hours depending on dilution factor. The bacterial colonies were transferred to new 1/10 TSA plates and grouped based on size and color. Colony PCR was conducted to amplify 16s rDNA fragments from the isolated bacterial colonies using V1-V3 hyper-variable primer. The PCR products were sequenced after purification. Taxonomic assignments of bacteria were determined by blasting to the Ribosomal Database Project Database. Two bacterial species (Bacillus and Chryseobacterium) were identified. However, the remainder of the bacterial colonies were under detection limits and could not be identified.

Poster: 43	**Studying Effects of Ripening Compound on 1-MCP Treated Anjou (*Pyrus communis*) Pears**	Poster: 43

Undergraduate Researcher: Skylar Lynch

Faculty Advisor: Amit Dhingra and Lori Carris

Co-authors: Seanna Hewitt and Amit Dhingra

Home Institution, Major, Class Standing: Bard College At Simons Rock, Colorado, Ecology, Junior

Abstract:

Pears are unique from most other fruit in the sense that they are harvested in a mature, but at an unripe state and require a genetically pre-determined amount of cold to ripen. In apple, a taxonomic sibling of pear, the compound 1-Methylcyclopropene (1-MCP) is used commercially to delay the ripening of fruit by blocking action of a primary ripening hormone, ethylene. In pear, however, 1-MCP treatment results in a complete and unrecoverable blockage of the process. A set of Ripening Compounds (RCs) have been identified in the lab that allow the pears to overcome the effect of 1-MCP, and thereby allow the fruit to ripen consistently and at the desired time. Experiments are ongoing to determine the optimal concentration and pH of RC. Solutions of 1%, 2%, 3% RC, as well as a 1% RC solution titrated to pH values ranging from 2-7, have been evaluated. In a 20-day time-course experiment, an increase in CO2 production and ethylene evolution, and decrease in firmness in the RC treated fruit was observed. All these parameters are physiological indicators of ripening. Pears treated with RC solutions that were titrated to a neutral pH did not ripen, suggesting that the pH of the compound may influence the ripening process. Taken together, the preliminary results form the basis for continued experiments in which the pH and concentration of RC can be optimized to reduce any damage to the fruit, while still retaining RC's ripening properties. The outcomes of this research are expected to reduce postharvest losses that result from unpredictable ripening.

Poster: 44	Uncovering the Mechanisms Behind Calcium Signaling in Plant Innate Immunity	Poster: 44

Undergraduate Researcher: Hunter Sagaskie

Faculty Advisor: Amit Dhingra and Lori Carris

Co-authors: Matthew J. Marcec and Kiwamu Tanaka

Home Institution, Major, Class Standing: Central Michigan University, Biochemistry, Junior

Abstract:

Cytosolic free calcium is used as an intracellular signal to respond to various environmental changes. For example, plants generate a specific pattern of calcium signal known as a signature for activating defensive responses against potentially life-threatening events. The underlying cellular mechanisms of how such a calcium signature is generated and decoded during plant innate immunity remains poorly understood. We have examined a mutant Arabidopsis by the name of silent knight 1 (silk1) that does not produce any measurable calcium response to any stimuli yet tested. The silk1 mutant also exhibited enhanced susceptibility to bacterial and fungal pathogens. Interestingly, the silk1 mutant was deficient in producing reactive oxygen species (ROS), which is another essential signature during plant immune responses. Therefore, the mutant can be a great tool for in-depth understanding of cellular signaling based on calcium and ROS signatures in plant immunity. In the present study, we focus on characterization of genetic and phenotypic traits of the silk1 mutant. Identifying the causal gene for the mutant phenotype is a first critical step. Through the whole genome sequencing, we have already identified eight candidate genes for the silk1 mutation. In this research project, (1) we perform a PCR-based genotyping for isolation of homozygous knockout mutant lines carrying T-DNA insertion in the eight candidate genes, (2) the isolated mutant lines are subjected for introgression of the aequorin transgene, a calcium sensor, thereby allowing identification of mutant lines phenocopying the silk1 mutant in terms of calcium response, and (3) ROS production in the candidate mutant lines is also compared to that in the silk1 mutant. Based on the results, together with our previous data, we will discuss how calcium signaling relates to plant innate immunity.

Poster: 45	Physiological Differences Between Male and Female C57Bl-6 Mice During Exercise	Poster: 45

Undergraduate Researcher: Jay-J Yarbrough-Jones

Faculty Advisor: Amit Dhingra and Lori Carris

Co-authors: Jennifer A. Eldridge and Bertrand C.W. Tanner

Home Institution, Major, Class Standing: Washington State University, Kinesiology, Senior

Abstract:

Understanding muscle function, basal metabolic rate, and exercise metabolic rate is important in regard to curing degenerative diseases like muscular dystrophy, osteoporosis, and heart disease. Better characterization of these physiological conditions would aide in advancing cures for these degenerative diseases or alleviate the pain caused by these diseases. Using Wild-Type mice (C57Bl-6 strain) we measured respiratory function during exercise in 8 male and 8 female mice. We hypothesize there would be a difference between male and female energy expenditure and energy expenditure rate at VO_2 Max (i.e. the amount of oxygen utilized at maximal exertion). The mice were run on treadmills inclined at 25° inside a metabolic chamber that measured oxygen and carbon dioxide exchange ratio. Males expended more energy and had greater rates of energy expenditure compared to females. This is preliminary data to be used as control group measurements for comparison with similar measurements using mice with a strain of muscular dystrophy. This data now sets a baseline to better understand exercise physiology parameters in healthy and diseased rodent models and of human physiological exercise capacity.

Group 7: Plant Genomics and Biotechnology

Poster: 46	**Marker-Assisted Selection for Photoperiod Insensitivity in the Nuña Popping Bean**	**Poster: 46**

Undergraduate Researcher: Zane Ketchen

Faculty Advisor: Amit Dhinra

Co-authors: Bruce A. Williamson, Theodore J. Kisha, and Amit Dhingra

Home Institution, Major, Class Standing: Heritage University, Envisomental Science, Junior

Abstract:

Several nutritional and aesthetic characteristics of the Peruvian nuña bean (*Phaseolus vulgaris L.*) make it attractive for growing and marketing in North America. Nuña beans pop and expand, similar to popcorn, during rapid heating. Nuña beans are photoperiod sensitive, which makes it challenging to produce them in the Pacific Northwest. Nuña bean plants do not flower when exposed to a 12 hour or more day photoperiod. A solution to this problem is to conduct crosses between a closely related photoperiod insensitive bean, such as the common bean Phaseolus vulgaris L. PI 172023, and commercially interesting nuña bean accessions. We found a previously reported photoperiod-associated SCAR (Sequence Characterized Amplified Region) marker which can be utilized for Marker-Assisted Selection (MAS). This SCAR marker was first validated using known photoperiod sensitive and insensitive bean genotypes as controls. The SCAR marker was then used to screen 192 F2 individuals derived from the cross of PI 6084402 (Nuña Mani Roja) x PI 172023 (photoperiod insensitive). A total of 61 individuals are predicted to be photoperiod insensitive in accordance to the SCAR marker results. This total number follows the expected segregating ratio (25%) for a recessive gene (photoperiod insensitive). The 61 photoperiod insensitive individuals will be backcrossed with PI 6084402. After F3 individuals are obtained, the future plans will be to keep backcrossing the progeny to achieve a true nuña bean with the photoperiod insensitive trait.

Poster: 47	**Postharvest Phenomics: Enabling High Throughput Measurement of Respiration for Analysis of Postharvest Physiology**	Poster: 47

Undergraduate Researcher: Akshay Thapar

Faculty Advisor: Amit Dhinra

Co-authors: Seanna L. Hewitt, Richard M. Sharpe, and Amit Dhingra

Home Institution, Major, Class Standing: Yakima Valley College, Civil Engineering, Junior

Abstract:

Post-harvest plant products, such as fruits and tubers release carbon dioxide (CO_2) as they ripen, or senesce. High throughput monitoring of carbon dioxide levels can provide useful information regarding product quality in a research setting. Carbon dioxide can be monitored using a post-harvest respiration chamber system. In such a system, fruits are placed into multiple sealed containers fitted with input and output lines through which compressed air is metered in, and air (plus respired carbon dioxide) metered out, respectively. The carbon dioxide gas that is released from the ripening fruit is ported through a three-way solenoid valve to a LI-COR LI-7000 CO_2/H_2O Analyzer. Each container has its own solenoid valve, which directs the gas coming out of the container to a manifold that is connected to the CO_2 analyzer. The solenoids are controlled by custom software via a Measurement Computing 24 channel USB digital I/O device. The CO_2 analyzer, which is connected to a computer operating WinBerries software, measures efflux CO_2. WinBerries automatically calculates the respiration rates of the fruit, determined by the difference in CO_2 inflow and outflow. The respiration system components can be modified by replacement of input gas, analyzer type or both separately, to analyze different aspects of postharvest fruit ripening physiology.

Identification of Vaccinium Hybrids Using TRAP Markers in Population Screening

Undergraduate Researcher: Grant Nelson

Faculty Advisor: Amit Dhinra

Co-authors: Danielle Guzman, Nathan Tarlyn, and Amit Dhingra

Home Institution, Major, Class Standing: Washington State University, Cell Biology, Junior

Abstract:

One of the most economically important berries in the US is the highbush blueberry (Vaccinium corymbosum). It represents a large portion of revenue for several northwestern states, one of the most significant being Washington state. Nutritiously, blue berries are quite beneficial, however, within the same genus the mountain huckleberry (Vaccinium membranaceum) is considered to have far greater health benefits and taste. However, the huckleberry remains undomesticated due to undesirable traits that prevent large scale production, including specific cultural requirements for growth, and low berry yields that prevent efficient harvesting. With the goal of conferring the most desirable traits of both berries into a single fruit, crosses were made between seven species of blueberry and two wild selections of huckleberry, generating an F1 population of 1,560 individuals. A molecular marker technique, Target Region Amplification Polymorphism (TRAP) will be utilized to characterize the hybrids and comparing them to the parents. TRAP analysis is an approach that works by producing multiple polymorphic markers around targeted gene sequences. TRAP-derived PCR products will be electrophoresed on a 6.5% polyacrylamide gel to visualize the polymorphic loci. After identifying the hybrids within the population, further screening will be done in the segregating population to identify individuals with phenotypes favorable to cultivation and production. Selected individuals will be used as parents in future crosses and propagated, until the desired phenotype is obtained. This will allow identification of new hybrid berries, creating a nutritional product for consumption by the public.

Group 8: Bioplastics and Biocomposites

Poster: 48	**Drying Methods for Mycelium-Based Composites**	Poster: 48

Undergraduate Researcher: Jacob Bowen

Faculty Advisor: Michael Kessler

Co-authors: Hui Li, Peter Mueller, Gavin McIntyre, and Karl Englund

Home Institution, Major, Class Standing: Letourneau Universtity, Mechanical Engineering, Junior

Abstract:

Mycelium-based composites have been successfully demonstrated to serve as renewable alternatives to their more hazardous, non-compostable counterparts such as composites manufactured with methylene diphenyl diisocyanate and urea-formaldehyde resins. Mycelium works as an adhesive resin by forming a matrix around and within the substrate. There is further advancement that can be made within the production process of mycelium composites to optimize results. This study will investigate the effects that convection and conduction drying methods have on the final performance of the products after being compressed to various densities. After mycelium growth is complete, test composites will be either convection dried prior to compression or conduction dried during compression. After the composites are pressed to the final densities, testing will be conducted to determine internal bond strength, vertical density profile, water swell, compressive strength, and screw hold.

Poster: 49	Thermoplastics Starches based Thin Films with Polyacrylated Glycerol as Plasticizers	Poster: 49

Undergraduate Researcher: Amelia Cantwell

Faculty Advisor: Michael Kessler

Co-authors: Nacú Hernandez and Andrew Becker

Home Institution, Major, Class Standing: University of Montana, Chemistry and Mathematics, Senior

Abstract:

Polyacrylated starch as a water-insoluble polymer is desirable in the field of bioplastics due to the high abundance, accessibility, and low cost of starch. Starch's solubility in water hinders its use as a plastic in food packaging. Acrylation of starch as a method for cross-linking to decrease water solubility was performed by esterification. Dimethyl sulfoxide (DMSO) and dimethylformamide (DMF) were found to dissolve wheat starch and were used as solvents in esterification reactions. Three methods of esterification were studied; Fischer esterification using acrylic acid, transesterification using methyl methacrylate, and methacrylic anhydride esterification.

Poster: 50	Developing Renewable Propylene from Bio-based 1,2-Propanediol and Glycerol	Poster: 50

Undergraduate Researcher: Daniel Fortino

Faculty Advisor: Michael Kessler

Co-authors: Chengyun Liu and Junna Xin

Home Institution, Major, Class Standing: Stevens Institute of Technology, Chemical Engineering, Senior

Abstract:

Background: Polypropylene is the second most produced polymer by volume. Today, most propylene is produced from the refining of gasoline or splitting, cracking, and reforming of hydrocarbon mixtures but an increasing amount of effort is being placed into finding new, commercially viable on-purpose methods of production. In this project, we have developed new and more economic production methods for bio-based propylene using sugar-derived 1,2-propanediol (1,2-PDO) as feedstock.

Introduction: Production of 1,2-PDO from lignocellulosic C6/C5 sugars is already a commercially viable process. The focus of this research is the conversion of 1,2-PDO to propylene using a 3 step catalytic reaction process in a fixed bed reactor. This process will be attractive for applications in both academia and industry.

Experimental Method: For each step of the reaction, several catalysts are tested in the fixed bed or batch reactor, and the conversion and selectivity of each is recorded. For the dehydration steps, several different Al/Si zeolite catalysts are considered, while SiO_2 and Carbon supported metal catalysts are used for the hydrogenation step. The catalyst is loaded into the reactor, then the reaction is completed and Gas Chromatography is used to analyze conversion and selectivity.

Results: We have determined a viable catalyst for the dehydration steps. We found that HZSM-5 Is useful for this purpose, as it is an already commercially available catalyst and yielded acceptable conversion and selectivity. Further experiments are required to determine a suitable heterogeneous catalyst for the hydrogenation step, however Pt/SiO_2 and Pd/SiO_2 are potential candidates. Additionally, we must optimize reaction conditions to maximize selectivity and conversion in each step.

References:
[1] Perosa, A. and Tundo, P. (2005). Selective Hydrogenolysis of Glycerol with Raney Nickel. Industrial & Engineering Chemistry Research, 44(23), pp.8535-8537.
[2] S. Nishimura, Handbook of heterogeneous catalytic hydrogenation for organic synthesis. Norwich, NY: Knovel, 2005.

Poster: 51	Fully Biodegradable Plastics with Insecticide Functionalities	Poster: 51

Undergraduate Researcher: Ryan Funk

Faculty Advisor: Michael Kessler

Co-authors: Cindu Annand and Dr. Chunhui Xiang

Home Institution, Major, Class Standing: The Pennsylvania State University, Materials Science and Engineering, Junior

Abstract:

The rise of Zika and other insect driven viruses are becoming an epidemic that has been directly impacted by climate change. This is driving a market need for a product that is able to not only prevent insects but also reduce the effects of the spread of these insects. The goal of this project is to develop biodegradable fibers with insecticide functionality for protective garments. Poly (lactic acid) (PLA) is one of the most promising biopolymers able to replace the petroleum-derived polymers for industrial applications. In this study, PLA fibers were first spun with an extrusion machine and then went through a fiber-drawing unit to achieve an average fiber diameter of approximately 20 micrometers. The fiber drawing process aligns the polymer molecules along the fiber longitudinal axis and hence increases the strength of the fiber. N,N-Diethyl-meta-toluamide(DEET), which was incorporated during the fiber extrusion, was used as the control insecticide to evaluate the efficacy of the natural insecticides. The mechanical properties of PLA and PLA/DEET fibers were tested on a universal tensile tester. The effect of the fiber diameter and the drawing process on the strength of the fibers was also explored. The linear density of the fibers demonstrated the strength of PLA and PLA with various concentration of DEET. The optimal insecticide concentration with highest fiber strength was determined.

Poster: 52	Mechanical Pretreatment of Alpha-chitin to Produce Chitin Nanofibers Using Wet- and Dry Grinding Methods	Poster: 52

Undergraduate Researcher: Nathan Glandon

Faculty Advisor: Michael Kessler

Co-author: Tuhua Zhong

Home Institution, Major, Class Standing: Texas A&M University, Chemistry, Junior

Abstract:

The objective of this program is to develop a green way to produce chitin nanofibers from commercial α-chitin using mechanical pretreatment followed by mechanical disintegration. Due to the bulky particle sizes and the strong inter- and intramolecular hydrogen bonds of chitin, fiber clogging often occurs during the mechanical disintegration process, which leads to the termination of the production process. To address this problem, chitin is mechanically pretreated using wet- and dry grinding methods to prevent clogging. The Ball mill (dry grinding) and the supermass colloider (wet grinding) are applied in the pretreatment. The effects of grinding types and grinding variables on the morphology, particle size, size distribution, and crystallinity will be investigated. The effects of mechanical pretreatments on the properties of chitin nanofibers also will be determined in terms of morphology, particles size, mechanical and thermal properties.

Poster: 53	Bio-based Adhesives	Poster: 53

Undergraduate Researcher: Mason Moeller

Faculty Advisor: Michael Kessler

Home Institution, Major, Class Standing: Iowa State University, Agricultural Systems Technology, Junior

Abstract:

This papers reviews the development and characterization of a bio-based construction using glycerin from transesterification of soybean oil for the production of biodiesel. The results indicate that the bio-based adhesive has the ability to perform as well as, and in some cases better than commercially available petrochemical adhesives. The bio-based adhesive is based on renewable feedstocks, has zero VOC (Volatile Organic Compounds), and is sustainable. The bio-based adhesive was compared to commercial petrochemical adhesives in terms of lap shear strength, water stability, creep resistance, and three point bend strength. In addition, construction materials, such as oriented strand boards (OSB) were produced with the bio-based adhesive and compared to commercially available OSBs. Based on threepoint bend tests and water stability, the results indicate that the bio-based OSB products performed as well as OSB products based on petrochemicals. Future tasks involve discovering and optimizing more applications for the bio adhesive such as rubber adhesion and flexibility, and pressure sensitive applications.

Poster: 54	**Hydrophilic Bentonite Nanoclay-Activated Douglas Fir (*Pseudotsuga menziesii*) for use as High Performance Potting Media**	Poster: 54

Undergraduate Researcher: Aleesha Slattengren

Faculty Advisor: Michael Kessler

Co-authors: Vikram Yadama, Indranil Chowdhury, and Mehnaz Shams

Home Institution, Major, Class Standing: University of Minnesota - Twin Cities, Bioproducts and Biosystems Engineering, Sophomore

Abstract:

Agriculture is one of the largest uses of freshwater in the world. Additionally, excess fertilizers applied to crops can produce runoff and leach into nearby bodies of water, harming the ecosystems there. Nanoclays in particular have been shown to be excellent at holding water as well as binding with nutrients. This study attempted to investigate the possibility of combining woody biomass (douglas fir), nanoclay (hydrophilic bentonite), and fertilizer (urea) in order to create a potting soil that would be more capable of water retention, and to provide a slower release of nutrients. Several methods were tested to impregnate the wood chips with nanoclay, and their water holding capacity was tested. Later the effect of combining this material with urea was tested to determine its release rate of nitrogen. It was found that the nanoclay did not increase the water absorbency of the wood, indicating that complete dispersion of the nanoclay platelets was not achieved. However, the incorporation of nanoclay with urea in the wood did provide a slower release of nutrients than that without nanoclay.

Poster: 55	Ultrasonic Welding of PLA	Poster: 55

Undergraduate Researcher: Anna Treppa

Faculty Advisor: Michael Kessler

Co-authors: David Grewell and Karla Lebron

Home Institution, Major, Class Standing: Wayne State University, Biomedical Engineering, Sophomore

Abstract:

This project focuses on the ultrasonic welding of the interfacial healing of biopolymers. The bioplastic that was used in this study was polylactic acid (PLA), which is made from starch rich products such as corn or sugarcane. Two different types of samples were used in testing, sharp energy director and round energy director. Tensile testing was completed in order to collect data about the mechanical strength and characterization of the welds. The tensile testing also allowed for the ability to make a comparison with the sharp energy director and the round energy director. While doing this project, incorporating the dynamic hold method, in addition to varying weld distance and amplitude, was significant in making more consistent and stronger welds. This included finding the optimum condition for the dynamic hold method. This was done by varying the hold velocity, along with other influential parameters such as hold distance within the dynamic hold method. The results assisted in the development of the models used throughout the project. The temperature profiling done on Mathcad and Ansys helped to predict the weld strengths for model validation. Future research work on this project would continue to improve weld strengths and molecular diffusion models to better predict the performance of biobased products.

Poster: 56	Odor Control in Agave Fiber	Poster: 56

Undergraduate Researcher: Samantha Trimble

Faculty Advisor: Michael Kessler

Co-author: Mitchel Michel

Home Institution, Major, Class Standing: University of Tennessee, Material Science and Engineering, Junior

Abstract:

The purpose of this research is to determine if the odor released from a new biocomposite will be tolerable or unobtrusive under various temperature conditions. The goal is to find a combination that will release either an insignificant odor or no odor at all. The biocomposite is an extruded mixture of polypropylene and agave fibers. When the agave fibers are heated at high temperatures, such as during extrusion or injection molding, the sugars they contain caramelize and off gas an odor. We will perform odor analysis tests using predetermined samples, which consist of differential amounts of washed or unwashed fibers, polypropylene and other additives. Each sample will be sealed in a jar, placed in an oven for up to 24 hours, and then immediately smelled by five random noses. These participants will then rate the smell on a given scale that measures perceptibility and how disturbing the odor is. We can assess the results from testing and determine whether the fibers, along with their odor, will be appropriate to use in replacement of other plastics. The findings could be very useful in applications of small, interior car parts.

Poster: 57	Synthesis Pathway of Glycerol Derivative Block Copolymers as a Biobased Feedstock for Pressure Sensitive Adhesives	Poster: 57

Undergraduate Researcher: Nicholas Van Nest

Faculty Advisor: Michael Kessler

Co-authors: Fang-Yi Lin and Eric Cochran

Home Institution, Major, Class Standing: Stony Brook University, Biomedical Engineering, Senior

Abstract:

Dependence on fossil fuel as an adhesive feedstock prevents production adaptability to fluctuations in market price. As a major byproduct from plant oil interesterification in the production of biodiesel, glycerol shows its economic potential as an inexpensive alternative to conventional feedstocks. Our study continued development of the synthetic pathway of monomers that use glycerol and its derivatives as substrates for block copolymers in the application of self-tackified biobased pressure sensitive adhesives. To undergo radical polymerization, functionalizing glycerol with active vinyl groups is required. Solketal is a derivative of glycerol with an acetal capping two adjacent hydroxyl groups. This controls monomer functionality, and results in a thermostable linear polymer in the downstream. Herein we present a low-cost and ecofriendly pathway for acrylation of glycerol via enzymatic transesterification of solketal and methyl acrylate by Novozym 435. Enzymatic transesterification is a green alternative to current techniques because it performs well under ambient temperature, is a solvent-optional process, and allows for reuse of the enzyme. One area of focus in this work was the determination of optimal conversions when changing the enzyme to substrate ratio. To remove in situ methanol as a byproduct, molecular sieves were introduced to the system and the quantity was optimized. Optimal synthesis durations were also determined. Block co-polymers of glycerol derivatives and glassy macro-chain transfer agents will be polymerized by Reversible Addition–Fragmentation chain Transfer (RAFT). We hope the use of glycerol as a biorenewable feedstock via this novel synthesis pathway will provide a cost effective and sustainable alternative to current adhesive technologies.

Poster: 58	Novel Synthetic Approach to a Bio-sourced Epoxy Curing Agent via Eugenol and Thiol–Ene Click-chemistry	Poster: 58

Undergraduate Researcher: Dan Vincent

Faculty Advisor: Michael Kessler

Co-authors: Yuehong Zhang and Yuzhan Li

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

Abstract:

In this study, a novel two-step synthetic pathway has been devised and carried-out to generate a previously unreported diamine compound that is derived from the bio-renewable resource Eugenol, and is designed to be used as a curing agent of epoxy resins. The major feature of the synthetic approach is the application of UV-catalyzed thiol-ene 'click-chemistry' in the second step. This reaction requires only commercially available reagents and mild reaction conditions, while still having the advantage of being very high in yield and simple to carry out. The structure and purity of the product from this method was confirmed by analysis of its ^{1}H-NMR spectrum. The newly formulated compound was applied as a curing agent in a variety of epoxy systems, and the curing kinetics of those reactions were investigated along with the thermal and mechanical properties of the resultant materials.

Group 9: Gerontechnology-focused Summer Undergraduate Research Experience (GSUR)

Poster: 59	**Relationship Between Crystallized and Fluid Intelligence and Success on The Night Out Task: A Measure of Everyday Functioning**	**Poster: 59**

Undergraduate Researcher: Maia Blumofe

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Reanne Cunningham and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: Washing State University, Neuroscience, Junior

Abstract:

The Night Out Task (NOT) was created to test everyday functional abilities in individuals by mimicking complex, open-ended situations people may experience in everyday life in the clinic. Individuals completing the NOT are tasked with preparing for a night out, which requires completing eight subtasks (e.g., gathering correct change for bus) while multitasking and interweaving for efficiency. This study explores how crystallized (knowledge acquired throughout life) and fluid (ability to solve novel problems) intellectual abilities affect success on the four main NOT variables: total task errors, total time on task, accuracy score and sequencing score. Participants were 47 older adults between the ages of 50 and 83 (M = 63.72, SD = 8.22) who completed the NOT in a lab setting. The recently completed digital NOT app was used to score their behavior. Participants also completed neuropsychological tasks that assessed crystallized and fluid abilities. Using multiple regression analysis, we examined whether Crystallized and Fluid Intelligence were significant predictors of NOT task performances. A significant regression equation was found for total errors, $F(2, 43) = 4.74$, $p = .014$, $R^2 = .142$, with Crystallized Intelligence emerging as a significant predictor ($p < .05$). A significant regression equation was also found for total time, $F(2, 47) = 5.699$, $p = .006$, $R^2 = .161$, with Fluid Intelligence emerging as a significant predictor ($p < .005$). The regression model did not yield significant predictors for the sequencing score or accuracy score. In prior work we found that older adults performed the NOT task slower than younger adults but did not differ in error rate. The findings may suggest that knowledge gained through experience may be important for completing the task components without making errors. Concomitantly, fluid intelligence, which declines with age, may play a mediating role between age and efficient task execution. These suppositions will require further exploration.

Poster: 60	Object Detection for Activity Support Robot	Poster: 60

Undergraduate Researcher: Nathaniel Burley

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Sean Kallaher, Diane Cook, Matthew Taylor, and Gabriel de la Cruz

Home Institution, Major, Class Standing: Washington State University, Applied Mathematics, Sophomore

Abstract:

As our population continues to age, the number of nurses and caregivers able to monitor the health of the elderly will continue to decline. The longer an elderly or disabled person can safely live independently, the greater their quality of life will be, and the less of an emotional and financial burden they will be on their family. Robotics represents a rapidly growing sector of gerontechnology, a field that merges gerontology with technology. As a technological tool with a physical presence, robots can provide personal assistance. They can aid in performing simple chores, retrieve critical items, and interact with residents throughout a physical environment to provide reminders on how and when to complete activities of daily living. In order to do this, the robot must be able to map and autonomously traverse its surroundings, as well as locate and retrieve essential objects.

This research project aims to utilize neural networks and simultaneous localization and mapping (SLAM) algorithms to program a robot equipped with a 3D camera, robotic arm, and Digital Memory Notebook to map its surroundings, and autonomously locate and retrieve objects.

The contribution of this project is to design a deep network to recognize objects necessary for the robot to identify, locate, and retrieve. To accomplish this task, we utilize Google's TensorFlow Object Detection API, YOLO Darknet default, and a custom trained version of YOLO Darknet. We compare the alternative approaches based on training speed, object detection speed, and object recognition accuracy in naturalistic environments. The robot's onboard computer has limited processing power, so faster, less computationally expensive networks are desirable. Finally, we integrate the deep network into a Robot Activity Support system, RAS, to demonstrate the benefit that a mobile robot can offer for helping older adults in their everyday environments.

Poster: 61	Compensatory Strategy Use and Medication Management	Poster: 61

Undergraduate Researcher: Lisa Chudoba

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Catherine A. Sumida, Abere Sawaqdeh Church, Alyssa Weakley, and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: Eastern Washington University, Applied Developmental Psychology, Senior

Abstract:

It is estimated that approximately 50% of community-dwelling older adults have difficulty remembering to take their medications, effecting medication adherence. In this study, we investigate the accuracy of older adults in self-reporting compensatory strategies that they use to manage their medications. Participants were 47 community-dwelling older adults (36 female and 11 male, between 54 and 90 years of age; M = 73 ± 9.6 years). During Session 1, participants self-reported whether they used each of the following five strategies to assist with medication management: (1) pillbox, (2) notes or alarms, (3) their routine, (4) keeping medications in a visible location, and (5) using a strategy to help them "know" they have taken their medications. During Session 2, researchers visited the participant in their own home, having them demonstrate their daily medication routine while being video recorded. Researchers elicited information regarding organization of medication, how the participant remembered to take their medication, and how they knew they had taken their medication. Self-reported medication management strategies were compared with what was observed on video during the in-home assessment. A small subset of the sample (N = 22) also had knowledgeable informants report on their perception of the five strategies that the participant used to organize and remember their medications. To determine accuracy of participant self-report, we will compare the rate of use agreement for each compensatory strategy between the participant self-report and what is observed in-home. For the sub sample, we will also compare rate of use agreement between informant report and participant self-report, as well as informant report with what is observed in home. Future studies aim to examine how the number of strategies used is related to medication adherence, using Estimote stickers to identify actual adherence and strategy use in real-time compared to the routine described by the participant in-home.

Poster: 62	Google Home App for Smart Homes	Poster: 62

Undergraduate Researcher: Declan Edgecombe

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Brian Thomas and Bryan Minor

Home Institution, Major, Class Standing: University of Washington, Computer Science, Freshman

Abstract:

Throughout the world the population is aging. The number of people over age 65 is increasing every day. Due to the exponential increase in older adults, there is a large market for technology that helps older adults, the so called world of gerontechnology. In order to improve the lives of older adults, we have created an app for the Google Home which can answer various questions about smart homes including what the occupant has done within the last 24 hours. The app uses a natural language interpreter called API.ai to figure out what the user is asking. The interpreter then sends a JSON request to the API that we built. The API receives and stores data from smart home sensors. Based on the data it receives and what it determines the user is asking about, the API tells google home to give an audible answer to the user. This interactive display will be put into the science center as an exhibit to increase awareness throughout the community about how smart homes can be utilized to monitor the health of older adults. Eventually, the horizons can be broadened and the technology could be deployed within a person's home so they could hear about their own health habits.

Poster: 63	Entity Counting and Tracking Using Microsoft Kinect Depth Maps	Poster: 63

Undergraduate Researchers: Sheree Enlow and Jared Meade

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Jared Meade, Brian Thomas, and Aaron Crandall

Home Institution, Major, Class Standing: Washington State University, Computer Scienece, Senior

Abstract:

The Palouse Discovery Science Center (PDSC) in Pullman has requested a headcount system to track the number of patrons coming in and out of their building as well as their corresponding heights (adult or child count). Gathering accurate headcount through traditional surveillance can be intrusive and is not ideal for a family friendly facility or in a (smart) home. Using a ceiling mounted Microsoft Kinect V1 above the main door was our solution. Since Kinects are equipped with an IR depth sensor, we are able to use the difference from a person's head to the ground as a means to detect someone walking under the Kinect. The IR depth sensor is essential in determining height too. Since the top of one's head is closest to the sensor this creates a concave region which is the key to the unsupervised "waterfill" algorithm we used. This algorithm utilizes random seeding to simulate rain drops congregating and filling in holes (concave parabolas) and filters out regions that contain shoulders, arms, and other body parts from the depth image. Stationary objects such as desks or chairs within view will also be disregarded using a background subtraction method so strictly objects moving into view are detected. In order to determine the walking direction our system includes path tracking of the detected heads and this is then used to count the number of people walking in or out. After a person crosses a certain boundary within the Kinect's field of vision the running in or out total will be incremented.

Poster: 64	Multiview Deep Transfer Learning For Activity Recognition	Poster: 64

Undergraduate Researcher: Kyle Kippen

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-author: Feuz Kyle

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

Abstract:

Supervised machine learning typically requires large amounts of labeled data to build an accurate classifier but obtaining labeled data and then training on that data is usually a resource intensive process. In the case of activity recognition, this process must be repeated for every new sensor system. We propose a solution to use multiple sensor platforms with some labeled data and a deep learning environment to transfer knowledge from one sensor system to another.. Using the Keras platform, built on top of TensorFlow, we have achieved baseline accuracy results of 87%. We also show that using a variation of auto-encoding one can accurately map data from one view to the other view which provides a direct way to leverage the training data from either view to improve performance of the model in the other view. These results appear to be promising but more research is needed to conclusively prove that. In conclusion using deep learning can improve activity recognition when using multiple sensor platforms with both labeled and unlabeled data.

Poster: 65	Optimizing Help Tools for a Memory Notebook App	Poster: 65

Undergraduate Researcher: Timothy McAleer

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Jessamyn Dahmen, Katelyn Brown, and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: University of Washington, Computer Science (Intended), Sophomore

Abstract:

This project focuses on the effectiveness of a written, and in-app tutorial for the Digital Memory Notebook app. The Digital Memory Notebook, or DMN, is an iPad app for the elderly with cognitive impairment built to aid them in their day-to-day activities. The DMN includes sections to record events, set reminders, and write down notes for the day. The written tutorial, as well as the in-app help section, is meant to clearly explain how to use each section of the app. An in-app tutorial includes video walkthroughs on how to complete some of the more difficult DMN task applications. The goal of the research is to obtain user-feedback on both the written and in-app tutorials. Younger and older adults will complete tasks on the app after reading the written tutorial, and using the on-app help screen. Data being recorded include how accurately the participants can complete the tasks, as well as how easy participants thought the tasks were, using a standard Likert scale to measure their responses. This data will be used to help improve the on-app help screen so it is more clear, concise, and effective.

Poster: 66	Comparison of Two Tutorial Methods for SHiB (Smart Home in a Box) Installation	Poster: 66

Undergraduate Researcher: Zamzam Mumin

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Yang Hu, Matthew E. Taylor, and Diane Cook

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

Abstract:

This project focused on a study that compares the teaching effectiveness of two methods to train participants for installing a Smart Home in a Box (SHiB):-, an online intelligent tutoring system (ITS) and a standard paper manual. SHiB is a kit that consists of motion sensors, temperature sensors, relays and an Ethernet server and is used to collect and transmit sensor data, developed by the Washington State University Center for Advanced Studies in Adaptive Systems (CASAS). The long-term purpose of this project is to design a tutorial guide that can be easily used to self-install the SHiB kit by individuals from diverse backgrounds and can thus be utilized to provide valuable activity information. Participants involved in this study are Pullman residents and students from the Summer Research community. Participants were assigned randomly into one of two groups. In Group 1, participants were trained using a SHiB ITS. The tutoring system consisted of pre-test, training and post-test sessions teaching the participants how to effectively position the sensors in a home. In Group 2, participants were given a textbook, which contains three worked examples. The training for Group 2 participants consisted of spending as much time as needed to read the textbook. After the training, all participants were given an instructions guideline explaining the different devices in the kit and a visual description of the design. They were given the SHiB to self-install through two experiments. After installation of the SHiB, the participants' performance was evaluated by the researchers for the accuracy of device positioning and efficiency of overall installation. The results are used to compare the two training methods.

Poster: 67	Development of an Estimote App to Understand Routine Activities and Compensatory Strategy Use in Older Adults	Poster: 67

Undergraduate Researcher: Kily Nhan

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Maureen Schmitter-Edgecombe, Bryan Minor, Brian Thomas, and Kaci Brooke Davis

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

Abstract:

Deploying Estimote sensors in the homes of older adults could improve understanding of everyday routine activities and the strategies that older adults use to remain functionally independent. Estimote sensors are small and can easily stick to most household objects, such as doors and medications. In this study, the reliability and accuracy of data transmitted from Estimote sensors will be tested by monitoring behavior in a home environment. The sensors will gather information about the daily activities of older adults, including individuals with memory impairment, for one week. Each time participants use designated objects to complete everyday activities, the sensors will transmit signals that will be recorded by an app. This data will represent the daily routines of older adults. To accomplish this research, I developed an iOS app to receive information from the sensors and produce sensor data in a specific JSON format. I also created a python script to parse the JSON file and compute time calculations. The JSON file will later be merged with smart home data for further analyses. Pilot testing of the sensors and app will be conducted in several homes. Six participants will use time-logs to track each time they use 10 to 20 items in their homes for one week. Each of these items will have an attached Estimote sensor. This will allow comparison between the sensor data and the time-logs to ensure the sensors data is reliable and accurate. Other factors that might affect the sensor data will also be evaluated, including sensor range, wifi and Bluetooth settings on the iPads, and sensor battery level. This app and software could improve further research by providing a cost effective solution to non-obtrusively gathering real-time data about important activities of older adults (e.g., medications).

Poster: 68	Assessing the Effects of Cognitive Decline on Planning Performance and Task Execution	Poster: 68

Undergraduate Researcher: Julia Ulziisaikhan

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Katelyn Brown and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: Pullman High School, Psychology, Freshman

Abstract:

Planning is an essential, yet complex skill needed for everyday life. Planning requires prioritization and organization, and if done well, can lead to efficient completion of everyday activities. As people age or begin to experience cognitive decline, change in planning abilities may emerge. The objective of this study is to investigate what aspects of a created plan can predict efficient execution of a naturalistic task, called the Day Out Task (DOT). Participants included healthy older adults (HOA), young adults (YA), and adults with mild cognitive impairment (MCI). Participants prioritized, organized and executed a series of eight subtasks to prepare for a day out (e.g., collect ingredients for recipe, gather change for bus ride, etc.). Prior to completing the DOT, participants were given 5 minutes to develop a written plan that would lead to accurate and efficient completion of the task. The developed plans were coded using a comprehensive coding scheme that measured: items and locations mentioned, repetitions and links, extraneous units, amendments to the plan, indications of time, and interactions among plan components. The coded planned items will be compared across groups, as well as used to predict DOT accuracy and efficiency scores. Understanding what aspects of plans lead to efficient task completion will give insight into effective planning strategies that can be used to help those with cognitive difficulties function with greater independence day-to-day.

Poster: 69	Influence of Genetic Variants in Cognitive Disorders	Poster: 69

Undergraduate Researcher: Manninkattil Sridevi Unni

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Robert P Fellows, Bruce Robert Wright, and Maureen Schmitter-Edgecombe

Home Institution, Major, Class Standing: University of Idaho, Non-degree: Neuropsychology, Senior

Abstract:

Dementia is a major cause of disability and dependence among elderly adults, and formulating effective treatment is a major challenge confronted in the medical science. Recent research studies suggest that predisposition to cognitive deficits involve interaction between an individual's unique genetic variation and the environment. This study focusses on the identification of single nucleotide polymorphism (SNP) variants present in genes that are associated with dementia. We isolated genomic DNA from healthy elderly adults (n = 32) and sequenced the data to identify relevant variants. Participants also completed neuropsychological tests that assessed memory and other cognitive constructs in the laboratory. In addition, blood pressure was taken and a physiological and metabolic panel was completed on blood work to measure C-reactive protein, triglycerides, High density lipoprotein (HDL) and Low density lipoprotein (LDL) cholesterol, and fasting glucose. The objective of this pilot work is to examine for associations between the genetic variants, cognition, and clinical biomarkers of health. Preliminary analysis revealed few associations, which may be due to small sample size. Future work to increase the study sample size is planned. Early detection of risk factors for cognitive impairment could delay or slow down disease progression thereby increasing quality of life and decreasing costs associated with dementia care.

Poster: 70	Optimization of Robotic Arm and Autonomous Mapping in Assistive Robotics	Poster: 70

Undergraduate Researcher: Lucia Ward

Faculty Advisor: Diane Cook and Maureen Schmitter-Edgecombe

Co-authors: Diane Cook, Matthew Taylor, Sepehr Nesaei, Sean Kallaher, and Gabriel de la Cruz

Home Institution, Major, Class Standing: University of Wyoming, Statistics and Mathematics, Freshman

Abstract:

Existing Smart Home technologies have become very accurate in identifying activities of daily living and detecting declines in independent functionality, but can do little to intervene when a resident has forgotten to complete a task or needs assistance. Robotic Activity Support (RAS) is a robot that will work within the Smart Home system by approaching residents when an activity has not been completed. The robot will issue a reminder and have options to assist the resident, including retrieval of necessary objects, leading the resident to objects, or providing a video of how to complete the activity. There are several components of RAS that are being developed, including activity recognition, robot mapping and localization, and recognition of everyday objects. The focus of this project is testing optimization of the robotic arm and the autonomous mapping software. This is valuable in determining the limits of the role that the robotic assistant can play in home settings. Preliminary experimentation indicates the need for a more advanced robotic arm system, as the servo motors return overload errors when no load is present and the size of the arm limits its practical abilities. However, reducing the maximum top speed and being conscious of more stable positioning makes the arm more functional. Other experimentation investigates the accuracy of the visualization and navigation systems to determine limits of stability and the accuracy of the maps that the system generates. The robot needs to be able to locate objects within its environment, so accuracy in position reporting is essential. This research provides a framework for continued testing of alternative robots that will provide physical assistance as part of the ongoing RAS project.

Group 10: Other WSU Projects

Poster: 71	**Defining the Roles of RBP-208 and a Decapping Enzyme (DCPI) in Stress Granule Formation, P-body Interaction, and RNA Localization**	Poster: 71

Undergraduate Researcher: Johanna Bautista

Faculty Advisor: Thomas Okita

Co-authors: Hong-Li Chou and Thomas Okita

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

Abstract:

Transport and localization of RNAs are important processes carried out by RNA-binding proteins (RBPs). Through the formation of dynamic ribonucleoprotein (RNP) complexes, RNA is transported from the nucleus to cytoplasm and localized to specific ER locations. This process is best exemplified by the RNAs that code for the two major classes of rice seed storage proteins; prolamine mRNAs are transported to the PB-ER that bound PB-I (composed of prolamine intracisternal granules), while glutelin mRNAs are transported to adjacent interconnecting cisternal-ER. Stress granule formation in the cytoplasm can affect the localization of mRNA and can lead to degradation of mRNA through the interaction of stress granules with P-bodies, whose mRNAs are targeted for decapping and degradation. Here, we initiated studies to define the roles of an RBP-208 and a decapping enzyme (DCPI) in stress granule formation and P-body interaction. Two T-DNA binary vectors designed to express RBP-208 and Rice DCPI fused to mGFP were constructed and used to transfect rice calli for in vivo studies. Overall, these efforts will accelerate our understanding of how storage protein mRNA's movement to specific cellular locations in rice endosperm tissue is affected by stress granule formation.

Poster: 72	Validation of RBP-Z Protein–Protein Interactions via Yeast Two-hybrid Assay and BiFC	Poster: 72

Undergraduate Researcher: Christopher Castillo

Faculty Advisor: Thomas Okita

Co-authors: Lianing Zhang, Li Tian, and Thomas W. Okita

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

Abstract:

RNA localization mechanisms have been observed to play important cellular functions, such as controlling gene expression or RNA processing, in nearly all organisms. In rice, Oryza sativa L., RNA localization governs where glutelin and prolamine, the two major storage proteins, will be synthesized on the cortical endoplasmic reticulum membrane complex located at the cell's periphery. Specifically, prolamine RNAs are directed to the protein body-ER (PB-ER) that bound the prolamine intracisternal granules while glutelin RNAs are localized to adjoining cisternal ER. Previously, our lab conducted an affinity chromatography study using prolamine cis-localization RNA sequences as a bait and identified unique RNA binding proteins that bound to the matrix. By generating antibodies to these proteins, subsequent studies using immunoprecipitation coupled with LC-tandem mass spectrometry (IP-MS) were employed to identify protein complexes hypothesized to be involved in the RNA localization of glutelin and prolamine in developing rice seed. My project is focused on the validation of protein-protein interactions identified by IP-MS between RNA Binding Protein Z (RBP-Z), KH domain containing protein (KH1), and two C-x8-C-x5-C-x3-H type zinc finger family proteins, zinc finger 2 (ZF2) and zinc finger 3 (ZF3). The two methods used to validate protein-protein interactions are bimolecular fluorescence complementation (BiFC) and yeast two-hybrid assay (Y2H). With a better understanding of the protein complexes involved in rice seed protein RNA localization, further insight will be gained on the role of RNA localization plays in translation, processing and storage of RNAs.

Poster: 73	Rates of Vibrational Energy Transfer of Gas-Phase Ions Following Photon Absorption	Poster: 73

Undergraduate Researcher: Isaac Davies

Faculty Advisor: Brian Clowers

Co-authors: Kelsey Morrison, Theodore A. Corcovilos, and Brian H. Clowers

Home Institution, Major, Class Standing: Duquesne University, Physics, Senior

Abstract:

Ion mobility spectrometry (IMS) is a process used to discern the structure of gas-phase ions by leveraging the subtle interactions between gas-phase ions and neutrals. Under the influence of a weak electric field, the relative energies between ions and neutrals directly impacts the speed of ions move. As an ion travels in a drift cell, it repeatedly collides with the neutral gas and ultimately alters an ion's effective temperature to the level of the neutral bath gas temperature. However, the rate at which the relaxation process occurs has affects the speed of the ion and is fundamental energy distribution. By accurately measuring shifts in ion velocity as a function of changes in ion effective temperature a wealth of fundamental and physical properties may be deduced. Using an innovative electrode design, which minimizes radial ion distributions and optical irradiation of a gas-phase ion cloud, we aim to establish the foundations of a new analytical measurement technique. In contrast to most IMS systems currently in operation, the apparatus developed at WSU uses a set of electrodes that drastically limits the effects of radial diffusion. This design confines ions within a 2 mm radius which directly enables optical spectroscopy. When an ion absorbs a photon, its internal energy changes which directly impacts its observed velocity, or drift time, in an IMS cell. The degree of any shift will tell us more about the nature of the molecule and help distinguish it from other background signals. However, the magnitude of the effect is unknown. For this reason we need more detailed models to describe the complex interaction between ions, photons, and neutrals. My model shows the shift in drift time across multiple effective ion temperatures and photon energies. The magnitude and direction of this shift will reveal information about the structure of the ion.

Poster: 74	Expression of Pho1 and Pho1 Mutant Gene	Poster: 74

Undergraduate Researcher: Saul De La Pena

Faculty Advisor: Thomas Okita

Co-authors: Koper Kaan and Thomas W. Okita

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

Abstract:

To study the interactions of the proteins HaloPho1, HaloL80 and HaloGFP, that are extracted from kitake rice. Pho1 plays an important role to initiate the starch synthesis and the maturation of starch granule in developing rice seeds. L80 is the domain of Pho1. The protein of interest (Pho1, L80) are cloned to then study the interactions of the proteins using HaloGFP as a control. We amplify these proteins to break them down into smaller chains to increase the amount of abnormal proteins to cause conversions. The Halotag protein binds to the protein of interest by covalent immobilization. Thus enhancing the expression of soluble recombinant proteins in *E. coli*. Purifying the Halotag proteins results in a high yield and purity of the proteins of interest. As the expected size is shown and strong band is shown in the SDS gel resulting in a high yield of proteins. After purifying the proteins, a protein pulldown assay is done to show interactions between the proteins of interest in a silver stain gel. The GFP protein has the weakest signals in the silver stain gel.

Poster: 75	# Omecamtiv Mecarbil Reduces Cardiac Myosin Cross-bridge Detachment Rate, while Maintaining Cross-bridge Attachment Rate at Physiological Temperature	Poster: 75

Undergraduate Researcher: Thinh Kieu

Faculty Advisor: Bertrand Tanner

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

Home Institution, Major, Class Standing: Washington State University, Pullman WA. 99164, Biochemistry/ Biophysics, Senior

Abstract:

Heart failure is a life-threatening condition that occurs when the heart muscle becomes weakened, thus, inadequately circulates blood and oxygen around the body. In the United States, approximately 5.7 million adults have the disease. Recent developments in treatment for heart failure include the drug Omecamtiv mecarbil (OM), a small molecule, cardiac myosin activator. The target of this drug was found to be the actin-myosin cross-bridge, which transforms chemical energy from ATP hydrolysis into mechanical energy to provide the force and shortening that pump blood throughout the body. OM was found to increase force production in cardiac muscle fibers at drug concentrations of 0.1 and 1M. However, the detailed mechanisms for how this drug influences contractility is only partly defined. Our work set out to measure OM's calcium-dependent effect on the cross-bridge kinetics of Sprague-Dawley rat skinned papillary muscle strips at physiological temperature (37C). More specifically, we hypothesized that OM increases force production by prolonging myosin cross-bridge attachment time, due to decreased cross-bridge detachment rate. Our preliminary data showed that myosin cross-bridge detachment rate was slowed by increasing OM concentrations at submaximal and maximal Ca^{2+}-activation. Meanwhile, cross-bridge attachment rate did not change at either level of Ca^{2+}-activation. Ongoing experiments will further solidify these findings, and help inform how OM effects cross-bridge activity to modulate contraction in the heart.

Poster: 76	Reconfiguration of Cobalt Catalysts by Subcarbonyl Rupturing and Diffusion	Poster: 76

Undergraduate Researcher: Trevor Wood

Faculty Advisor: Jean-Sabin McEwen

Co-authors: Greg Collinge and Jean-Sabin McEwen

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

Abstract:

As our society becomes more environmentally conscious, the need for clean renewable energy increases. To accomplish this, carbon neutral processes need to be developed and adopted. Derived from various plant and animal wastes, biomass is an attractive source of carbon for clean renewable energy because it can be converted to carbon monoxide (CO) and hydrogen (H_2). CO and H_2 can then be used in Fischer-Tropsch (FT) synthesis to form synthetic petroleum or other valuable chemicals that are traditionally produced from crude oil. However, FT synthesis is only accomplished with the help of a catalyst: typically a transition metal, such as cobalt (Co). To optimize these catalysts one needs to place them under realistic reaction conditions to arrive at a predictive model.

It has been shown that the metal surface of a catalyst can reconfigure during a reaction. Metal carbonyls have been proposed to be partly responsible for these reconfiguration. Although, it is not fully known how these changes occur on a molecular level, and they are difficult to track experimentally. To investigate the possibility of metal carbonyl formation, we have built a computational model of a cobalt catalyst and then simulated the adsorption of CO molecules onto the cobalt surface. This was done to see if a rearrangement of the surface is thermodynamically favorable and, if so, to describe a mechanism for surface reconfiguration that can be targeted experimentally. Specifically, this was accomplished by calculating the binding energy and the Gibbs free energy of many CO configurations over a large range of CO coverages adsorbed onto the model cobalt surface seeing if the most favorable structure would undergo surface reconfiguration. With this knowledge, more control can be wielded over real world processes such as FT, which will ultimately lead toward the better utilization of biomass as a renewable energy source.

Development of a Straight-forward Bioinformatics Pipeline to Pinpoint Unknown Secondary Insertion Sites in Plant T-DNA Mutagenesis Lines

Undergraduate Researchers: Chance Lewis and Chase Lewis

Faculty Advisor: Hans-Henning Kunz

Co-authors: Chance Lewis, Andrew Lefors, and Hans-Henning Kunz

Home Institution, Major, Class Standing: WSU School of Biological Sciences, Biology, Sophomore

Abstract:

T-DNA mutagenesis is a common tool in plant science to study loss-of-function and gain-of-function effects in plant genomes. However, 10 to 20 years ago when most germplasm collections were made publicly available, sequencing costs were high and sample preparations were laborious, so flanking regions of T-DNA insertions could only be annotated using Tail-PCRs on the left border.

Unfortunately, this has led to many unknown insertion sites in mutants which can result in dangerous misinterpretation of mutant phenotypes especially when only one T-DNA line is available for a genetic locus. Since consumable and reagent costs are crumbling more and more, scientists are gradually incorporating sequencing technology into their scientific routine. This has resulted in a plethora of publicly available genome-resequencing and RNA-SEQ data sets. However, poor documentation makes it challenging for undergraduate and graduate students to really mine these datasets. Often times, troubleshooting is cumbersome and only works as a community effort involving assistance from online forums.

Therefore, we developed a straight-forward bioinformatics pipeline using already existing tools to identify T-DNA insertions in genomic DNA or RNA-SEQ data sets from plant mutants. We were able to show that our method is reliable and cost-effective. We provide a detailed documentation for our method to guide current and future plant science students through the process and allow them to learn the most about their mutants. This will strongly prevent misinterpretation of mutant phenotypes in the future.

Group 11: Landscape Ecology and Ecosystem Dynamics in the Colombia River Basin: Integrating Terrestrial and Aquatic Perspectives

Poster: 77	**Landscape Ecology and Ecosystem Dynamics of the Columbia River Basin REU Program at WSU Vancouver**	**Poster: 77**

Principal Investigators: Gretchen Rollwagen-Bollens and Stephen Bollens

Undergraduate Researchers, **Home Institution**: Victoria Avalos, University of Portland; Chris Allen, WSU Vancouver; Summer Henriksen, University of Portland; Terryn Mitchell, WSU Vancouver; Bridget Ovall, Clark College; Zachary Robbins, Portland State University; Elinor Wilson, University of Portland; John Zalusky, Portland State University

Abstract:

Landscape ecology and ecosystem dynamics have often been approached differently in terrestrial vs. aquatic systems, especially with respect to the relative importance of biotic vs. abiotic drivers. Faculty research in the School of the Environment at WSU spans both aquatic and terrestrial habitats, and includes investigations to understand fundamental science questions, as well as addresses applied, natural resource issues (water, agriculture, fisheries, wildlife, climate change) that are currently pressing public policy and management challenges. Our REU project embraces the differences and similarities between terrestrial and aquatic ecosystems as a model for teaching and understanding landscape ecology and ecosystem dynamics. During Summer 2017, REU students in Vancouver are investigating questions ranging from the ecological effects of urban heat islands in Portland, OR, to how to model the impacts of wind farms on eagles, to how habitat quality influences the distribution and abundance of an invasive clam in the Columbia River.

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