



SOURCE

SYMPOSIUM OF UNIVERSITY RESEARCH & CREATIVE EXPRESSION

2020

www.cwu.edu/undergrad-research

DES MOINES | ELLENSBURG
MAY 12 | MAY 13 & 14



Sponsored by the Office of Undergraduate Research.
CWU is an EEO/AA/Title IX Institution. For accommodation email: DS@cwu.edu.

Central Washington University Presents

SOURCE 2020

*Symposium of University Research and
Creative Expression*

Program and Proceedings

25th Annual Conference

**Online in Partnership with the Student Opportunity Center
May 18th-24th, 2020**



Sponsored By

CWU Foundation
Student and Activities Fees
School of Graduate Studies and Research
Office of the President
Office of the Provost
Office of the Associate Provosts
James E. Brooks Library
Student Success
The Wildcat Shop
Wildcat Printing
Enrollment Management
CWU Catering

Table of Contents

College of Arts and Humanities	5-18
Art	5
Communication	6-11
English	9-11
Film and Video Studies	12-13
History	14-17
Philosophy and Religious Studies	17-18
Theatre Arts	18
College of Education and Professional Studies	19-43
Accessibility Studies	19-20
Education	20-22
Engineering, Technologies, Safety & Construction	22-39
Family & Consumer Sciences	40-41
Health Sciences	42-43
College of Business	44-45
Business	44
Economics	44
Finance & Supply Chain Management	45
College of the Sciences	46-101
Anthropology & Museum Studies	46-49
Biological Sciences	49-59
Chemistry	60-64
Computer Science	64-69
Environmental Studies	70
Geography	70-72
Geological Sciences	72
Law and Justice	73-79
Mathematics	79-80
Physics	81-90
Political Science	89-90
Primate Behavior and Ecology	90-91
Psychology	91-97
Science Education	98-99
Sociology	100-101
Mentor and Scholar of the Year Nominees	102
Acknowledgements	103

Presentations

College of Arts and Humanities

Art - Constructed Object and Poster Presentations

Forget Me Not - *Kenna Alson, Faculty Mentor: Stephen Robison*

Constructed Work

This project was done through the C. Farrell Fine Arts and Research Scholarship. Each ceramic vessel explores the idea of home and family through botanical imagery. The project combines the two through the idea of foundations, a foundation becomes a starting place. The home itself, the relationships, the experiences, everything that happened there is significant to who this person is. It is similar for plants, their roots are the foundation for all that they are or could be. Each ceramic piece has a plant on it to represent a specific trait, all of these come together to create the family. The serving dishes and pouring vessels are more universal, those plants represent something that is essential to the family as a whole. The materials used in this project also have a connection to nature, clay is a mix of finely-grained rocks and other organic material. This clay was picked for its darker color to resemble soil. The plants were carved into each piece to add texture. This project focused on family relationships and our connection to earth.

(Pneuma) Revealed: A C. Farrell Fine Arts and Research Project - *Laura Mentele.*

Faculty Mentor: Rachel Kirk

Poster Presentation

I often see a disconnect between who we believe a person to be and who they truly are. My work is influenced by this idea. It is an exploration of how humans projected 'identity' and a visual representation of the hidden emotions or things we are unable or unwilling to see in others. With this project I created a body of work that speaks about inner pain. Rather than hiding it, I revealed these hidden emotions. As a reflection of my myself and my own gender, I approached this concept by using all female figures for references.

I made deliberate formal choices focusing on composition, additive and reductive painting techniques along with added hints of text in order to convey emotional implications. I additionally focused on human connection as it pertains to the eyes. Eyes are important facets of how humans relate to others and are firmly rooted to ideas surrounding expression of emotion and identity. In western culture, eye contact is associated honesty and confidence, which acts in dichotomy to my ideas of hiding and revelation.

As such, I have affected the eyes of my figures through application of paint or obscured them through formal and compositional decisions, thereby changing how the viewer relates to the piece. The resulting body of work consists of seven paintings and three drawings of women. All images speak towards ideas of pain, identity, vulnerably and, for some, the strength of one's self during an ordeal. While creating my work I meditated on the fact that people are often unseen and/or misinterpreted. It is my goal that my body of work generates a conversation on how we hide this pain and how the person before us could be experiencing something we do not realize.

Communications - Oral Presentations

Strategic Impact Analysis on the Future of Planned Parenthood - Amy Morris, Riley Kizziar, Faculty Mentor: Jamie Gilbert

Planned Parenthood is an organization that focuses on delivering vital reproductive health care, sex education, and information to millions of people worldwide. The organization offers a variety of different services that focus on sexual health, but due to some of the controversial issues that surround their services, they tend to go unnoticed. Planned Parenthood also offers general health checkups for women and men, and provide resources for individuals in the LGBT community, such as information about sexual orientation, coming out, gender identify, asexuality, and hormone therapy for transgender patients. The organization has a large impact on the communities that it serves, especially in lower socioeconomic communities. However, due to the controversy surrounding Planned Parenthood, some have a negative view of the organization and those views can lead to major cuts in funding, as have been demonstrated these past few years. For this project, we conducted a Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis of the organization and determined how each of those areas impact the future of Planned Parenthood.

CWU SWAP (Students With A Purpose) SWOT and Funding Analysis for Long Term Sustainability -

Laurel Portner, Rachel Retchless, and Phoebe Ching Ting Lai, Faculty Mentor: Jamie Gilbert

CWU Students With A Purpose (SWAP) is a student lead club created with the intention of providing an outlet for meeting students with a strong passion for non-profit and social entrepreneurship work, making a difference, and collaborating with like-minded individuals by engaging in non-profit/social entrepreneurship related activities. The club has attracted members from disciplines across colleges on both the Ellensburg campus and in the CWU online programs, and while they have had a successful first year in terms of the opportunities and events they have provided their members, there is room for growth. For this project, we conducted a Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis of the student club and the opportunities they have offered this far. Through this analysis, we identified where an increase of funds, via a potential grant, could benefit and enrich future opportunities and events that the club could offer for their current membership, future students, and community members. A projected budget was developed for each of these opportunities to demonstrate how potential funds could be utilized.

Applying the PESO Model: Public Relation Strategic Content Marketing and Branding for Local Washington Restaurant - Rachel Retchless, Michaela Phillips, and Rawlings Braman, Faculty Mentor: Jamie Gilbert

Recent research from the Content Marketing Institute found the top two factors in increasing content marketing effectiveness are (1) doing a better job with content creation (85%) and (2) developing or adjusting their content marketing strategy (72%). Without a documented content strategy, organizations are left creating random pieces of one-off content that may or may not support their organization's Public Relations (PR) goals and objectives. The presentation focuses on our PR research and developed strategies targeted to utilize the PESO Model (Paid, Earned, Shared, and Owned Media Content) to help a local community restaurant, the Red Arrow Drive-In, increase their branding recognition. The Red Arrow Drive-In is a burger restaurant located in Cle Elum, Washington. The restaurant was originally named McKean's and was built by their family in 1953. The restaurant had been a staple in the community for decades until it was sold in the late 1990's. Under the new ownership, the restaurant developed a less than stellar reputation. When the Sill family recently purchased the restaurant, they felt the organization needed to be rebranded to rebuild the restaurant's image, and therefore, renamed the restaurant the Red Arrow Drive-In. They remodeled the restaurant improving both the building's interior and exterior along with adding various menu items while keeping the popular choices. The presentation includes an analysis of the Red Arrow Drive-In's advertising content, marketing potential, and developed PESO strategies showcasing our proposed multifaceted campaign, "Where do you Burger – Bringing Classic Burgers to Travelers", utilizing the overlapping PESO tactics.

4-H (Head, Heart, Hands and Health): Reaching Urban Youth Through Sustainable, Inclusive Youth Network Development Programs

April Sheeley, Meredith Carr, and Teena Chase, Faculty Mentor: Jamie Gilbert

As the nation's largest, youth non-profit organization, 4-H (Head, Heart, Hands, and Health) has been an integral part of the United States farming community for over 100 years. 4-H was created to bring advances in agricultural technology to community farmers through mentoring youth in applying new ideas so they could learn more about the industries in their community. The organization's 21st century goals include reaching out to all youth: rural, urban, and suburban in every state in the nation. The presentation focuses on the need for 4-H to improve upon their key weaknesses which were identified through an in-depth Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis of the 4-H organization. Almost six million 4-H youth members have addressed issues, such as community health inequities, civil discourse, and equity and inclusion for all. Yet, the analysis demonstrated that 4-H is still struggling to reach urban youth. The analysis further showcases that by missing out on these 4-H opportunities, the urban youth are also missing out on critical programs that aid in increasing their confidence levels, leadership abilities, and critical thinking skills through hands-on learning programs. Independence in agriculture and hydroponics, bio-fuels, waste management, and fibers for clothing are just some examples that the extension programs can teach in urban communities. The presentation will demonstrate how beneficial youth networks can be formed and funded to meet these 21st century sustainable organizational needs.

Contemporary European Animation - *Skyler Smith, Faculty Mentor: Jamie Gilbert*

Animated film in Europe makes up a small percentage of the world's global film market, but its impact is indisputable. Although contemporary European animated films do not always meet with monetary success or wide recognition like the Pixar and Disney films of America, they can often meet with critical success. This is despite overall smaller budgets and a distinct lack of animation infrastructure within the European Union. The European animated film industry constantly adapts to changes in the global market by experimenting with subject matter and visuals and makes up for the lack infrastructure by working in close collaboration with countries and industries both inside and outside the European Union. There is a huge amount of potential in the future of contemporary European animated cinema and it is important to pay attention as this small niche of the cinematic world grows.

The Impact of a Team Development Intervention (TDI) on an Interdisciplinary Student Leadership Team - *Leana St. Claire, Spencer Clifton, Sean Tamngin, Laurel Portner, Rachel Retchless, Jaidyn Alemazkour, Dylan Gilbert, Jackson Sorensen, Ali Hunt, Amy Morris, Lili Stevens, and Alex Repass, Faculty Mentor: Jamie Gilbert*

In the workforce and the classroom, one of the fastest growing trends is teamwork. The importance of teamwork and collaboration is currently taking over the workplace, and managers have indicated that the amount of time spent on team related tasks has increased by 50%. This demand is not isolated to one field, but spans across varying fields and disciplines. To be better prepared for future careers, it is important that students have sufficient interpersonal and team based competencies. The purpose of this interdisciplinary research project is to determine if a Team Development Intervention (TDI) can positively impact the communication and productivity of an interdisciplinary student leadership team. For the methodology, a team building intervention focused on four main components: interpersonal communication management, problem solving, role clarification/flexibility, and goal setting/achievement will be implemented with an interdisciplinary student leadership team consisting of fourteen students from multiple disciplines spanning four colleges at Central Washington University (Arts & Humanities, Business, Sciences, and Education and Professional Studies). The students will complete reflections focusing on each of the four components before, during, and after the team building intervention has been implemented. The impact and results of this intervention/reflection process on the interdisciplinary student leadership team and future implications will be discussed during the presentation.

English - Oral Presentations

Queer Theoretical Efficiencies, Inadequacies, and Context Applied to a Mainstream Film - *Sara Albin (Women's, Gender & Sexuality Studies), Kayla Haggard, and Vanessa Arostegui, Faculty Mentor: Michelle O'Brien*

This panel will apply theories about queer sexuality and gender identity with a focus on women's sexuality and gender expression while applying a theoretical perspective to a specific thematic text. We will do this by having a three-part perspective, where one advocates for the theory's application, another points out its shortcoming, and one mediates the conversation between the two. This panel will delve into queer theoretical framework needed to critically evaluate the merit of queer theories and recognize the impact these theories have had on gay activism and queer futurism. Analyzing a mainstream movie, this panel will examine how this film frames female sexuality and gender for a heterosexual audience. The panel will also focus on the ways that different queer theories can influence either the acceptance or rejection of queer individuals when interacting with real-world restrictions, and the statement films and literary texts make through their portrayal of queer women within society. The proposed panel would offer students the opportunity to apply critical theory to mainstream texts with a specific focus on queer sexuality and gender identity among women.

From Clarissa to Mrs. Dalloway: The Longing for Independence - *Allie Caughie, Faculty Mentor: Christopher Schedler*

This paper investigates the hidden homosexual desires and traditional gender role expectations of Clarissa Dalloway in the novel *Mrs. Dalloway* by Virginia Woolf. Drawing on literary criticism and feminist theory that discuss female gender roles and sexuality, I analyze Clarissa's repressed desire, and ultimate failure, to pursue a life independent from her husband, Richard. Throughout the novel, Woolf suggests that Clarissa longs to express her homosexual desires but hides her individual identity to fit in with the gender expectations of her peers and the rest of society. It becomes evident that, regardless of being a perfect housekeeper and fulfilling her duties as a woman in the early 20th-century, she fails to fulfill her individual desires. As Mrs. Dalloway, she is an exemplary hostess, wife and mother, but other than these roles, she has no other purpose in life and finds herself depressed and wishing for more. Early in her life, Clarissa's interactions with Sally Seton introduced her to the passion of homosexual desire, but also suggested how to break through the barriers of society and live an independent life outside of marriage. Likewise, with her friend Peter Walsh, Clarissa is passionate and driven, her thoughts and opinions are important to her, and she is not afraid to speak her mind. Ultimately, despite Clarissa's need to explore her repressed homosexual desires and independence, the traditional gender role expectations of Mrs. Dalloway prohibit her from pursuing her life as an individual.

Public Persona vs. Private Identity in Hemingway's *The Sun Also Rises* - Haley Cottingham, Faculty Mentor: Christopher Schedler

This paper investigates how gender and sexuality are socially constructed, and therefore how these two facets of individual identity largely rely on the perception of others. Examining Ernest Hemingway's novel *The Sun Also Rises* through a queer studies lens provides insight into how three main characters (Jake, Brett, and Romero) embody a variety of gender expressions and sexualities. Since the time period of the novel was one of more rigid social standards, the lack of acceptance for seeing gender and sexuality on a spectrum, rather than in binary terms, led to the characters altering their personas to fit into socially accepted roles. However, in private settings, they uphold an identity that is truer to their sense of self. The protagonist, Jake Barnes, has surface-level relationships to conceal both his deeply rooted insecurities about being emasculated from a war injury and his repressed homosexual desires. Brett emphasizes her public masculine performance and promiscuous sexual activity while uncovering a private emotional side. Romero embodies traditional masculine gender norms, yet he proves to be very insecure in his masculinity as he attempts to feminize Brett. Ultimately, the characters choose to display the gender traits and sexual behaviors they believe will give them more social power. The movement to dismantle traditional gender roles and social norms of sexuality was just beginning to emerge during the 1920s. In the novel, these deeply rooted social norms cause inner conflict between the characters' public persona and private identity that is kept hidden.

Tracing The Influence of Eastern Philosophy on Western Modernism In Virginia Woolf's *Mrs. Dalloway* - Sawyer Henry, Faculty Mentor: Christopher Schedler

The modernist period ushered forth numerous scientific discoveries and philosophical theories that had a notable influence on art, literature, psychology, and philosophy. Discoveries such as Einstein's General Theory of Relativity and Darwin's Theory of Evolution inspired theologians, philosophers, and psychologists to focalize new concepts of self, identity, time, reality, and human experience. These shifts in contemporary human understanding happened in concurrence with increased global travel and intellectual exchange between Western and Eastern countries. As a result, writers, philosophers, and artists became more interested in Buddhism, Hinduism, and other Eastern philosophical beliefs. Virginia Woolf, while being a self-proclaimed atheist, was deeply influenced by Eastern religious philosophy and well versed in contemporary scientific theories. Drawing on literary and biographical criticism on Virginia Woolf, I trace the intersections of Eastern philosophical beliefs and Western scientific discoveries through the stream of consciousness narration of *Mrs. Dalloway* by analyzing both what and how things are experienced by individual characters. In the novel, the integration of each character's stream of consciousness fabricates a dissonant medium in which singular moments in the present time are experienced through the minds of multiple characters, while they simultaneously navigate past spans of time within their individual narrative consciousness. Through the analysis of narrative form and narrative consciousness in Virginia Woolf's *Mrs. Dalloway*, it is possible to track the impact of distinct Eastern philosophies that were being merged with Western scientific theories in Britain's academic and artistic communities during the early 1900s.

The Vulnerability of the Night Stalker - Anthony Krueger (William O. Douglas Honors College), Faculty Mentor: Tamara Caulkins

In some parts of Madagascar, particularly the Marolambo district, there's fables and myths regarding a mysterious creature that lurks through forests at night, seeking small, unguarded children that it may devour. It's been told that this Night Crawler, if caught and eaten, will pass on horrendous attributes to the one who consumed him. These attributes include constant greediness and fierce aggression. Of course, this malicious entity is no entity at all, but rather a misunderstood animal that has developed a web of legends and fables revolving around its mysteriousness. This animal is the *Cryptoprocta Ferox*, or commonly known as the fossa. Fossas are a fascinating animal with unique histories in subjects such as mythology and taxonomy. However, the fossa's population levels have drifted into a vulnerable state given the dangerous factors that come with being native to the Madagascar rainforests, such as deforestation, harmful human involvement, and intense natural disasters. Animal conservation in terms of saving the fossas may come in several forms, such as more research on the species, a hunting ban, or maybe a method a bit more drastic such as species reintroduction. Saving the fossas is key in sustaining the biodiversity levels in Madagascar. Biodiversity is necessary for an ecosystem to be resilient, elastic, and to maintain its ecological function. Without proper biodiversity, specifically when speaking of the fossa population, the entire food chain may be thrown off its delicate balance, thus affecting ecosystem dynamics. For example, the declining state of the fossa may result in overgrazing by some of its prey species which can create a whole different set of problems for Madagascar, a country already in very poor conditions.

English - Poster Presentations

The correlation between the morals communicated in the Latin-American legend “La Llorona” and modern Chicano values. - Mariana Gonzalez, Faculty Mentor: Barry Shelton

This presentation analyzes the classic Latin-American legend “La Llorona” translated as “The Weeping Woman”. Before the tale of “La Llorona” became a popular theme in Hollywood and the media, it was a simple story passed from generation to generation. This tale primarily told to Chicano children by their parents as a scare tactic to keep children obedient, may promote values that are still important to the Chicano community today. A close look at this centuries-old legend has revealed a possible correlation between the morals communicated in the Latin-American legend “La Llorona” and modern Chicano values. This may be suggestive of how influential this specific legend is and allude to the effect such folk tales have on their listeners. This analysis will aid in interpreting the impact such stories may have on their audience. Examination of published retellings of this Latin-American tale and research on Chicano culture were crucial in achieving a satisfactory response.

Film and Video Studies - Oral Presentations

Escaping Suburbia-A Study in Film Auteur - Morgan Bedard, Faculty Mentor: Melissa Johnson and Maria Sanders

At SOURCE I will be presenting a study on the “Film Auteur” theory with regards to the filmmakers Tim Burton and The Coen Brothers. My presentation will use Powerpoint to show visuals from these filmmaker’s films that will help to explain how “auteur theory” works. Auteur theory refers to the filmmaker as the “author” of the film; meaning that they hold ultimate creative control and leave a lasting signature that is unique to their work. An example of an auteur trope is Tim Burton’s use of exaggerated body parts such as large eyes and long limbs that harken back to his influence from German Expressionism. I will be comparing the styles of these two authors with regards to their similar background of wishing to “escape suburbia” and enter a world of imagination and wonder.

Sound and the Slasher Film - Scott Lien, Lennon Sullivan, and Parker Thompson, Faculty Mentor: Melissa Johnson

The Slasher subgenre in film is synonymous with masked killers, their weapons, transgressing victims, brutal deaths, secluded or isolating locations, and a final girl left to fend for herself. While Slasher movies might bring to mind the iconic apparel of the killers, or their weapons, just as important as what’s seen on screen is the sound that accompanies the images. Sound is a key element that contributes to the world of the story, the tone of the film, and the events that unfold on screen; the presence of a musical cue, or the absence of one, can dictate what’s next in the story. This video essay focuses on two films, Bob Clark’s *Black Christmas* (1974), and Tom McLoughlin’s *Friday the 13th Part VI: Jason Lives* (1986). These films exemplify how sound can be used within the Slasher subgenre, but to different effects. *Black Christmas* takes a more grounded and ominous approach to produce its scares, emphasizing diegetic sounds and an ambient/minimalistic use of music, and no music, to create a sense of dread. *Jason Lives* dumbs down the serious tone of previously made Slasher films, taking a lighter approach. The use of musical cues, an 80’s soundtrack, and a dramatic score, accompanies the interactions characters have with the invincible killing machine named Jason. While the kills are still brutal, *Jason Lives* is a film that is self-aware of the Slasher subgenre’s tropes and cliches, helping aid the film’s plot points by leaving a comical touch to the madness.

German Expressionism: Nosferatu vs Nosferatu the Vampyre - Scott Lien, Faculty

Mentor: Todd Maetani

German Expressionism was a crucial movement in film history, and its influence can be seen all throughout cinema today. In 1922, F.W. Murnau produced one of the most influential films of the German Expressionist movement, "Nosferatu". German Expressionism gave birth to a dark and moody aesthetic in which "Nosferatu" has popularized. Deep shadows, silhouette lighting, and exaggerated sets/costumes are just some of the visionary choices that were utilized to personify the mental states of the film's protagonists, and reflect the anxieties of society within the story world, and in real life at the time. New German Cinema, a German film movement spanning from the early 60's through the 80's, sought to ignore and move past the works of previous filmmakers and movements due to generational tensions, and a declining German film industry in the 50's. Among the filmmakers of this period was Werner Herzog, who instead of ignoring his country's cinematic grandfathers, decided to pay tribute to them. Herzog's tribute came in the form of a re-imagined take on Murnau's Nosferatu named "Nosferatu the Vampyre" (1979). By comparing both Murnau's and Herzog's renditions of Bram Stoker's "Dracula", it's clear that Herzog was paying homage to Murnau through a deeply expressionistic film that otherwise wouldn't exist had Murnau not laid the groundwork for it. However, while "Nosferatu" and "Nosferatu the Vampyre" contain similar narratives, differing technology and directorial decisions created two vastly different films that both still manage to exemplify the values of German Expressionism.

Film and Video Studies - Creative Works Projects

Strangers At A Party - Quincy Harthun and Shelby Wise, Faculty Mentor: Michael

Caldwell

Quincy Harthun has partnered with Shelby Wise to create a 13-minute short film about the dangers of sex trafficking. The film is a psychological thriller that combines Quincy's research into the statistics of sex trafficking with Shelby's research into the foundations of psychological thrillers. The thriller centers around our main character Amelia trying to help a woman named Sammy escape her abusive pimp. This project is the culmination of their honors capstone project. Shelby Wise and Quincy Harthun are proud to present Strangers At A Party.

History - Oral Presentations

Becoming the Atomic City - *Kirstie Magee, Faculty Mentor: Marji Morgan*

In the 1940s, Hanford, Washington contributed to the development of the atom bomb that ended the Second World War and ushered in the American atomic age. Since then, research has been conducted on the Hanford site, its employees, and the environmental effects of nuclear energy on the surrounding area. However, few studies have been done on the cultural development of the site's housing community in Richland. The following paper explores the development of Richland throughout the 1940s and 1950s through analysis of local newspaper articles and souvenir programs from annual celebrations. This analysis reveals how Richland's industries and community events both reflected and contributed to the atomic age, thus establishing the town's identity as an atomic city. Richland embraced its atomic identity by adapting infrastructure and annual celebrations to accommodate the growing population of residents and tourists. Residents promoted Richland as modern and prosperous by incorporating atomic language and imagery into the town's businesses and community events. While the atom bomb had a significant impact on global politics, it also shaped the culture of the United States in the years following the war. This research examines the cultural effects of the atom bomb on a regional level.

The Belfast Boycott: Sectarianism in Anti-Partition Rhetoric - *Katie Omans, Faculty Mentor: Jason Knirck*

The Belfast Boycott was a protest designed to dislodge loyalism in Northern Ireland and punish its adherents for perceived intolerance toward Catholics. The boycott was set off by the expulsion of several thousand Catholic workers from employment in Belfast in July 1920. A total boycott of all goods coming from Belfast was implemented in September 1920. Both unionists and nationalists attempted to legitimize their actions in the context of the boycott by framing them as non-sectarian, realizing the need to distance themselves from accusations of religious bigotry. For the boycott to be viewed as legitimate, it had to be framed as a political, rather than a religious, act. However, the Dáil's goals regarding the boycott were both political and economic. One of these goals was to punish Belfast for unfair treatment of Catholics. The larger goal of the boycott, however, was to eliminate Protestant ascendancy and end partition. One key aspect of boycott promotion was the assurance that only by boycotting could partition end. This paper will explore the ways in which southern Irish nationalists used the Belfast Boycott, often in contradictory ways, to attempt to both punish Belfast while simultaneously calling for Irish unity.

Singing Patriotism: An Analysis of American Revolutionary Broadside Ballads 1770-1779 - *Katherine Shogren, Faculty Mentor: Daniel Herman and Mark Samples*

My paper is about how music was used as a tool by the wealthy elite to spread messages of freedom and liberty in the era of the American Revolution. These wealthy elite in the North American British colonies used music that to cultivate support in the general population of the American colonists for liberation from Great Britain, gaining freedom and liberty for themselves. Such a combination is found in places of such unrest as the revolutionary era in early US history. By examining the pieces of music that took tunes from British songs with new American lyrics, my paper discusses how these new songs created an easier avenue for people to show their support and I find that I examine songs that were printed on broadsides, known as "Broadside Ballads." These were songs that were printed on posters and the common British melodies used made learning and repeating the messages easier. Some were taken from British innocently and others purposely made fun of the original piece. By studying the difference between the tunes and the syllables in each piece is how I determine that. Different ways of spreading messages of liberty and freedom for a new nation were needed to get around the British rules in place created new avenues by which to spread such messages. These helped raise awareness of liberty and the oppression the Americans were facing. The stolen songs they sang came from their place of yearning, for freedom and a world in which they could live under a government of their own creation. My paper brings in a mix of biography and musicology to the standard history research to have a well-rounded view of the people writing these new lyrics and how the songs came to be so popular as to echo through the pages of history.

Derry as a Whole: Bloody Sunday and the Broader Context of the Troubles in Northern Ireland - *Katarina Volchek, Faculty Mentor: Jason Knirck*

On January 30 1972, fourteen Catholic civilians were killed and another fourteen were injured by British army soldiers in Derry City, Northern Ireland. Since then Bloody Sunday has become one of the most remembered and influential incidents of the Troubles. This paper will touch on the general themes of late 20th century Northern Irish politics by focusing on Bloody Sunday as a key event in the Troubles. This research looks at the thematic reasonings behind Bloody Sunday and the long-harboured tensions of the region without being caught up in the loyalties of the IRA, Unionists, or Britain. By analysing British, Catholic, and Protestant reactions to Bloody Sunday, this paper address Bloody Sunday in a broader context that is inclusive of the historical and political issues. Focusing on propaganda as a tactic, the history of sectarian tensions, the trend of low-level escalating violence, and the effects of Bloody Sunday as a state killing, this paper highlights the core themes of the Troubles. Bloody Sunday was one incident in a much larger 30 year conflict, but historically it provides a framework for analysing the Troubles as a complicated conflict that goes beyond the reunification of Ireland.

History - Poster Presentations

An Integrated Approach to American Revolution History: I. The Framers - *Kevin Cassidy, Faculty Mentor: Marilyn Levine*

There are many analyses of the American Revolutionary founders, however there are few that analyze them as a group with respect to quantitative analyses. There is a growing utilization of statistical and network analysis in history that can now deliver new perspectives and the American Revolution is an excellent research area, particularly the people who created the revolution and those that resisted the revolution. This preliminary study is one of three papers based on the full dataset of over 700 individuals with 219 possible attributes including categories such as birth/death (date, location), kinship, careers, education, organizational memberships, occupations, positions, key events, among others.

This paper is specifically based on the signatories of the four founding documents of the United States (N=159), the framers who signed the Continental Association, the Declaration of Independence, the Articles of Confederation, and the Constitution. These signatories include Roger Sherman, John Dickinson, and Thomas McKean. The analysis used an integrated approach that combined statistics, cluster analysis, geospatial analysis, network analyses (centralities, cohesion, linkage maps, ego networks) and an example micro-case study of an intriguing individual that typifies the possibilities of integrated approaches. It also is important to present what were common factors such as generation, common educational institutions, geospatial factors, affiliations such as the Freemasons.

Considering the importance and relevance to past and present US history, it is crucial to further explore the American Revolution with new approaches that can help us find fresh understandings that may be relevant and useful even in the 21st century.

An Integrated Approach to American Revolution Biographies: III. Loyalists - *Barton Hasz, Faculty Mentor: Marilyn Levine*

There are many analyses of the American Revolutionary founders, however there are few that analyze them as a group with respect to quantitative analyses. There is a growing utilization of statistical and network analysis in history that can now deliver new perspectives and the American Revolution is an excellent research area, particularly the people who created the revolution and those that resisted the revolution. This preliminary study is one of three papers based on the full dataset of over 700 individuals with 219 possible attributes including categories such as birth/death (date, location), kinship, careers, education, organizational memberships, occupations, positions, key events, among others. This paper is specifically based around the prominent Loyalists in the American Revolution (N=112), this includes military personnel, politicians, and those who switched sides during the war, e.g., John Graves Simcoe, Benedict Swingate Calvert, and Benedict Arnold. The analysis used an integrated approach that combined statistics, cluster analysis, geospatial analysis, network analyses (centralities, cohesion, linkage maps, ego networks) and an example micro-case study of an intriguing individual that typifies the possibilities of integrated approaches. It also is important to present what were common factors such as generation, common educational institutions, geospatial factors, and affiliations. Considering the importance and relevance to past and present US History, it is crucial to further explore the American Revolution with new approaches that can help us find fresh understandings that may be relevant and useful even in the 21st century.

An Integrated Approach to American Revolution History: II Prominent Revolutionaries - *Alex Muetze, Faculty Mentor: Marilyn Levine*

There are many analyses of the American Revolutionary founders, however there are few that analyze them as a group with respect to quantitative analyses. There is a growing utilization of statistical and network analysis in history that can now deliver new perspectives and the American Revolution is an excellent research area, particularly the people who created the revolution and those that resisted the revolution. This preliminary study is one of four papers based on the full dataset of over 700 individuals with 219 possible attributes including categories such as birth/death (date, location), kinship, careers, education, organizational memberships, occupations, positions, key events, among others. This paper is specifically based on the attendees to the 1st and 2nd Continental Congresses along with prominent revolutionaries (N=122), that included non-signatory individuals for key documents such as the Declaration of Independence or the U.S. Constitution, but still contributed significantly to the revolution, e.g., Thomas Paine, Abigail Adams, Nathanael Greene. The analysis used an integrated approach that combined statistics, cluster analysis, geospatial analysis, network analyses (centralities, cohesion, linkage maps, ego networks) and an example micro-case study of an intriguing individual that typifies the possibilities of integrated approaches. It also is important to present what were common factors such as generation, common educational institutions, geospatial factors, affiliations such as the Freemasons. It is crucial to further explore the American Revolution with new approaches that can help us find fresh understandings that may be relevant and useful even in the 21st century.

Philosophy & Religious Studies - Oral Presentations

Change Must Come: Exploring Dr. Martin Luther King Jr. Through Kierkegaard - *Murshed Ramos, Faculty Mentor: Lily Vuong*

This paper seeks to investigate Dr. Martin Luther King Jr. as a character who fits within Søren Kierkegaard's schema of a "knight of faith". The knight of faith is characterized by their ineffability in regards of a social morality, for they act on incommunicable faith. King exemplifies this knighthood by way of defying the social morality of 1950s and 1960s America. He does this by being a prominent black leader in the Civil Rights Movement and by asserting his "dream", a faith for racial integration and positive racial socialization in the future. In the context of the Civil Rights Era, a time where the universal was associated with white identity, segregation, and black depreciation, King defies those associations by affirming black identity and battling segregation. This defiance, the faith in his dream, is something the universal of the time cannot understand, therefore King is in opposition as a knight of faith. Interestingly, King also exerts a new universal upon this universal, where Kierkegaard's original imagining of the knight was to always lie outside of the universal, let alone act upon it and change it dramatically. This paper is not completely exhaustive; there is more to be said on this topic.

A Feminist Reading of Genesis: The Problematic Argument of Precedence for Female Ordination in the Catholic Church - *Blake Trujillo (Women, Gender & Sexuality Studies), Faculty Mentor: Lily Vuong*

In my presentation I will discuss the issues around the Catholic church claiming the argument of precedence for their ban on female ordination. Through the lens of the prominent feminist scholars in the field, chiefly Phyllis Trible and Elaine Pagels, I reexamine the Genesis story and point out the inconsistencies in the interpretations of Genesis adopted by the Catholic church. Instead of the common portrayal of Eve as a weak willed, unintelligent temptress, I argue that she is instead the very founder of humanity and the progenitor of free will. By deconstructing these faulty interpretations put forth by many of the early church fathers, we get not only a more equitable view of Christianity, but a more accurate one.

Theatre Arts - Oral Presentations

Cataloging and Archiving CWU Theatre Department's Collection of Historic Clothing - *Parker Gliessman, Faculty Mentor: Scott Robinson*

The CWU theatre department maintains a collection of 400-500 antique clothing items that have been set aside from our overall working collection due to their historical significance or lack of strength for use in production. While these garments may have a less obvious purpose than our stage worthy collection, they do serve as an incredible working resource in overall historical style trends and historical garment construction. Unfortunately, due to the constant growth of this collection, storage space and archival resources have become scarce. This has prevented the proper storage and archival of these garments, causing them to be stored in ways that are detrimental to their existence. I decided I wanted to preserve this collection and increase its accessibility so that it continues to serve as a resource for future fashion historians to come. For my senior research course last quarter, I began by researching methods and products of clothing archival and determining the best way to archive this collection. I then sorted through and roughly photographed and then cataloged the first portion of garments into a rudimentary online database. Separately, I continued documenting the remaining garments and completing my database for my UNIV 400 course with intentions of fully completing my process early this quarter. Unfortunately, the current circumstances due to the COVID-19 pandemic have potentially postponed my completion until I am able to physically return to campus. However, I am still applying for grants to hopefully secure funding to follow through with proper archival once I am able.

College of Education and Professional Studies

Accessibility Studies - Oral Presentations

Online Inclusivity-the new normal or a passing trend - *Angela Kyle, Faculty Mentor: Naomi Petersen*

A Central Washington University student majoring in Accessibility studies along with Dr. Naomi Petersen introduced the ASP Club Initiative. The ASP Club for Accessibility minor and certificate students at CWU will be finalized in Spring Quarter 2020. This project's objective is to support students with the planning of internships for service-learning, social online interaction to reduce feelings of isolation for online students, increase involvement and inclusivity for all students to be involved, social collaboration among students, and capstone project enhancement. Resources related to their coursework, community volunteer opportunities, and leadership positions will also be created for ASP club officers and members. The ASP Club will promote and increase the awareness of the Accessibilities program at CWU, ADA, accommodations for students at CWU, and awareness of PWD and our community's plan of inclusion for all. Planning stage 1 of recruitment, CWU club policy and procedure, recruitment and content creation occurred during Winter Quarter 2020. Preparation stage 2 of recruitment, completion of club forms and policy packet, officer induction, and media/canvas set up will occur during Spring 2020. Implementation stage 3 of rollout, engagement, officer training, support of Summer Certificate students, and preparation for Fall 2020 field trip will occur during Summer 2020.

This project will include research on the change from class room instruction to online instruction and the restructure of our campus clubs and events to online formats and the impact on our future. COVID-19 has opened the door to more online social interactions and the positive occurrence of inclusivity for all individuals including people with disabilities. Can we continue this trend of inclusivity for all or will it return to the days prior to COVID-19 where individuals were excluded from certain activities?

Accessibility Studies - Poster Presentations

Risks, Fears, and Misconceptions: How Supplemental Security Insurance Traps People in Poverty - *Katherine Chiles, Faculty Mentor: Naomi Petersen*

Although there are many tools and resources available to people on Supplemental Security Insurance (SSI), a program of the Social Security Administration, to achieve financial independence, a confusing, restrictive system promotes misconceptions that keep people with disabilities from being able to work.

Both as people interested in Accessibility Studies and as caring citizens, we should invest in understanding the social security system and what it means for people with disabilities who want to return to work. Information for this poster was drawn from online sources including news sources, blogs, and the website of the Social Security Administration. This poster synthesizes only a small part of the information available regarding systemic disincentives that prevent or discourage people with disabilities on SSI from achieving financial independence. It briefly summarizes issues that face SSI beneficiaries wishing to return to work part or full time, including barriers to information access, savings caps, and enforced smaller hourly wages. The poster titled "Risks, Fears, and Misconceptions: How Supplemental Security Insurance Traps People in Poverty" is meant as a public outreach. It encourages readers to think about the unnecessary challenges that face people with disabilities who receive SSI. In this way, readers will become more educated citizens and be able to identify and eliminate stereotypes that they may hold without realizing it.

Education - Oral Presentations

Happiness - *Khodi Kaviani (CWU Faculty)*

From the times of Cyrus the Great, the founder of the Achaemenid Persian Empire in 549 BC to the Early Enlightenment period (1685-1730) when the British philosopher John Locke (1632-1704) lived, the concept of "happiness" has been linked to liberty and ideal governance. Thomas Jefferson (1743-1826) read *Cyropaedia* and this book written by Xenophon around 370 BC was among his favorites. He also read works by John Locke and used ideas from both sources to write the Declaration of Independence.

His wisdom to include "the pursuit of happiness" is a bold reminder that people have natural rights and it is the duty of the government to ensure the rights of the people are protected. Thus, pursuit of happiness and liberty go hand-in-hand.

Neenah and Nadia: A Story About Epilepsy - Rebekah Post, Faculty Mentor: Khodi Kaviani

This project highlights several issues within elementary education and children's literature. Many educators aren't aware of the prevalence or effects disabilities can have on their students' lives. There is also a lack of children's literature that can educate both teachers and students on the realities of living with a disability. In response to these problems, I decided to use my personal experiences and skills to produce a picture book appropriate for children that contains information about a specific disability, epilepsy. I discovered there were very few books aimed at children and teens about epilepsy or had a character with epilepsy. Epilepsy is a fairly common neurological disorder, with about 1 in 100 people suffering from some form of it. In this presentation, I review some basic information on the causes, prevalence, types of seizures and their symptoms. In addition, a review of children and young adult books, covering the subject of epilepsy will be presented. The picture book I produced contains original characters, writing, and illustrations created by me to tell the narrative of a child learning to understand her diagnosis. My hope is, more people will learn about epilepsy and how it impacts a person's life.

Education - Poster Presentations

Kanji Acquisition Techniques for L1 and L2 Japanese Speakers - Amber Richardson, Faculty Mentor: Yukari Amos and Joshua Nelson

Kanji are ideograms, a morphographic system borrowed from Chinese and used in Japanese writing. 2136 kanji are used in the average Japanese newspaper, required for job placement, and academic certification. A qualitative study was conducted to observe the optimum methods to learn kanji. Japanese native speakers who were educated by the Japanese school system grades 1 through 12 are classified as L1 or first language speakers. American students, L2 or second language speakers must have been educated in the American education system grades 1-12. L1 speakers were students attending Central Washington University (CWU) study abroad programs and L2 students were Japanese Major or Minor degree seeking CWU students. A comparison between L1 and L2 speakers was observed by interviewing 10 students from each group on acquisition strategies. Both groups of participants were asked what methods and techniques aided them in passing standardized tests for Japanese kanji. Students described drilling repetition of kanji ideograms for memorization, combined with reading for real time comprehension as the best method for kanji retention. The results of this research are discussed via Vygotsky's social-constructivist theory.

Ohana: An Analysis of Family Structure in Popular Instructional Materials - Areli Ruiz, Faculty Mentor: Susana Flores

In this undergraduate teacher action study, by ignoring different family structures, we are restricting learners to believe there is only one family structure that is important. The idea, morals, and values that we, as individuals, are living by are reflections of dominant family structures. When instructing young students, an educator must think of ways to reflect students' realities and make them feel visible. By exposing them to a variety of instructional material and classmates' realities, children have the opportunity of becoming better global citizens. The five movies and five books that I chose to analyze are good representations of varying family structures that are dominant, but oftentimes not valued for the message sent to these children. Frequently the messages that are sent through these movies and books are often overlooked or dismissed due to the fact that they are seen as controversial or excused for being uninformative. If used appropriately, these books and films can challenge the family structure bias. We, as educators can grant students the opportunity to see themselves represented within their education and society.

Engineering, Technologies, Safety & Construction - Creative Works/Constructed Objects

Speed Bump Power Generator - Osamah Abulghait (School of Graduate Studies), Faculty Mentor: John Choi

Pollution is one of the major issues in the country. Most of the power generation systems contribute some percentage in pollution. Therefore, coming up with a solution that has little or no environmental impacts is the best way. One of the significant goals in the research community is getting the energy generating systems that are non-pollutant. The paper is a paper gives a step by step procedure of constructing a speed bump power generator using available resources.

The analysis was done to design the device and help choose and manufacturing the parts. For instance, spring constant formula was used in order to choose the correct spring. Manufacturing had cutting, drilling, and bending. Most of the parts needed to be attached together to give stability and function properly. In, addition, one of the testing methods that was used was to plug in a multimeter to check the generating of electricity. The other method was to test the function of the complete device by applying weight on the top plate.

After construction of the design, the power produced was measured by use of digital voltmeter to measure the voltage. The system is able to produce 12V consistently. Stepping up the power generator can help in increasing the amount of power generated for commercial use. The power generated can be used for both commercial and domestic purposes. The speed bump power generator only work effectively where there is regular movement of vehicles.

Speed Bump Power Generator - Sultan Alanazi, Faculty Mentor: John Choi

A large amount of energy is wasted by the vehicles on the speed breakers through friction. Energy can be produced by using the vehicle weight and speed. The team proposes a smart speed breaker that generates power (Speed bump power generator). The device allows vehicles to pass from both sides. The system makes use of mechanical assembly with metal sheets with linkages that press down with spring arrangement.

Using the motion and weight of vehicles was the method that the team relied on to design the device. The mass of the vehicles allows the top plate to move the rack which convert the vertical motion to horizontal through the pinion which helps to rotate the generator. Welding, cutting, drilling were the manufacturing processes that that team used to build the device. Using weld process to join the outside structure of the device while using cutting to shape the top and bottom plate. Drilling process was used to join the parts of the whole device by screws.

The advantage of speed bump power generator is that electricity is generated throughout the year as long as there is the movement of vehicles. The amount of power generated is about 12 Volt. The speed bump generator can produce power that can be used to control traffic speeds therefore it ensures the safety of the pedestrians. Speed bump generator works in all weather conditions and it is environmentally friendly.

Fire Fighter Robot - Sultan Alhajri, Faculty Mentor: John Choi

The Fire Fighter Robot has been made in this project which can fight against the fire and that should be controllable over WiFi from the particular distance. The main objective of the design was that to fabricate the frame of the robot on which the whole top part of the robot can sit. The main constraint was that high-level skills were required for the implementation of some sections. The bottom part of the robot was first designed on the SOLIDWORK and Fusion360 software. The whole dimensions were set for the bottom part so that the water tank, camera and the top frame can easily sit on it. During the mechanical checkup of the cart it was found that the velocity of the cart was 2 m/s while during the one rotation the cart was covering the 12.56 inches' distance. During the motion on the smooth surface the force of the friction was found to be 313.9 N. The chained wheel in this part of the project had 52 links while the bottom part had the size of 33 lb. All the purchases were done from the Amazon except a few widgets were manufactured in a machine shop. To assemble all the parts with the chaises, few widgets were made such as the battery base, camera base robotic arm holder. All the widgets were manufactured by a CNC milling machine, lathe and a 3D printer. The final product which was made after joining the bottom and top part was able to move nicely on the floor. The cost of the whole project remained in the specific limits which was forecasted before the start of the project. All the drilling and assembling process was completed within the timeline. The robot was able to work quite perfectly in 70-degree Celsius Temperature.

Fire Fighter Robot- *Mohammed Alhajri, Faculty Mentor: John Choi*

This report talks about the fire fighter robot which can be used for fighting against the fire and which can be controlled from a safe distance. The most important objectives of designing such a device was to design and implement a test environment. Also the main objective was that to design and fabricate the frame of the robot. Furthermore it was necessary to design and implement a drive system. Some of the constraints in this project were that the designed robotic machine was not able to climb up the stairs. Also the material was not able to perform with hundred percent efficiency if the ambient temperature was quite high. This project was the team effort of the two students and work was evenly divided between the two class mates. Dimensional analysis was done for the parts which were utilized in the project right from the start. After that the whole design of the fire fighter robot was made by using the SOLIDWORK software in which the dimensions of all of the parts like wheel, chain the water tank, camera position and the top as well as the bottom frame was created. The water tank pressure was analyzed with the use of the formulas of physics. The force on the hose was calculated due to the pressure of water. The parts of the construction were 360 degree camera, motorized arm, fluid tank, front spacer, back spacer and camera base which were purchased from online store. Robotic arm holder widget produced some issues during the performance check which was fixed at the end. It was found during test, the robotic arm was easily rotating 100 degrees and was able to lift the tube and nozzle. Robotic arm holder was not strong enough and it was broken during test.

Mechanical Footstep Power Generator - *Mohammed Aljohani and Faisal Alonazi, Faculty Mentor: Charles Pringle*

Modern technology is focusing on newer and better sources of energy. Among the important areas are power generation methods since electricity has become part of our lives. Various researchers have conducted surveys to find out the feasibility of converting renewable kinetic energy into electricity. Some of the works done in the past emphasized the selection of suitable materials and power generation systems designs that appear complicated and expensive. To ensure there is cost efficiency and energy efficiency better power generation systems need to be embraced.

The footstep power generator is a system that utilizes the energy from people movement and transforms this movement into electricity. The system is efficient in the conversion of kinetic energy to electrical energy through placement of mechanical footstep power generator on the hind of footpaths. This project entails the conversion of the kinetic energy to electrical energy. The control mechanism carries the rack & pinion, D.C generator, battery and inverter control. The generator provides a simple and low-cost electricity production.

The mechanical footstep generator produces 1.56 kW for one down and up cycle without causing pollution which is an added advantage over other systems. Mechanical footstep power generator produces power on small scale therefore; the power generated applies to low power consuming gadgets. For instance, it can be used in lighting and running low power consuming devices.

Mechanical Footstep Power Generator- Faisal Alonazi, Faculty Mentor: Charles Pringle

This project was motivated by the need for a device that would generate electricity from human motion, especially footsteps. Electricity is a very important resource in our daily life. There are numerous sources from which generate electrical energy. The major sources of energy include but are not limited to coal, natural gas, petroleum, and nuclear energy. Most of these sources have adverse effects on the environmental inclusion such as air pollution; for example, from coal energy generation plants which then cumulatively leads to effects such as increase in rates of global warming. This project seeks to establish an environmentally friendly way of generating electric power from human motion. Such a system could be highly effective for installation in places that expect frequent mobility of a large population such as in educational institutions like universities and subway station entrances and platforms. The device will generate electrical power as non-conventional method by simply running on the train in the footstep. Non-conventional energy system is very essential currently to our nation. Non-conventional energy using footstep needs no fuel input power to generate the output of the electrical power. This project using simple drive mechanism such as rock and pinion assemble and chain drive mechanism. For this project the conversion of the force energy into electrical energy. The control mechanism carries the rack & pinion, D.C generator, battery and inverter control. Various applications were discussed and further extension. So this project is implemented to all foot step, the power generated is approximately 2.08 volts/step.

Viability of Smart Mirror Gaming Computers for Hotels and Dorm Rooms -

Christopher Berkshire, Faculty Mentor: Lad Holden

Hotels and dorm rooms are small and only provide space for a laptop, not a desktop for gaming. So, what is a gamer supposed to do if they can't afford a gaming laptop while living in a dorm room or traveling? This project looks at the feasibility of combining a mirror and a custom computer for utilization as a mirror as well providing a gaming platform for the travel and education industries.

A small custom computer with a two-way mirror and display on the front was tested to see if it could support gaming while taking up the space in a hotel or dorm room wall that is normally reserved for a mirror.

Providing a small custom computer that utilizes quiet water cooling and 12-volt fans could be utilized as a feature to increase attractiveness of dorm rooms and hotels.

Four Point Flexure Beam Fixture- *Nikolay Bobritskiy, Faculty Mentor: Craig Johnson*

Structural design is one of many important aspects in mechanical engineering. Newly discovered composites are making their way into the engineering world. These materials have certain properties which need to be tested in several ways before they can be put to application. One of such tests include the four-point bend test. The fixtures that can be purchased currently can be expensive, typically ranging from \$700-\$1,000. The University has been struggling to afford commercial jig at this cost and would be helpful if one was available. The device consists of a 6061-aluminum base making it light, cheap and faster to manufacture than other alternatives. The base secures to the Instron with pins, making it a quick process. The 4 contact points are made from A-36 steel which can be easily assembled to the base with a socket head screw. The device was thoroughly analyzed beforehand to withstand a maximum load of 1000 lbf, which easily met that requirement. Upon project completion the device total cost totaled to \$246, or much cheaper than what is available for purchase. Testing will consist of assembling the fixture and installing it onto the Instron. As well as performing a four-point bend test on a known material such as aluminum to see the difference in percent error between actual bending stress and experimental.

ASTS Frame - *Dustin Braun and Joshua Franklin, Faculty Mentor: Craig Johnson*

The automotive industry has been an industry of many breakthroughs in technology and mechanical systems over the course of its history. But in one area, its innovation has slowed. That is in the area of the short throw shifter. All aftermarket short throw shifters are currently one dimensional. No adjustability, no ability to finetune to one's personal desire. The goal of this project is to create a short throw shifter frame that is easier/faster to install, as well as allow for full adjustability of the shifter from inside the car. This frame design uses mostly 6061-T6 aluminum, along with some 1020 low carbon steel. Both of these materials are low cost, while maintaining strength and rigidity. Once the design was set, stress and strain calculations were made to insure the frame would hold up in the real world. The manufacturing process was then implemented to create all the individual parts of the assembly. Some of the manufacturing methods used included: CNC mill, manual lathe, and CNC plasma cutter. The testing for this project consisted of a strength test, a corrosion test, and a install test. The results show a frame that has the same strength(50lbsf) and corrosion resistance(1 year) as the stock frame, as well as a 50% faster time of install. All this was done well increasing ease of installation, and creating room to allow for full adjustability of the shifter.

Development of Smart Water Bottle That Tracks fluid Intake From the Bottle. -

Richard Braun, Faculty Mentor: Lad Holden

This project's goal is to provide the smart water bottle user with a data input to help develop or maintain a healthy lifestyle. We have all heard that our bodies need 8 cups of water per day but this changes between different body types and how active you are during the day. With our busy lifestyles who has time to keep track of how much water we are intaking during the day? With this project I aimed at making the solution to this problem as easy as the act of just drinking the water. By constructing a 3D printed bottle lid that incorporates an ultrasonic sensor and oximeter, monitored by a microcontroller that transmits the sensor data via Bluetooth to a phone app, the water bottle will be able to measure the amount of fluid the user intakes and record that data to keep track of how many ounces were consumed during the day, week, and month. Also, by syncing with the app it is able to remind the user to drink in order to reach a chosen goal. The built-in oximeter also lets the user measure their heartrate whenever they want. The project demonstrates a proof of concept that has the potential to be developed into a viable product contributing to the physical and mental health of the user.

EV Mirror Project- David Casillo, Faculty Mentor: Charles Pringle

An ongoing project for the Electric Vehicle Club is to build a fully working Electric Vehicle that can be used for any of the Electrathon America races across the country. Like most cars, the vehicle would need safety equipment that would allow the driver of the vehicle to drive the course both safely and efficiently. The event has specific requirements for the safety equipment that require the driver to be able to see behind them or when another driver is approaching from behind. Therefore, this project objective was to design and manufacture a set of mirrors that satisfy this requirement. The device is made from ABS Plastic, 18-8 (304) Stainless Steel Screws, and acrylic mirrors. These materials were chosen for the project due to the lightweight of the materials and corrosion resistance. This allows there to be minimal weight increase for the entire vehicle. The design of the project was chosen based of thorough calculations of forces on the mirror with a safety factor of 2. The device will be tested using visual assessments. The project result is expected to allow for the driver to see up to 200 feet behind the vehicle while maintaining a drag coefficient of .4.

Automatic Color Ball Sorter - Logan Cho, Faculty Mentor: Lad Holden

The objective of the project was to design and build an Automatic Color Ball Sorter. This was done with only three main parts; a microchip, a color sensor, and a few micro motors. The parts were combined in a way that would allow objects of three different color to pass by the sensor and be separated into their own compartments using the microchip and the motors. A program was built and downloaded onto the microchip that enabled this process. The results that the sensor gets from reading the different colors will determine where the motor will place each object. It was very important to design a case that will hold the parts together and also allow the balls to fluidly pass by the sensor and then be fed into their proper containers. This was fairly time consuming project but it also made for an interesting task.

JCATI Boeing Plane Composite Crusher. - *Payden Coffman, Faculty Mentor: Craig Johnson*

In collaboration with CWU students and faculty, improvements were made to the existing system that was intended to process scrap Boeing aircraft composite material. Current projects consist of changes to the design of the feed and crushing system, the system driving the crushing system, and the pyrolysis process. The previous feed and crushing system had a two step process that would feed and then delaminate the composite; the improved and redesigned system incorporates both these steps into a single process that both crushes and delaminates with a gear-like roller mechanism that will apply a load and then continually feed material through the system. Work so far has consisted of creating a shaft that sustain the high loads caused when the motor in the drive system is outputting its highest possible torque. From this, basic load and stress analysis was performed on the rest of the crushing mechanism and supporting chassis to ensure yielding and failure does not occur during testing. From the results found using Boeing's composite material, the amount of material that could be processed was only about 0.8 ft/min, 0.2 ft/min less than what the system was designed for; these feeding issues appear to be due to slipping on the tooth surface as material passes through. In addition, there is about 20% less delamination in the layers when compared visually to the delaminated layers from composite fed through the previous design; this is likely due to lower radial loads or spacing between the applied loads from the crusher.

Prototype for an indoor aeroponic cubic greenhouse- *Akrem Dawed, Faculty Mentor: Lad Holden*

The goal of this project is to create a automated cubic greenhouse where the base and sides contain receptacles for plants which supply nutrients aeroponically. The greenhouse will supply at least 45 receptacles for plants within a 17x17x20 cubic inch area. The cube design will allow more plants to be grown within a compact space then if the base was exclusively utilized. A microcontroller (Funduino Mega 2560) will utilize a temperature sensor, timer, humidity sensor and a ph sensor to facilitate desired changes to the growing space. If the desired conditions for the growing space are not satisfied, then the environment will be manipulated via heat lamp, pump, light strips and/or fans to restore the environment to its desired state. The variables that the user can manipulate via touch screen UI (which determine the desired state of the greenhouse) are area temperature, light duration for a 24-hour cycle, root humidity and nutrient ph.

Carbon Fiber Composite Recycling - *Wolfe Dennis, Faculty Mentor: Charles Pringle*

During construction of Boeing's aircrafts, carbon fiber reinforced composites are used as the primary material for the wings of the aircraft. Excess material during the manufacturing process is trimmed and discarded as waste. Although there is no viable process thus far, these trimmings have the potential to be recycled and reclaimed to be used in various other manufactured products. The trimmings of carbon fiber composite are approximately 10-12 layers of material bonded together. This project focuses on delaminating the trimmings into individual layers so that the carbon can be pyrolyzed from the bonding resin. In order to separate the layers of material the trimmings must be mechanically separated through a machine that uses extreme force. The machine constructed utilizes two gear reducers, powered by an electric motor to deliver the force necessary to feed the trimmings through a set of crushers. The crushers are two custom made gears that the trimmings have to pass through, resulting in transverse shear of the material. Past trials for delaminating the composite material were able to achieve a delamination of 80 percent. This benchmark had some success; however, the process was not a viable method because the machine had zero feed rate. This project is expected to result in a feed rate of 1 foot per minute while having a 100 percent delamination.

Forge Burner - Caleb DesJardins, Faculty Mentor: John Choi

Can small scale blacksmithing operations achieve a level of efficiency in their forge comparable to that of a large scale industry? The causes for the lack of efficiency needed to be pinpointed, and then the geometry of the existing design for the burner could be changed to fix the underlying issues, while still maintaining functionality. The problems with the previous design is the geometry of the intake giving an unknown air/fuel ratio, and the attachment of to the forge allowing the intake air to be contaminated by exhaust gasses. A burner needed to be designed that would solve these problems while maintaining the ability to output an oxidising flame for when an oxidised workpiece is desired. The final approach for finding the optimal intake geometry was based on a ratio between the propane injector outlet area and the air inlet area. This ratio was calculated based off of the desired air/fuel ratio and the density ratio between air and propane. This approach was compared with flow rate analysis at various propane pressure settings. The result of this calculation is that for any set propane pressure, the height of the intake opening needs to be .232 inches high. The input pressure of the propane does not affect this result. The intake valve was still designed to be adjustable so it could still produce an oxidising flame as desired. The optimized burner can be attached to a forge by a flange that prevents exhaust gasses from entering the intake.

Automatic Bead Stringing Machine- Huy Dinh, Faculty Mentor: John Choi

Humans were able to master the process of piercing objects through drilling holes as an advanced beading technique. There would be a great demand for beads and they appear more and more in human daily life. Many things are made from bead strings such as jewelry, furniture and house decoration. The beading process is usually done manually by hands of workers. The process takes a lot of effort and cost for labor. Therefore, this project is about building a simple device that helps to free the work effort and lower the labor cost. The bead strings machine has 3 main parts: frame, roller system and gear system. Beads go to roller system through the funnel on top. The gear system will deliver beads to final destination by using plastic elevator attached to the gear. The motor attached to the frame has two shafts, one uses for the motor the other uses for the gear. The material is made of stainless steel because of its high strength, high stiffness, good machinability, good formability and good corrosion resistance. The device is tested by using timer to determine the productivity. This project's result is expected to be more efficient than the traditional ways. Production rate was over 150 beads per minute and the machine cost less than \$400.

Next Generation Trucks (NG-Trucks) - Zach Ducatt, Faculty Mentor: Charles Pringle

A device is needed that will provide longboard riders with a truck that is specifically designed for the sharp turns and high speeds they experience throughout their ride. This longboard truck must have a design that is engineered for these purposes and avoids the standard pin and bushing design that is commonly copied from the closely related skateboard truck. This standardized design is outdated, and more importantly, was made to adhere to the skateboard style of riding, consisting primarily of performing tricks with less turning. The longboard truck provides a secure connection point upon the two wheels and the board itself. Additionally, the truck provides a controlled ride by adding additional assistance with turns from leaning the wheels upon the y-axis, unlike the standard skateboard truck design that turns due to motions strictly upon the x-axis. The design enables a larger wheel diameter without sacrificing a low center of gravity compared to a normal truck by relocating the turning pins to the front of the truck instead of directly below it. The truck's functionality was first evaluated on Solidworks and then 3-D printed to ensure that the motion did not interfere with the structure of the board or the ride. This design offers improved maneuverability while providing a stable ride and a turning radius of just 6 feet.

Modular Hardtop - Dennis Fedorchuk, Faculty Mentor: Craig Johnson

A Jeep Wrangler Hardtop is a product that becomes inconvenient during the hot summer days when someone wants to remove the top for the next few months of sunshine. The question that comes up is "Where does someone store the top in the offseason?". Unless an individual has a hardtop hoist in the garage, the hardtop will take up half of the garage. What if that individual does not want to drill holes in the ceiling or needs the floor space? That is where the Modular Hardtop comes into play. This project comprises of five individual panels that can be disassembled and stored in the corner of the garage. The hardtop is made of fiberglass with a foam core structure. The two side panels of the hardtop include a weight bearing steel frame with nuts welded onto it to secure the panels to the frame of the Jeep, and the individual panels with bolts. The overall cost of the project is like that of an aftermarket hardtop that could be purchased online. The hardtop is tested for weight bearing capabilities, noise reduction and that the final top is waterproof. The benchmark that the designed hardtop will be compared to is an original hardtop. The final product is expected to be able to carry a 200 lb. load, reduce noise by 15% and reduce heat loss by 20%.

Adjustable Short Throw Shifter (ASTS)- Joshua Franklin and Dustin Braun, Faculty Mentor: Charles Pringle

Every manual transmission vehicle has a shift lever for changing gears. The problem is that the shifting linkage is setup up for one kind of driving. Numerous vehicles have multiple settings for the suspension to adapt to varying driving scenarios (i.e. cruising, sport, track). No vehicle currently has an adjustable short throw shifter (ASTS) that can accommodate drag racing, drifting, sports car racing, rallying, off-roading, or casual driving. The design of the ASTS solves this problem by moving the central axis of rotation of the shifter up two inches, permitting the adjustment of the shifting throw between 20 and 40%. The swivel joint, at the central axis of rotation, is increased in size for the threaded sleeve to be press fit on the inside. Adjustments to the amount of throw are made from inside the vehicle because the threaded rod travels up and down the sleeve. For safety reasons the new shifter is also required to meet the same safety standards as the stock model shifter in the test vehicle, a 2005 Ford Mustang GT. The shifter must withstand a load of 50 lbs. with less than 0.5-inch deflection. Testing demonstrated it would support a 100 lbs. load with less than 0.5-inch deflection. The final design met all the requirements and performed with a throw reduction of 20-50% and providing an adjustability of throw within a tenth of an inch, thus allowing for max versatility and personalization from the customer.

Electric Vehicle Front Suspension - Daymon Fritz, Faculty Mentor: Charles Pringle

The Central Washington University (CWU) Mechanical Engineering Technology (MET) program owns an electric vehicle called the "Cat-Mobile" designed to be entered into an Electrothon America race. The Cat-Mobile is a collaborative project, various aspects of which are built by CWU MET students in the capstone sequence of the senior year. For the Cat-Mobile to operate safely and effectively, it was necessary to design and build a proper front suspension system. The suspension needed to meet Electrothon America Handbook rules dictating a minimum ground clearance of 2" and optimize material usage to keep added weight at or below 20lbs. Loading and stress analysis was used to design the suspension system, and FEA analysis assisted with optimization. The final design modeled a typical "double-wishbone" or "double A-arm" style suspension. A spindle assembly was mounted between the A-arms with the use of ball-joints. The spindles included provisions for steering, and potential mounting locations for braking components. A coil-over style shock absorber is used which can allow for height and dampening adjustments. The total mass of parts added to the dampening adjustments. The total mass of parts added to the Cat-Mobile was just 12.7 lbs. The ground clearance of the Cat-Mobile can be adjusted and at minimum height adjustment, conforms to the Electrothon America requirement of 2".

Fitness Tracker - Alex Garrett, Faculty Mentor: Lad Holden

There are many fitness trackers on the market today, but most of them do not give the users the ability to customize the software or hardware. My project will accomplish both so the user can get accurate information while exercising. Looking forward, my project needs to be downsized since it falls under the wearable category. I will do this mainly by finding a better display screen as that is the biggest component of my project. I am doing this because fitness trackers need to be as small and as convenient as possible otherwise no one will wear them if they become a burden to wear. I will also continue to tweak my code and make it more understandable and customizable for others to put in their exact information according to their own specific parameters. I will know my project is finished when my wearable is secure enough for running and able to use my exact information for precise calculations in regards to calories burned etc...

H.F. Hauff Portable Wind Fan Stabilizer- Tyler Hoffman, Faculty Mentor: Charles Pringle

Agricultural areas with cold weather in winter and early spring face significant risk of damage to crops due to freezing. To combat this issue, several farms use fans to keep goods from freezing. For some orchards and vineyards, the use of large-scale fans is not cost effective nor pragmatic. H.F. Hauff, a farming equipment company based out of Yakima, Washington, has developed a mobile, self-contained fan that operates on a seven-by-twelve-foot trailer. As a function of environment, the trailer sometimes operates on uneven or unlevel terrain. There arises a need for an improved outrigger system to keep the trailer stabilized. To address this need, a design was conceived, analyzed, and tested as part of the CWU MET Senior Project class in conjunction with H.F. Hauff. The main design uses telescopic outrigger booms with stabilizing legs to keep the trailer stabilized. Once the design concept was conceived, engineering analyses were conducted. A one-fourth scale model was then constructed and tested to prove the design concept. This report details the design of the stabilizing leg portion of the project. The outrigger boom design is contained in the report by Jose Reyna. During the testing phase, it was determined that the device met the design requirements. The device maintained enough structural integrity to counteract the applied forces to the system. The booms and stabilizing legs were able to articulate from two to four feet. Finally, the outrigger system was able to keep the trailer level on a 15% grade.

Tensile Specimen Punch - Triet Huynh, Faculty Mentor: Charles Pringle

There is a significant demand of tensile specimen for the students in MET 426 Lab. The solution would be to facilitate specimen production in the lab. This project designed a punch and die to take raw sheet material and produce some tensile specimens. The project was conceived, analyzed, and designed at the Central Washington University (CWU) Mechanical Engineering Technology department. Working within the constraints of our university resource, all the parts were made in the CWU machine shop. This project includes the base, that holds the specimen in place, and the punch, that will remove the material. Two dies and two springs will be placed right in the middle of the base to help push the punch back to the first position. Threaded fasteners were used to hold the punch housing in place and to avoid oscillating. The punch housing will support the punch, keep it stable, and aligned with the die. This project will be complete when the punch and die can be mounted to the arbor, the specimen can be supported on the base, and the punch can remove the desired material. Testing produced tensile specimens meeting the requirements of the project. The result is a 45% increase in part production as there is twice the capacity in the new design.

Dual-Axis Solar Tracker -*Bryan Kennedy, Faculty Mentor: John Choi*

Renewable energies, and fuels that are not fossil fuel-based, are one of the prolific topics of debate in modern society. With climate change now becoming a primary focus for scientists and innovators of today, one of the areas for the largest amount of potential and growth is that of the capturing and utilization of Solar Energy. This method involves using a mechanical system to track the progression of the sun as it traverses the sky throughout the day. A dual-axis solar tracker such as the one designed and built for this project, can follow the sun both azimuthally and in elevation by use of a photoresistor sensor mounted on the top of the panel frame that senses when the sun has shifted position. If done in such a way that the system does not require large amounts of energy, it can increase solar energy production by an extra 20%. The key to this system working efficiently is in using as passive a system as possible so that it does not continually drain power from the panels as well. Testing will be done by comparing the amount of energy generated by the panel in its optimal fixed position to that of the energy generated while the panel is tracking the position of the sun. Three clear, sunny days of testing for each position were gathered and the results averaged before comparison.

Drone Payload Storage & Release System- *Joseph Key, Faculty Mentor: Craig Johnson*

The retail giant Amazon has become a household name synonymous with nearly instantaneous online shopping. What previously took weeks to deliver at exorbitant shipping fees can now arrive at your doorstep within two days - all for free. This huge buyer incentive has skyrocketed the demand for online shopping, making Amazon the most valuable brand in the world. To meet this demand, Amazon and its distributors have proposed using drones to make deliveries. However, due to issues with cost and complexity, this has not yet materialized. As such, this project's objective was to create a cheap and lightweight package-delivery system that can be easily mounted onto a drone - the popular DJI Phantom 4 Pro. The approach was simple: create a purely mechanical system, eliminating the need for complex electronics. This was accomplished via the drone's built-in camera, which can move down to trip the package release trigger at the user's input. The entire system is attached to the drone via quick-release clamps. The project was constructed entirely using 3D-printing. This allows for the system to be manufactured cheaply within a matter of hours rather than days or weeks. The system was designed to store payload using a hybrid cage, which swings open to release packages. Testing has found that the system weighs only 5.31-oz, can carry packages up to 8x6x3" and 1.25-lb, and can travel up to 2 miles fully loaded. Finally, the system can be produced on a small scale for less than \$60.

Enhancement of a Gaming Controller with Triple Axis Accelerometer Modification -

Trey Kilmer, Faculty Mentor: Lad Holden

Gaming is one of the main sources for entertainment for a lot of people around the world, and with the amount of people playing video games constantly rising the need for better and better technology keeps growing. A staple in gaming is the controller, whether it's console or PC gaming a controller can be found in almost every gamer players house. Back when the first gaming consoles came out the controllers were simple and didn't have much to them just a few buttons, but as the technology advances more features are added. Take the PlayStation controllers for example the very first one just had a few buttons and now the PlayStation 4 controller has analog sticks, a trackpad, accelerometer, and much more. The project objective was to retrofit an original XBOX controller with a triple axis accelerometer to that so the controller will be able to be used as a steering wheel in racing games. The concept of adding the accelerometers to an existing controller is sound but does not lend itself to the development of a viable product because it's labor intensive to modify a wireless controller making the idea not financially viable.

Flexor Casting - Courtney Lehrman, Faculty Mentor: Craig Johnson

Strain gauge bases (Flexors) are scarce in the Mechanical Engineering Department. Flexors are used for MET lab classes to collect and analyze data so it is important for there to be more Flexors available. In order to acquire more, resources are available on campus such as the foundry and the machine shop in order to support the manufacturing of more Flexors in-house at a much lower cost. By creating a pattern that can be used numerous times in a foundry, not only will there be an opportunity to make more castings for students to use, there will not be a financial burden on the MET department in the production of more Flexors. The first step to this project included redesigning an existing Flexor to be compatible with the foundry. This included making many dimensional calculations to the pattern such as how wide and long the runner should be or the shrinkage rate of the Flexor after being poured. The next step was to manufacture these designs to a matchplate board in order complete the pattern. This involved manufacturing the designs into 3D models using ABS. Once the prints were complete, the assembly to the matchplate was then able to take place. With the pattern accommodating two Flexors at a time in production, pattern will then be able to be used in the foundry on campus to produce a dozen Flexors to support the MET lab needs.

Heat Exchanger- Chancellor Linarez, Faculty Mentor: John Choi

A water jet cutting machine can cause excess heat and humidity within a closed building, while also making it more difficult for the user to pick material off the cutting table. Water temperatures can reach as high as 150 degrees Fahrenheit in the tank. A system that would reduce the temperature of the water in a water jet tank would be beneficial for the occupants in the room in providing a better more comfortable work environment. Data was collected while the machine was in use. The data includes; temperature of water leaving the nozzle, the rate of change of tank water temperature over time. This data was used in determining design requirements for a heat exchanger system to keep water below 100 degrees Fahrenheit. A water to air heat exchanger with a rating of 20 kW was determined to be suitable for the application, assuming operation in a 88 degree Fahrenheit ambient air operating conditions. To manufacture the water to air heat exchanger, a series of copper pipes will run through aluminum fins, and a fan mounted to the unit. Glycol will be circulated through the unit and run through a copper coil submersed in the water jet tank. A circulating pump will be used to circulate glycol through the system. With the heat exchanger in place the temperature of the water increased at rate of 0.05 degrees Fahrenheit per minute during a 12 hour period. Without the heat exchanger in place the water temperature increased at a rate of 0.08 degrees Fahrenheit per minute. With the heat exchanger in place, the water increased in temperature 38% slower than without the heat exchanger.

J.C.A.T.I. Automated Pyrolysis Project - *Jim Lopez, Faculty Mentor: John Choi*

Previous students working on the JCATI project have created an oven that will be used for the Pyrolysis process of carbon fiber composites. The oven requires someone to operate it manually, as in they must lift up the cover, place the amount of material desired, and stop the oven when it reaches the desired time. This process can and should be made automated. This was achieved by creating a device that can select the amount of material needed for a batch, automatically put it in the oven through the cover, and then bring the material out of the oven at the desired time. The final design achieved all of these in three different devices. The first is a Dispenser that stores all the material that comes from the shredder and automatically releases the desired amount of material at the beginning of a cycle. Next, a rotating panel was installed onto the cover to allow the material to pass through without letting out too much heat or argon gas from inside. Finally, another rotating panel automatically turns to release the material at the end of the cycle. To test the device, the device underwent trial runs with the heat turned off to make sure that the material landed where it needed to and that all parts operated in sync with each other and did not activate until needed to.

R/C Baja Car - Drivetrain and Steering System - *Carlton McDonald, Faculty Mentor: John Choi*

The purpose of the Baja R/C Car is to compete in the ASME eFX competition in a series of events to prove the functionality of the vehicle. This series of events includes the Slalom, Drag, and Baja race, The Slalom is a test in the steering capability of the vehicle, the Drag is a test in the acceleration of the vehicle in a straight line, and the Baja puts all factors together in a race to test every component of the vehicle. This project is about building an R/C car that not only functions, but also has maximum performance capabilities to win the competition.

This report describes the analysis, construction, and testing evaluation of the drivetrain and steering systems of the R/C Baja Car. Collin McKenzie was responsible for the chassis and suspension portion, together the car is a complete system. The drivetrain was built with a two-gear reduction system, one at the motor to the driveshaft, and one from the drive shaft to the rear differential. The steering system was built with a high ratio servo, adjustable tie rods, and camber arms to ensure proper alignment. Lightweight material was used such as 6061 Aluminum and ABS plastic to keep weight low. An enclosed differential casing was used to allow a lubricated system.

Testing focused on the acceleration of the vehicle and the turning radius of the steering system. The testing results of the Baja car exceeded a speed of 20 mph and the turning radius met the requirement of 60 degrees.

Discrete Concealed Device Table- *Shyne McKay, Faculty Mentor: Charles Pringle*

How can people hide devices in their homes without being obvious with its location? People use safes to hide devices but intruders will know immediately that's where things are held. It's a common issue that people are having their safes stolen or broken into. To answer this question, a device was created to conceal devices in plain sight without being noticed. It's common to have a coffee table in ones living room. Combining the problem with this knowledge, a discrete concealed device table was created. The table looks normal to the naked eye, meaning one cannot tell that the table opens. Inside the table are manufactured parts that hold different sized devices. The manufactured parts are engineered to lock and hold in place, but also have the ability for quick and easy access. The table has a lock located in the inside, one can open the table by sliding a magnetic key card over the locks location. Doing so the table will freely open, revealing one's hidden devices. The device had a minimum force of 5 lbs and a minimum time of 5 seconds. The test revealed a force of 5 lbs and 7 seconds was required to open the tables top. This was due to having the devices being held on the inside of the tables lid. The second test is the force and time to remove a device from a holder. The requirement was under 10 lbs and 10 seconds. The force revealed was 8lbs and 5 seconds.

RC Mini Baja Car – Suspension and Chassis - *Collin McKenzie, Faculty Mentor: John Choi*

Two students have developed a unique design of the RC Baja Car to optimize functionality and performance. A Baja car is a remote controlled 1/10 scale car that is used for recreation or competition, usually meant for competing in the ASME Baja car competition versus various schools. The competition focuses on the best time achieved in different courses that utilize speed, turns, and jumps. The objective for the project was to create a unique suspension from previous individual's projects by creating a four-link suspension in which allows more travel in the suspension of the car and maintains functionality with the intent to improve overall performance. To integrate this concept, the design process was calculated and modeled carefully after researching the inspiration from competitive trophy trucks. The angle of the suspension arms and tolerances needed to be precise to produce a cohesive functional rear of the car. Upon manufacturing, linkage of the suspension from the rear axle and differential case to the rear strut support and main chassis plate was crucial. Using manufacturing machines such as mills, drill presses, and sheet metal benders, the supports for the struts and the chassis plate which connects the trailing arms were created. With the four-link suspension and allowable adjustments within the design, the RC Baja Car was able to withstand a drop of 1.5 feet and 94 lbf vertically simulating jumps needing to be withstood without failure of the suspension.

Package Conveyance Stability- *Sadie Mensing, Faculty Mentor: John Choi*

Dematic's new model of conveyor is called the 9570 unit and is a high speed live roller conveyor. This new model is designed to transport packages while maintaining a high speed of at least 3 m/s. While this new unit was being tested at the Dematic Tech center, it was discovered that when small and light weight packages get diverted onto the unit, they experience turbulence which causes the packages to spin or flip over. Orientation of packages on conveyor is extremely important for scanning purposes. In order to fix this problem, the problem first had to be replicated. A piece of the 9570 unit was sent to Central Washington University (CWU) to be reconstructed and manipulated. Once the conveyor was assembled, initial testing was done to recreate the same problem. After the problem was replicated, different variables were manipulated in order to determine how they affect the turbulence of packages. These variables included, changing the diverting location onto the conveyor or changing the speed the packages are diverted onto the conveyor. The testing concluded that in order to decrease the turbulence of small packages when being diverted onto the 9570, the diverting speed needs to be adjusted so that the packages are coming into contact with the rollers at a higher speed than what the unit is running at.

Composite Ruddervator Replacement - *Kelson Mills, Faculty Mentor: Charles Pringle*

The Beechcraft V-tail Bonanza is a popular general aviation aircraft. Over 10,000 were built, but with the weakness of magnesium skinned control surfaces. Control surfaces on aircraft must be light, and precisely balanced. The V-tail Bonanza uses a unique "ruddervator" system, which combines the rudder and elevator into one surface to reduce drag, controlling the pitch and yaw of the aircraft. Magnesium was chosen by the designers for its lightweight properties, but corrodes badly and is becoming difficult to source for replacement parts. Aerodynamic flutter, from flexibility in the lightly built surface, and corrosion can cause breakup in flight, and has grounded many aircraft. A complete replacement is needed, but cannot be constructed of aluminum due to its weight. In this project, a cored carbon fiber composite material was used to construct a prototype. The dimensions and mounting hardware are unchanged from the original surface, allowing a direct swap onto the aircraft, with no changes to controls, trim, or cable routing. Carbon fiber will not corrode, and is an extremely stiff material. Two layers of biaxial carbon fiber cloth are separated by a solid foam core, with bolted hinge attach points. The prototype was tested by static loading using sandbags in a welded steel jig, stimulating an aerodynamic load, while measuring the distance of deflection, and eventual failure point, to identify weak points and stress concentrations. The new surface was shown to have a 20% improvement in stiffness and strength over the original, as well as reducing aerodynamic drag.

Develop a Bluetooth Lost Flash Drive Detector- *Purvayne Mingeli, Faculty Mentor: Lad Holden*

An issue that many of us have with flash drives is that we use them in a computer, or put them down, then walk away and never see them again. This project tests the concept of using Bluetooth hardware and software, and a rechargeable battery, in a flash drive paired with a phone app to be able to locate a flash drive in Bluetooth range. The initial concept was to have a Bluetooth app to tell the user when it could detect a flash drive. The concept is feasible but to develop a viable product a small printed circuit board with a small pin-count microcontroller would be needed to operate and control the Bluetooth and battery charging processes.

Viability of Computer Vision in Apple Starch Analysis - Caleb Rath, Faculty Mentor: Lad Holden

Quality control in the agriculture industry is universally used by production facilities but remains almost unseen by the consumer unless it is done wrong, in which case it can be glaringly obvious. It is for this reason that QC programs should be meticulously structured to catch potential problem products before they are processed. Currently a vast majority of QC lab work is made from human observation, which leads to large variance in data due to human bias and error. With increasing strides in efficiency and accessibility in the field of computer vision, it is essential for companies to implement computer vision in their QC programs. The purpose of the Apple Starch Analyzer is to provide a simple to use and robust solution for detecting the starch contents of apples, a process commonly used in apple QC for any warehouse. This project shows viability and concept and could serve as a starting point for widespread adoption of computer vision in agricultural QC labs, saving companies money and prevent logistical complications before products even reach the packing and shipping floors.

Cubesat 5000 - Renee Redman, Faculty Mentor: Charles Pringle

Cubesat 5000 is designed for the annual Physics weather balloon launch which is done for the senior level astrophysics students. Students use the weather balloons to get better visuals of the sun in the upper atmosphere. The purpose of the Cubesat 5000 design is to keep the instrumentation inside safe during and after the launch, maintain working temperature, and to remain below a 400-gram weight requirements in order to achieve optimum altitude. The outer cube assembly was designed using Solidworks and printed using PETG filament. The weight of the cube has been measured and design changes were made done to remain within the weight requirement. Through 3D printing the outer assembly could be light weighted by removing excess material while leaving diagonal supports to protect the corners during impact. The container was insulated using foam coated in aluminum foil against the colder external temperatures. The instrumentation is mounted onto a plate with a repeated hole pattern which is then pinned to the internal insulation. The external cube assembly has been run on a non linear transient response analysis using Nastran Inventor to determine the weakest point of the assembly during impact. Per the analysis the design will be able to sustain the max internal strain during impact as the max strain is under the 6000 psi yield for the material. The maximum strain is 5400 psi at the lid support in the corner of impact. The insulation is suitable enough to keep the temperature above functioning levels for the electronics.

Outrigger Project- Jose Reyna and Tyler Hoffman, Faculty Mentor: Charles Pringle, John Choi and Craig Johnson

Agricultural areas sometimes experience cold weather in early spring and risk damage to crops due to freezing. To combat this issue, farms can employ temporary fans to keep the blossoms from freezing. The design of a 17-foot-tall wind turbine mounted on 7-foot-wide trailer can help mix the warm air that's above the wind turbine with the colder air that's below to keep the crop from freezing. These wind turbines can produce up to 2000 lbs of thrust force. At a height of 17 feet, this force then becomes a moment of 34,000 lb-ft. This moment will tip the trailers over as they don't cover a wide enough area to counter the moment. To counter this moment, telescoping outriggers were designed. Analysis was completed to determine the length of the outriggers, the dimensions of the square tubing used to manufacture the outriggers, and the max deflection allowable by the outriggers. A Solidworks model supported the calculations. The stabilizing legs design is contained in the report by Tyler Hoffman. Testing determined that the outriggers performed to the design specification. The outriggers weighed 550 pounds, they extended to a length of 16 feet, and retracted to a length of 7 feet. Under load the outriggers deflected less than 1 inch and maintained stability on a 15% grade.

Composite Guitar - *Ryn Rollins, Faculty Mentor: Craig Johnson*

Traditional wood-bodied products such as boats, hockey sticks, and guitars can be easily chipped or cracked if not properly taken care of. The wood can absorb moisture and deteriorate over time. If that wood is replaced with composite materials, those products can become stronger, more lightweight, and resistant to temperature and corrosion. Two of the most popular composite materials are carbon fiber and fiberglass. Because these composite materials have such a high strength, the core of a guitar body can also be replaced with a lighter material such as Styrofoam which makes for a lighter and more durable guitar. The carbon fiber can be molded to the guitar using either a wet layup or a vacuum bagging technique. Both of these have their own advantages and disadvantages. The vacuum bagging process allows the carbon fiber to mold more closely to the foam core but was found to have problems around the corners and edges of the guitar. The wet layup was able to form more closely around the corners but had small bubbles or imperfections around certain areas. Both processes had roughly the same cure time of about 6 hours. The initial testing was done on a separate piece of foam that was cut out and carbon fiber applied. The calculated load of the string was around 11 psi and the test piece was able to withstand well above that amount.

The Atlas Project- *Rowdy Sanford, Faculty Mentor: Lad Holden*

The Atlas Project started as a "simple" retrofit to bring a handful of old Atlas-II robotic arms, built in the 1980s, into the modern age of computing, as a low-cost solution for robotics trainers. The initial challenge with the project was reverse engineering the functionality of the original control system, with the only documentation available being a technical manual and a user manual, both lacking sufficiently detailed information to determine the bit-level operation of the hardware. Through experimentation the function of the circuit was deduced, and a testing setup was constructed to begin using LabVIEW, a data acquisition and control programming environment developed by National Instruments, to design a control system using a USB Data Acquisition module (DAQ) as a replacement for their "micro card." LabVIEW was chosen as the programming environment for the flexibility of the programs, called virtual instruments (VIs), the documentation tools and the graphical programming interface. In the years since the retrofit process began, this project has undergone multiple revisions. The driving force of the project was to reduce the cost of teaching hands-on industrial robotics, and give students the tools to apply their knowledge in a tangible way.

Modular General Aviation Tow Bar - *Devon Tandberg, Faculty Mentor: Craig Johnson*

In general aviation, pilots use either a tow bar or a tug to maneuver their planes to and from its parking place. A tow bar is a lightweight human powered device that allows a pilot to push and pull his/her plane by themselves using human power. A tug is a similar device, except much bigger and heavier, and is electrically powered, allowing for an easier time maneuvering a plane. The downside to a tug is since they are bigger and heavier, they cannot be taken with a pilot on a trip. The goal of this project was to combine the best parts of both devices, making something that is electrically powered and able to maneuver a Cessna 175 on its own, but is small and light weight enough to be taken with on a trip. The device is made from a 20:1 worm gear set, powered by a 20V DeWalt cordless drill. The drill power is transferred through the gearbox to a set of 8-in pneumatic wheel that will push and pull the aircraft. All these parts are connected to a frame made of 1"x1" T Slot extrusions. The frame can be taken apart into smaller pieces to allow for storage inside a Cessna 175. This project was tested on three areas; ability of device, weight, and storage. The device was successfully able to maneuver a plane on its own, as well as able to be stored in a Cessna 175. Unfortunately, the device's weight is 20 percent over target.

Development of an Automated Reptile Living Environment - *Libby Wittman, Faculty Mentor: Lad Holden*

Proper husbandry for reptiles can be difficult to maintain for many hobbyists due to unique needs for each animal and the environments are not like the average human home. This project automates the lighting, temperature and humidity of a reptile's enclosure. A heat mat is attached to the back of the tank to create ambient temperature. The heat mat will be controlled by feedback from the temperature sensor, the misting system will be controlled by feedback from the humidity sensor. The lux sensor would monitor ambient light in the room and turn on a light if the room is too dark and within the set daytime hours. By using sensors and a Raspberry Pi this will allow the animal to have its environmental needs met without the keeper doing daily maintenance. The design would allow the user to change parameters since many animals require specific temperatures and humidity. This project is a proof of concept for a product that can be marketed to hobbyists and do it yourselves in the herpetological community.

Electrical Vehicle Clutch Project - *Jacob Yordy, Faculty Mentor: Charles Pringle*

This project's goal was to add a clutch system to an electrical vehicle at Central Washington University. The project's second goal was to have the clutch system improve the electrical vehicle's fuel economy for Electrathon events. Electrathon uses an equivalent mpg formula to determine an electrical vehicle's "fuel economy." Based on the amount of energy in kilo-Watt hours in a gallon of gas, Electrathon assumes each car uses 0.026 gallons of "gas" in the hour long race and the mpg value given to an electrical vehicle is based on the distance the vehicle travels in the race. Analyzes and problem solving showed that only a lightweight clutch system was going to effectively increase the fuel economy of the small electrical vehicle.

A one-way clutch was purchased. Then a hub was manufactured, and the clutch was pressed into the middle of the hub, then screws held the clutch system up against a sprocket on the driven shaft. This clutch system allowed the electric motor to drive the vehicle forward. When power is no longer being delivered from the motor, the clutch system allows the vehicle to "coast" forward. This idea of covering more distance with the same amount of input energy is what makes the addition of a one-way clutch system so useful.

The clutch system proved to add as much as 5 mpg (6% increase) to the electrical vehicle's fuel economy. In a full speed test, the vehicle coasted 48 more feet on average when the clutch system was equipped.

Family & Consumer Sciences - Oral Presentations

Maternal Language Barriers as a Moderator in the Association Between Attachment Security and Academic Success - *Alondra Venegas, Faculty Mentor: Sarah Feeney*

The goal of this study was to see if maternal language barriers moderate the association between attachment security and academic success within a diverse sample of college students (18-30 years old). Participants were recruited to take an anonymous online survey (N = 68) through various social media platforms (Facebook, Snap chat, etc.). Respondents answered questions in regard to attachment security, their current academic achievement (GPA), and maternal language barriers. Findings indicated that the relationship between attachment and GPA was significant only among students whose mothers did not have language barriers.

Family & Consumer Sciences - Poster Presentations

Generational Status as a Moderator in the Relationship Between Perceived Parental Support and Perceived Stress Among College Students - *Ashley Arriaga, Faculty Mentor: Sarah Feeney*

Existing research highlights a connection between perceived parental support and stress, but primarily among adolescents rather than college students. The current study examined the association between parental support and stress and explored generational status as a moderator, with the expectation that this relationship would be stronger for first-generation students. Data were collected using an anonymous online survey distributed via social media websites. Participants were current college students between the ages of 18 and 30 (N = 101). Consistent with previous findings, family support was associated with stress, however, when first-generation and continuing generation college students were analyzed separately, results revealed a stronger correlation among first-generation college students. The difference in strength of the two correlations was not statistically significant.

Coping Styles Among Adults When Experiencing Complicated Grief Symptoms During Bereavement - *Gwendolyn Cavalier, Faculty Mentor: Amy Claridge*

Many studies exist examining the relationship between experience of death and grief symptoms, but there is still a need to study the relationship between complicated grief and coping styles. This study focused on the association among adults who experienced the death of a loved one within the last year. In total, 63 participants between 18 and 70 years old completed an online survey. The results of the correlation analysis revealed that there were weak positive associations between complicated grief and both mental disengagement and denial coping styles. These results indicate that participants who reported more symptoms of complicated grief also reported more mental disengagement and more denial during the period of bereavement.

Pediatric Medical Experiences and Medical Care Avoidance During Adulthood -

Connor Jensen, Faculty Mentor: Amy Claridge

Various researchers have studied both pediatric medical experiences and adult medical care avoidance previously. However, research aimed at identifying an association between the two does not seem to exist. Using online survey methodology disseminated through social media platforms, this study recruited a convenience sample of 168 participants between the ages of 19 and 85 years old. Participants completed an online survey consisting of two separate scales to measure participants perceived pediatric medical experiences and later medical care avoidance during adulthood. Associations were identified between the two variables where participants who reported more negative pediatric medical experiences also reported higher levels medical care avoidance within their last year of adulthood. Age and Gender were found to moderate the association where males were more likely to avoid the hospital during adulthood in association to pediatric medical experiences than women and emerging adults (19-25) more so than older adults (26-85). These findings imply a greater need for child life services during pediatric medical care in order to weaken the long-term association with medical care avoidance during adulthood.

Food Insecurity During Childhood and Later Attachment in Personal Relationships -

Tierra Willoughby, Sabrina Fuentes, Kailie Jenkins, and Ashlyn DiDonato, Faculty Mentor: Amy Claridge

According to existing literature, experiencing food insecurity can be linked to negative outcomes for children and their parent(s). There is not enough research on the correlation between food insecurity in childhood and attachment in adulthood. In the present study we looked at the correlation between experiences of food insecurity in childhood and attachment in adulthood. Participants were recruited through social media. In total, 262 adult participants completed an anonymous online survey. Results indicated a connection between food insecurity in childhood and attachment in adulthood, meaning those who experienced food insecurity as an adolescent, were more likely to struggle with attachment in adulthood.

Health Sciences - Oral Presentations

Demographic and Clinical Indicators Associated with Meeting Recommendations For Infant Feeding in Rural Communities - *Emily Gunderson, Faculty Mentor: Tishra Beeson*

Mother's breast milk is considered "liquid gold" providing essential nourishment for growth in all areas including cognitive and motor functions that benefits both the mother and infant. The optimal way to feed infants is exclusively breastfeeding a minimum of six months introducing only breast milk. Women in rural counties have significantly lower rates of exclusive breastfeeding compared to those located in urban settings. The team conducted a pilot study in Rural Kittitas County, Washington using an original survey instrument to determine differences in exclusive breastfeeding rates. For the purpose of this pilot study, the defined dependent variable was whether or not the mother reported her infant received breastmilk exclusively during the first six months of life. Independent variables included household income, age of infant the mother returned to work, gestational age, household size, race/ethnicity, length of leave, unpaid leave, maternal age and spoken language. We collected patients' self-reported information on the type of delivery, employer policies pertaining to breastfeeding break time, or if the employer provided a breastfeeding space. A total of 25 women responded to the survey, with n=8 providing complete responses for analysis. We concluded significance with exclusive breastfeeding between household income and household size based on the Qualtrics survey software with a p-value of 0.0175 and 0.03, respectfully. Limitations indicate the data skewed toward mostly white, highly educated middle-income families and the sample of n=8 is considerably small. These findings are an important step toward scaling efforts to understand correlates of exclusive breastfeeding in rural communities.

Strength Under Pressure - *Jasmin Washington, Faculty Mentor: Jill Hoxmeier*

Intimate Partner Violence (IPV) is a prominent public health issue in the U.S., and evidence suggests that IPV disproportionately affects Black women. Additionally, Black women who are victimized may be reluctant to report and/or seek supportive services. Given these disparities, it is important to understand the context of IPV in the Black community. Although the Superwomen Schema (SWS) conceptual framework's utility for explaining other health-related outcomes, such as mental health issues, among Black women is emerging, its use to understand the experiences of Black women and IPV in the Black community is limited. In this paper, we provide an overview of SWS and IPV to find intersectionality between the two among Black women, including risk factors for victimization, barriers to the usage of mental health services, strength used as a coping mechanism, religious and spiritual concerns and interventions needed for Black survivors. We argue that there is great need for more research using the SWS to understand IPV among Black women, how SWS must be integrated into cultural competency training for counselors, and policies that keep Black women who report IPV safe from incarceration.

Health Sciences - Poster Presentations Presentations

Malaria in Africa - *Jacob Szumski, Faculty Mentor: Tishra Beeson*

This project was a case study of malaria in Africa, specifically the Sub-Saharan region. The research poster will present the public health actions and results, as well as a set of recommendations for future efforts to promote the health of the high-risk people/population. The major health determinants for Africa are primarily poverty and lack of access to resources. The African region accounts for about 93% of malaria cases and 94% of malaria deaths worldwide (World Health Organization, 2020). Patients cannot afford preventive gear or necessary medication to help with the symptoms of malaria. Over the years there has been improvements in both prevention and development of medication. Vaccination development is still in progress but is something that is being worked towards. In recent years the number of malaria cases within Sub-Saharan Africa has fallen, which is a step in the right direction. In an effort to help, public health officials have increased production of preventative instruments, expanded testing and continued to work towards finding a vaccine. My recommendations on this matter are to improve access of preventative instruments to low income communities and greater distribution of anti-malarial drugs to those infected. Public health officials should focus on prevention of this infection to help the people of Africa now, rather than waiting and hoping on a vaccination, which may take many years to develop. Assisting in prevention and creating better access for these low-income communities is what I recommend for a public health action on this issue.

Improvement of Athlete Experience at the High School Level in Cheerleading - *Molly Thomas, Faculty Mentor: Judy Beard and Christina Denison*

Cheerleading is an evolving sport that has not always involved the need for athleticism from the participants. In Washington State, cheerleading started as a rally program with the main goal of generating school spirit and has changed into a performing empire within the many high school programs, each one different from the next. There is now a need to ensure that athletes are provided with a safe and challenging athletic environment that allows for a growth-mindset in bettering their physical abilities. Currently, most cheerleading programs in Washington State for high schools do not require that the coach has any training regarding injury prevention, effective uses of coaching philosophies and goal-setting to name a few. The most common requirement is that the coaches have some experience as a cheerleader themselves. This project is a reference point and guide to research-based practices that have been shown to better improve a cheerleading program at the high school level within Washington State.

A Rural Mothers Guide to Breastfeeding - *Haley Tillett, Faculty Mentor: Amy Claridge*

Breastfeeding is defined as the gold standard of infant health. The benefits provided to both the baby and mother by breastfeeding are unmatched when compared to formula feeding. Recent studies have shown a decrease in rates of breastfeeding, primarily in rural areas. This may be due, in part, to the fact that mothers in rural areas struggle to find the resources and support they need to successfully breastfeed. This guide will provide an overview of breastfeeding resources with a focus on rural areas. Resources include but are not limited to government programs such as WIC, hospital or birthing center offerings, and community involvement opportunities such as support groups.

College of Business

Business - Poster Presentations

The Exploitation or Protection of Communities and Exploited Persons? - Spencer Boldt (*William O. Douglas Honors College, Women's, Gender and Sexuality Studies*), *Faculty Mentor: Anne Cubilie*

This study, *The Exploitation or Protection of Communities and Exploited Persons?*, was intended to dissect the inner workings of the newly implemented Bill C-36 in Canada, *The Protection of Communities and Exploited Peoples Act* through a mixed methods approach. This was done through comparing statistical research (demographics, crime data, and overall economic state) within Regina to interviews conducted with those individually involved in prostitution and the community of the city. This study was meant to draw out the differences between what the statistics depict, a growth in the overall safety of Regina, versus the perspectives gained from multiple interviewees. With this mixed methods approach I have deduced that Bill C-36 is not achieving what it was set out to do. The conclusion of this paper outlines a variety of alternative measures, aimed at efficiently improving the safety of these women affected by Bill C-36 and the communities of Canada. The solutions proposed are gained from different global case studies and research done pertaining to sex work and the intricate business industry it has generated.

Economics - Oral Presentations

Washington State Real Estate Prices - Blake Ellestad, *Faculty Mentor: Thomas Tenerelli*

For my presentation, I will be analyzing housing prices in different counties in Washington state. My goal is to evaluate why some counties cost of living has become much more expensive versus other counties. I plan to relate new businesses and infrastructure into my analysis and the impact they have on the county they are located in. I will be looking directly at housing prices in these specific counties where new businesses have a prominent appearance against other counties that are not as fortunate.

Finance & Supply Chain Management - Oral Presentations

United Airlines Holdings (UAL) Stock Evaluation - *Jargal Ganzorig, Faculty Mentor: Thomas Tenerelli*

This presentation will analyze a company to determine its worthiness as an investment vehicle. A summary of the business will be provided and the competitors will be identified. The company's market position and growth opportunities will be evaluated. That evaluation will be translated into quantitative assumptions on growth in a two-stage discounted cash flow model of company valuation. The company's value will be estimated and presented using a detailed financial model in Excel.

Stock Analysis - *Jeronimo Silvas, Faculty Mentor: Thomas Tenerelli*

This presentation will analyze a company to determine its worthiness as an investment vehicle. A summary of the business will be provided and the competitors will be identified. The company's market position and growth opportunities will be evaluated. That evaluation will be translated into quantitative assumptions on growth in a two-stage discounted cash flow model of company valuation. The company's value will be estimated and presented using a detailed financial model in Excel.

Financial Analysis - *Derek Zinn, Faculty Mentor: Thomas Tenerelli*

This presentation will analyze a company to determine its worthiness as an investment vehicle. A summary of the business will be provided and the competitors will be identified. The company's market position and growth opportunities will be evaluated. That evaluation will be translated into quantitative assumptions on growth in a two-stage discounted cash flow model of company valuation. The company's value will be estimated and presented using a detailed financial model in Excel.

Macroeconomic Outlook - *Derek Zinn and Jargal Ganzorig, Faculty Mentor: Thomas Tenerelli*

This presentation will attempt to offer insight into near-to-medium-term stock market movements by assessing the current macroeconomic conditions and the current stock market valuation relative to historical levels. The relationship between recessions and stock market corrections will be identified. The macroeconomic outlook, in particular, the probability of recession, will be evaluated. Current unemployment rates, inflation rates, and interest rates will be analyzed in the context of an aggregate demand and aggregate supply model. Ultimately, current unemployment will be measured relative to the perceived Non Accelerating Inflation Rate of Unemployment (NAIRU) / Natural Rate to understand future effects on wage inflation and hence Fed discount rates. The probability of a recession in the next 6 months and beyond will be assessed. Stock market valuation will also be analyzed to better understand the downside stock market risk in any potential future recession.

College of the Sciences

Anthropology & Museum Studies - Oral Presentations

Japanese Shintoism: The Way of Kami - *Alexander Cook, Faculty Mentor: Penglin Wang*

This presentation focuses on the key aspects found within the religion Shintoism, focusing on its main categories, “Kami”, and how Shintoism co-evolved with Japanese society, politics and technology. Firstly, this presentation will try, and concisely explain the ideas that form the foundation of Shintoism. The ideas of Kami, integration of nature, and animism will be integral to forming a strong understanding of this religion. With this we will also focus on the creation myths of Japan, supernatural beings of importance, and the roles of Kami in Japanese life. Along with the spiritual, the physical themes of Shinto will also be addressed, with a focus on Shinto shrines, and activities observed there. This will include priesthood, shrine creation, and rituals. After presenting the common tenants, and beliefs of Shintoism, the presentation will focus on the ways that Shintoism has changed through history. Going from the early creation of Japan's monarchy, to the age of isolationism, and present day. Part of this section will be devoted to the idea of “State Shinto”, when the Japanese government used Shinto ideals to gain support for action during WWII, especially the notion of the Emperor being a “God King ”. Moving from WWII, we will look at the interesting relations formed between Shintoism, and Buddhism, and how these faiths are expressed in Japan’s modernized population. The goal of this presentation is to bring a more general understanding of Shintoism, and to explore important anthropological topics such as animism, ancestral worship, and ecological relations with belief systems.

Coexisting Natures in the Tropical Dry Forests of Mexico - *Mackenzie Stinson and Jazmin Gonzalez, Faculty Mentor: Rodrigo Renteria*

The coastal region of Jalisco, Mexico, known for its biological diversity, is home to many endemic species of the tropical dry forest. In the heart of the forest resides the Estación de Biología, Chamela (EBCh), a biological research station administered by Universidad Nacional Autónoma de México (UNAM). EBCh is located in the Chamela-Cuixmala Biosphere Reserve, and within this region biologists work intensively to try to understand the biological dynamics and systems throughout this unique coastal ecosystem. Wherever research is produced, local knowledge, participation, and opposition often become intertwined. This intersection allows for anthropological lenses to unveil perceptions from the community of the land to the community of science, thus to ultimately understand the challenges among various stakeholders. A comparison of the perceptions of wildlife and domesticated life was conducted among farmers, biologists, and conservationists throughout the region of Chamela and Cuitzmala, Jalisco. Ethnographic accounts show that although the guarded natural lands benefit regional tourism, preservation, and conservation, the discrepancies of land use between these institutions and the public threaten the need for future integration of biological and cultural conservation.

Anthropology & Museum Studies - Poster Presentations

Sanders Site Archaeology: Feature Identification - *India Briggs, Faculty Mentor: Steven Hackenberger*

Following the lead of other student collection analyses this study examines the documentary and artifact evidence for features in six strata. The results of this study can be split into two sections: feature identification and stratigraphic analysis. Results illustrates general activity areas and discrete features including concentrations of bone refuse. Concentrations of bone with spiral fractures represent marrow extraction from deer and deer size long bones. In these concentrations, bones with spiral fractures represent marrow extraction. Most of this subsistence activity dates to about 3000 years ago; however, one feature may date as early as 5000 years. Fauna samples from the lower strata supplement a larger sample analyzed by Endacott and others. This lower strata also contain deer: however, Big Horn sheep (*Ovis canadensis*) are also present. With additional analysis of other samples, we may be able to document changes in environment, subsistence, and settlement displayed during the Frenchman Springs phase.

A Geoarchaeological Investigation at Sentinel Springs (45KT297), southcentral Washington - *Mackenzie Hughes (School of Graduate Studies), Steven Spencer and Josh Allen, Faculty Mentor: Steven Hackenberger*

The Summer 2019 Central Washington University field school and Central Washington Anthropological Survey excavated four 1x1 m units at lower Sentinel Springs (45KT297) for the US Army Yakima Training Center. The stratigraphy of Units 2 and 4 were documented and bulk sediment samples were taken for each stratum. Unit 2 was excavated in 10 cm levels to 120 cmbd and a bucket auger was used to collect samples to a depth of 386 cmbd in arbitrary levels. A bone from 61 cmbd is dated to circa 2,200 years ago. Data for texture, color, magnetic susceptibility, and debitage are compared for each sediment sample (n=34). The results indicate varying depositional processes working at Sentinel Springs and buried soil horizons associated with three major episodes of climate change.

Comparison of Faunal Assemblages Through Time at the Sanders Site (45KT315) - *Mackenzie Hughes, Faculty Mentor: Patrick Lubinski*

The Sanders Site (45KT315) is located adjacent to Johnson Creek on the Yakima Training Center (YTC) in southeast Washington. Excavations in 1978 and 1979, followed by subsequent analyses undertaken at the site over the past fifty years, have resulted in several unanswered research questions. This investigation assesses the faunal assemblage variability between the upper and lower levels of Unit 26 in Trench 1504 using NISP, taxonomic determinations when possible, and size classes. Previous researchers have used these methods to explore similar research questions within Trench 1504, however, Unit 26 has yet to be analyzed. In coordination with the seven radiocarbon dates currently possessed for the Sanders Site, further faunal analysis of the depositional components can reveal differences in resource extraction by the occupants of the Sanders Site over time.

Gender and Sexual Orientation Differences on Attractiveness of Venus Figurines with Varying Waist-to-Hip Ratio's - Miranda Maple, Faculty Mentor: Karisa Terry

Venus Figurines from Eurasian Upper Paleolithic archaeological sites have several origin theories, ranging from fertility deities to forms of self-expression, either way, something about the figurines was considered valuable – valuable enough to be produced in the past and now studied in the archeological record. Is there something that our early human ancestors found attractive in the figurines that we also find attractive today? Studies of Waist-Hip-Ratios (WHR) of human populations correlates higher degree of perceived physical attractiveness of females by males to those with WHR between 0.60-0.80 (e.g. Bovet 2019; Marlowe et al. 2005; Singh 1993). Archaeologists (Dixson and Dixson 2011) have correlated these findings of living human populations to level of attractiveness of Venus Figurines from Eurasian Upper Paleolithic archaeological sites. However, none of these studies have considered how gender and sexual orientation play a role in how humans perceive attractiveness of Venus Figurines with a WHR that exceeds 0.60-0.80. This study incorporates sexual orientation, gender identity, and WHR as variables in determining level of attractiveness of Venus Figurines through questionnaires of CWU students, staff, and community members. We expect that the figurines with the closest to a desirable WHR (0.60-0.80) will be deemed most attractive. Additionally, results from the questionnaire are compared to the expectation that the familiarity of the Venus of Willendorf figurine from popular culture should result in this figurine having a high attractiveness score regardless of WHR.

35-WA-288 A – Tryon Creek – A Comparison of Projectile Point Types - Noella Wyatt, Faculty Mentor: Steven Hackenberger

The Tryon Creek assemblage (Hells Canyon) is curated under an agreement with the USFS. The author continues to collaborate with Hackenberger and students to manage and study the collection. A re-examination of the type and distribution of point types confirm the diversity present in dart and arrow size points. Stratigraphic and activity area analysis of House 2 (500-1500 B.P.) illustrate the correspondence of types, which may reflect behavioral mutualism. Metric analysis of four forms represented in an overall sample of 126 points indicate an expected spread of sizes in arrow points. Twenty-six points were selected based on completeness for metric analysis. Corner-Notched points (n=100) dominate in all levels of the house, although Basal-Notched points are common (n=16). Side-Notched points (n=8) also occur in all occupation zones/levels. Nine lithic sources are represented, and both Chalcedony and Chert/Jasper are heat-treated. Red-Glassy Basalt is locally available and common. Obsidian is surprisingly rare given the relative proximity of the Timber Butte source (approx. 400 km).

Anthropology & Museum Studies - Creative Expression Presentations

In Our Own Skin - *Jonah Kathlean, Faculty Mentor: Lene Pedersen*

Based on research of the Tlingit, a Southeast Alaskan Tribe, this short anthropological documentary showcases contemporary Tlingit artists alongside their artwork. These artists express changes among Native American identity through their various forms of art and contribute to important discussions about what it means to be Tlingit today. This mini-documentary accompanies a larger student project that was delayed due to the recent COVID-19 pandemic. This project involved exploring the community of Tlingit members to better develop an understanding of how this community is threatened by a disappearing language. With a focus on Native American visual arts to showcase the importance of expressing culture through artistic mediums, this presentation is an intermediary project, based on phone interviews with our participants, existing interview footage from principal shooting, and other stock footage. It will include an introduction of contemporary Tlingit artists and their important contributions to Tlingit identity along with other Native American tribal artists located throughout the nation. This mini-project presents an opportunity to explore outside the Tlingit community to study what kinds of symbols and patterns other tribal artists around the country are including in their artistic expressions to represent a culture. In addition to showcasing the Tlingit, other Native American artists, and their contributions to discussions about indigenous identity, this short documentary will set in motion a series of artistic collaborative meetings in preparation for the larger project and production, the People of the Tides documentary.

Biological Sciences - Oral Presentations

Plant Responses to Disturbance and Drought in a Mexican Tropical Deciduous Forest - *Carla Barbosa, Faculty Mentor: Daniel Beck*

Tropical deciduous forests show strong seasonality in rainfall with a pronounced dry season extending 6 to 8 months; they are also among earth's most endangered terrestrial ecosystems. This study took place in a tropical deciduous forest of coastal Jalisco, Mexico within Estación de Biología Chamela (EBCh). In October 2015, our study site was struck by Patricia, a category 5 hurricane which drastically altered the structure of the forest. I investigated the potential effects of this disturbance to epiphytes in the genus *Tillandsia*, both inside and outside the forest. I compared photosynthetic activity of *Tillandsia rothii* and *T. intermedia* between open, edge habitats (like those created from the disturbance of the hurricane) and more closed, forested habitats. I also explored how several common tree species respond to the strong seasonal drought in the forest. I worked with researchers from EBCh to measure growth rates under normal (control) and drought conditions in six different tree species trees found in the tropical deciduous forest. For epiphytes, I found no significant differences in photosynthetic rates between forest and edge habitats. We might expect different results in areas with greater human disturbance. Tropical dry forest trees showed considerable variation in their response to drought. Cedro (*Cedrela odorata*) and Kapok (*Ceiba pentandra*) had the most notable drop in growth rates under the drought treatment. *Ficus* sp. and *Guaiacum coulteri* showed relatively little response. Trees that were more strongly affected by drought were those which seemed to thrive better in areas with a nearby water source.

Structure and Morphometrics of two Cane Toad (*Rhinella marina*) Populations in Coastal Jalisco, Mexico - Angelica Bustos-Ortiz, Faculty Mentor: Daniel Beck

An important goal in ecology is to understand what allows species to be successful invaders. The cane toad (*Rhinella marina*) is native to Mexico and South America but has successfully invaded 1/3 of Australia since being introduced in the early 1900s. To explore factors associated with why *R. marina* are such successful invaders, we investigated Cane Toads in a seasonally dry tropical forest (SDTF) in coastal Jalisco, Mexico, where they are native. We compared features of two cane toad populations: one from a relatively undisturbed forest (Chamela) and another, approximately 12 km away, in a village (Francisco Villa). Previous data suggested that toads from the forest were larger than those in the village and therefore might be more nomadic. Therefore, I predicted that forest toads would show differences from those of the village in size and population structure. I measured body and limb lengths of all captured toads and used the mark-recapture methods to estimate population sizes. Population sizes were similar in Chamela and Villa, toads in Chamela were significantly larger and heavier (with longer limbs). Both populations had sex ratios highly skewed towards females (which were also larger than males), traits that contribute to their potential to be invasive. Plausible reasons for size differences could be predators, levels of activity, and food availability. Continued investigation of these cane toads year after year will help better understand the dynamics of their populations and why *Rhinella marina* can become so invasive in habitats where they are not native.

Thermal Biology of the Mexican Spotted Wood Turtle in a Tropical Deciduous Forest - Nicholas DeHollander, Faculty Mentor: Daniel Beck

As global temperatures have increased with climate change, hurricanes have become stronger in the tropics. In October of 2015, Hurricane Patricia, a massive, category 5 storm struck the tropical dry forest (TDF) of Chamela, Jalisco, a biosphere reserve in western Mexico where this study was done. The strong winds broke branches, toppled trees, and deposited considerable woody debris onto the forest floor, resulting in a more open forest canopy and increased surface temperatures. We investigated how the Mexican Spotted Wood Turtle (*R. r. perixantha*), an endemic terrestrial turtle in Mexico's TDF, responded to the changes in forest temperatures brought about by this disturbance. We outfitted six turtles with continuous hourly temperature dataloggers during 12 weeks of the dry (March-June) and wet (August-October) seasons of 2019. We also sampled forest temperatures by placing temperature-logging copper models on exposed surfaces, and under woody debris, in microhabitats available to the turtles. Temperature data were retrieved on three males and one female for both seasons. Temperatures of dataloggers carried by the turtles during the dry season were significantly cooler and showed much greater variation ($25.98^{\circ}\text{C} \pm 4.5$; $n=4$), than during the wet season ($28.08^{\circ}\text{C} \pm 2.6$; $n=4$). Temperatures of data loggers (copper models) in the forest were higher (and less variable) during the wet season, suggesting that thermoregulation may be more challenging at that time because there are fewer temperature options for turtles. As forest temperatures increase due to climate change, turtles may have more difficulty finding adequate microhabitats in which to thermoregulate.

Mary Cynthia Dickerson: A Forgotten Female Herpetologist - *Emma Houghton, Faculty Mentor: Tamara Caulkins*

Mary Cynthia Dickerson (1866-1923), the first female curator at the American Museum of Natural History, founded the museum's Herpetology Department (reptiles and amphibians). She was highly regarded as a herpetologist at a time when most scientists were men. She discovered over twenty new reptile species and four species/subspecies were named after her. She pioneered new ways to preserve reptiles to create more life-like exhibits. In 1906, she published *The Frog Book: North American Toads and Frogs with a Study of the Habits and Life Histories of Those of the Northeastern States*, describing the life history (reproduction, social behavior, life cycle, etc.) of all of the known toads and frogs in the Northeastern states at the time of the publication, about 58 species. She included 290 of her own photographs which made the book popular with the public. Despite these accomplishments, Dickerson is virtually unknown to both scientists and the public today. My research has shown that it is likely due to her male colleagues that her work is not well documented in history. They blamed Dickerson's developing mental illness on her overly ambitious workload. Many men in this time period did not believe women were capable, authoritative, or intelligent enough to be placed in leadership positions. As a woman, Dickerson did not even have the right to vote until three years before she died. My research not only showcases Dickerson's remarkable scientific accomplishments but also celebrates a female scientist who has been unjustly forgotten due to her gender.

Me, Myself, and I: The Impact of Metacognitive Strategies on Student Locus of Control and Critical Thinking Skills - *Danielle Kuchler (School of Graduate Studies), Faculty Mentor: Ian Quitadamo, Jennifer Dechaine, and Ralf Greenwald*

Just 60% of students graduate from 4-year colleges and universities in 6 years or less. Two skills possessed by university students who do graduate on time are high critical thinking skills and an internal locus of control. These two skills can be improved through metacognitive techniques. This study examines if increasing metacognitive practices in an undergraduate biology class will shift students' academic locus of control and critical thinking skills within an academic quarter. This quasi-experimental study compared two groups of CWU Biology 101 lab students; one group received increased metacognitive questions in their lab handouts and the other group was taught with standard lab handouts. Participants in each group completed an Academic Locus of Control Scale and California Critical Thinking Skills Test at the beginning and end of the quarter to determine changes in those areas. Although statistically significant changes were not observed in either group overall, age and parents' education level were found to be significant contributors to the critical thinking changes that did occur. Student work was also analyzed to determine performance on higher-order thinking skill questions in their labs. These results inform us about factors that contribute to academic achievement as well as the best methods to prepare students for their university experience.

Early Life History and Stock Discrimination of Kokanee Salmon (*Oncorhynchus nerka*) in an Alpine Lake Environment - Alexandra McCarrel (School of Graduate Studies), Faculty Mentor: Paul James

Kokanee salmon (*Oncorhynchus nerka*) are an ecologically and recreationally important species in many lakes in the Cascade Mountains. One such population that inhabits Lake Keechelus in the central Cascades of Washington state are considered a vital food base for a critically low population of bull trout in the lake. The kokanee spawn in large numbers in the lake's main tributary, Gold Creek. However, other than spawning areas, not much is known about the early life history of this population, how they interact with unique features in their rearing environment, or their natal origins (hatchery vs. wild-born). With my research I created a descriptive early life history of Gold Creek kokanee and a framework to determine the natal origin of spawning adults. Monitoring in 2019 showed kokanee that spawned in Gold Creek produced viable eggs that survived the winter, and emerged in mid-April. The majority of adult kokanee avoided spawning in Gold Creek itself, preferring a man-made outlet channel from Gold Creek Pond that had significantly higher water temperatures and a prominent beaver dam. Significantly higher densities of larvae were recorded below the beaver dam compared to upstream, with larvae emergence being episodic throughout spring months. Stock discrimination (hatchery vs. wild-born) of spawning adults is being determined by comparing early life history stages using otolith microstructure analysis. With this research, the future restoration efforts of the region can integrate the life history data of kokanee as well as quantify the potential role hatchery fry contribute to the ecosystem.

Investigating the Avian Species Composition, Diversity, and Abundance of Engelhorn Pond - Kiana Rose, Faculty Mentor: Alison Scoville

Central Washington University's Engelhorn Pond contains important habitats for many organisms, particularly migratory birds, and is a valuable resource for students. However, little information is available about the wildlife inhabiting the pond. The pond's discrete location means that many people are unaware of its existence. In addition, the pond is threatened by a number of anthropogenic sources, including garbage, chemical runoff, and feral cats. By using point counts, a common ornithological survey technique, I recorded the bird species present at the pond during all seasons of the year. I collected data using point counts during 13 visits from June of 2019 to March of 2020. I made 13 additional visits to the pond to take photographs and make observations from April of 2019 to February of 2020. I found that at least 70 bird species were present at Engelhorn Pond. During my surveys, I took photographs and created sketches, which I have used to compile a field guide for the public to use. This guide will serve as an important resource for students, teachers, and other pond visitors. My goal is for this guide to raise awareness of the pond and increase the number of visitors to this hidden gem. In addition, I hope that my project will spur more effective management and conservation practices at the pond.

Ecological and Genetic Connectivity of Shrews (*Sorex* spp.) Across Interstate-90 in Washington State. - *Jordan Ryckman (School of Graduate Studies), Faculty Mentor:*

Kristina Ernest

To mitigate impacts on wildlife from widening Interstate-90 in the Cascades, the Washington State Department of Transportation in collaboration with other organizations is building wildlife crossing structures to increase ecosystem connectivity. This study focused specifically on shrews near sites where crossing structures will be built. The main objectives were to determine habitat preferences of the several sympatric shrew species and to assess the population genetic structure of the most abundant species. We set up live-trapping transects north and south of the highway in three different habitat types: wetland/riparian, lowland, and upland. Pitfall and Sherman traps on each transect were trapped twice for two consecutive nights during summer 2019. We also measured microhabitat characteristics within each habitat type to determine correlates of shrew abundance. We captured six species totaling 135 individuals of Marsh Shrew (*Sorex bendirii*), American Water Shrew (*S. palustris*), Trowbridge's Shrew (*S. trowbridgii*), Montane Shrew (*S. monticolus*), Vagrant Shrew (*S. vagrans*), and a sixth species (possibly *S. rohveri*). Total captures and individual species showed no significant preference for habitat types or microhabitat characteristics. DNA extracted from tissue samples of these individuals will be analyzed to determine the genetic structure of populations on the same side of I-90 compared to opposite sides to determine if I-90 acts as a barrier to movement. The results of this study will aid future habitat restoration projects and can be replicated in the future to determine the success of wildlife crossing structures for even the smallest of mammals.

The Effects of Induced Polycystic Ovary Syndrome in NAG-1 Transgenic Mice -

Nicholas Werner, Faculty Mentor: April Binder

Polycystic ovary syndrome (PCOS) is the leading cause of infertility, and the most common endocrine disorder among women of reproductive age, affecting between 8-12% of the population worldwide. PCOS is characterized by cystic ovaries, hormonal irregularities, and metabolic dysfunction. The metabolic dysfunctions associated with PCOS may include obesity, glucose intolerance, and type II diabetes. Because hormonal irregularities are the primary cause of the metabolic symptoms, they are difficult to treat. However, previous studies conducted on the gene NAG-1 have shown it may prevent metabolic disorders when overexpressed. Studies on NAG-1 have focused on diet induced metabolic disorders, and not hormonally induced disorders like those seen in PCOS. Our study focuses on NAG-1, and if it can prevent any of the metabolic disorders associated with PCOS. To study this, we induced PCOS in mice via dihydrotestosterone (DHT) implant, and monitored them for 90 days, after which tissue and serum samples were collected for analysis.

We observed no change in weight between the NAG-1 DHT and placebo groups, suggesting NAG-1 may prevent hormonal induced obesity. We also observed no changes in adipocyte sizes between the NAG-1 groups. DHT treated animals entered puberty at an earlier age than placebo groups and ovarian dysfunction was observed. DHT treated animals had disrupted estrus cycles and significantly less corpus lutea in their ovary, suggesting altered ovarian function. WT placebo and DHT groups had significant differences in all aforementioned metabolic phenotypes. Our findings suggest that overexpression of NAG-1 may prevent some metabolic dysfunctions associated with PCOS.

Diversity Analysis of Soil Fungus Communities in Disturbed, Nursery, and Mature Forest Conditions- *Dana Whitmore, Faculty Mentor: Jim Johnson*

Success of revegetation efforts is often limited by poor soil quality. The Forest Service and WS-DOT will face this reality when they introduce plants to the I-90 wildlife overpass. One proposed solution is to inoculate the bridge with native soil plugs to restore microbial communities. Establishment of diverse soil fungi communities will have great positive impact on soil quality and increase survivorship of introduced plants. This study will provide an analysis of community structure and diversity of fungi in the soils on the bridge, in the nursery soils where the plants are being primed for transplantation, and at a possible site for native soil plug collection. Future studies of the crossing structure will use this project as a baseline. A total of 121 soil cores have been gathered from the four sites, and fungal DNA was extracted from each core. After sequence data are returned from MrDNA labs, the sequences will be designated to operational taxonomic units. OTUs will then be sorted according to mycorrhizal or saprophytic lifestyle and examined for overlap between the sites. Diversity indices will be calculated from species richness and evenness. Reduced diversity and saprophyte-dominant communities are expected in soils on the crossing structure due to intense disturbance. The nurseries are anticipated to have moderate diversity indices as a result of constant low-level disturbance and known prevalence of particular species. Soils surrounding Swamp Lake are characterized by numerous hosts and low disturbance, so are predicted to contain diverse fungal communities of late succession species.

Biological Sciences - Poster Presentations

Batting around Wildlife Crossing Structures: Under or Over the Highway? - *Jenna Chapman, Faculty Mentor: Kristina Ernest*

Roads can have negative effects on wildlife by isolating populations, fragmenting their habitats, and directly killing animals in collisions with vehicles. Recent studies have highlighted the negative impact roads have on the availability and accessibility of roosting and foraging habitats for bats. This cannot be taken lightly because insect-eating bats have important ecosystem roles, and their conservation status in North America is of growing concern. Washington State Department of Transportation (WSDOT) has created multiple wildlife crossings along Interstate-90 near Snoqualmie Pass to increase ecosystem connectivity. WSDOT and its partners, including CWU, are monitoring various wildlife species to evaluate their use of these structures. Our proposed study will investigate whether wildlife crossing structures help reduce the negative effects of roads on bats by providing them a safe way to cross the highway. My specific objectives are to determine whether (a) bats are crossing the interstate, (b) all or only a subset of bat species in the habitat adjacent to the interstate are crossing the interstate, and (c) bat activity is more frequent within crossing structures than at nearby unmitigated sections (areas of the interstate without crossing structures). To achieve this, I will use mist netting and acoustic detectors to monitor and compare bat activity under 3 underpasses, above 3 unmitigated sections, and in the montane habitats north and south of the interstate. By comparing activity among these sites, we can start to understand if crossing structures facilitate movement between habitats fragmented by a major highway.

Effect of plant growth-promoting bacteria on freezing-tolerance for winter wheat (*Triticum aestivum*)- Samantha Darling, Faculty Mentor: Mary Poulson

Winter wheat (*Triticum aestivum* L.) is of huge importance to global agriculture. Wheat is sown in the fall, germinates and then goes dormant to resume growth in the spring. Although winter wheat strains are bred to tolerate gradual changes in temperature, unexpected frosts in the spring can potentially cause cellular damage and decreased growth rates for young plants. Plant growth promoting bacteria (PGPB) have been shown to play an integral role in increasing plant tolerance to drought, salinity and pathogens but effects of PGPB on plant cold hardiness has not yet been well documented. In this project, young wheat plants were inoculated with three PGPB strains shown to enhance plant stress tolerance: *Pseudomonas fluorescens*, *Bacillus subtilis* and *Paenibacillus polymyxa*. After germination and a short growth period at 21°C, plants were exposed to cold (5°C or 12°C) salt (100 mM NaCl) or drought (25% of water given to control plants). Plant productivity was determined by measuring total plant biomass and freezing tolerance was assessed by measuring ion leakage from cells after freezing. Growth of plants was reduced by nearly 50% for plants at 12°C or 5°C. Salt did not affect plant growth. Drought reduced plant fresh weight by 40% but only 10% dry weight. PGPB did not affect plant growth or susceptibility to freezing tolerance for salt or drought plants. For plants not previously exposed to cold stress, however, inoculation with *P. polymyxa* did lend some protection from freezing stress.

Demographic Comparison of Semi-urban and Wild Populations of *Kinosternon chimalhuaca* - Jose Garrido, Faculty Mentor: Daniel Beck

Members of the mud turtle family, Kinosternidae often use man-made water sources such as cattle troughs and irrigation ditches to survive in increasingly urbanized and arid regions. However, the effects these conditions have on turtle population structure are still poorly understood. The Jalisco mud turtle (*Kinosternon chimalhuaca*) was first described in 1997 in a small range south of Puerto Vallarta, Mexico. Since its description, critical ecological research has remained largely nonexistent, hindering conservation and management. Our research reports the first analysis of *K. chimalhuaca*'s population structure in a comparative study of a pristine wild habitat in the Chamela-Cuixmala Biosphere Reserve, and a nearby semi-urban habitat in a nearby town. In 2019, our team surveyed a small ~1km irrigation ditch in the middle of this town and astonishingly captured 226 turtles, estimating a population of $\sim 750 \pm 56$ individuals. Similar trapping effort in the wild habitat surrounding the Chamela field station yielded only a dozen individuals. In town, turtles exhibited an inverted female:male ratio ($\sim 2:1$, $n=200$) when compared to wild turtles ($\sim 1:4$, $n=35$). Furthermore, wild turtles were found to be significantly larger in length between sites ($p= 0.0004$) with wild males exhibiting a more bimodal distribution. This warrants further investigation into the driving factors of abundant semi-urban populations and the significance of human-turtle interactions and in the face of global turtle declines. These findings represent a preliminary dataset prior to conducting a full comparative ecological study of population structure, diet and movement ecology at both study sites this summer.

Evaluation of anti-Leishmania properties of lactam organic molecules for the treatment of leishmaniasis- *Kenlei Gunther, Faculty Mentor: Blaise Dondji*

Leishmania are protozoan parasites that cause a complex of diseases known as leishmaniasis. There are six species causing disease in humans: *L. tropica*, *L. major*, *L. mexicana*, *L. braziliensis*, *L. donovani*, and *L. infantum*. We use *L. major* in lab. It is the causative agent of cutaneous leishmaniasis and found in sparsely inhabited regions in west and central Africa, the Middle East, and India. In cutaneous leishmaniasis, sand fly vectors transmit the parasite through a bite. Ulcers appear at the site of the sand fly bite. Severity of ulcers depend on age and other factors. 350 million people worldwide are at risk of becoming infected with leishmaniasis. Surprisingly, there is an overlap between leishmaniasis infected areas and areas of increasing human immunodeficiency virus (HIV) infections. Thirty-five countries have reported co-infections. Current anti-Leishmania drugs are toxic with serious side effects. Consequently, there's a need to develop safer therapeutic methods. Organic compounds that belong to the lactam group were tested in vitro to identify potential anti-Leishmania drugs. Assays were carried out to evaluate the activity of tested compounds against Leishmania parasites. 1% DMSO was used as negative control and Amphotericin B was used as positive control. DMSO negative control is justified by its use to dissolve candidate compounds. Amp B is one drug used to treat human leishmaniasis. Alamar Blue dye was used to evaluate activity of compounds. In living cells, Alamar Blue is reduced from blue to red and wells show high optical densities such as 0.85 after the spectrophotometer read.

Ticks on Lizards: Parasite-Host Interactions of the Southern Alligator Lizard (*Elgaria multicarinata*) in Washington State - *Emma Houghton (William O. Douglas Honors College), Faculty Mentor: Daniel Beck*

I investigated interactions between ectoparasites (ticks) and their host, the southern alligator lizard (*Elgaria multicarinata*). Alligator lizards are capable of complement-mediated killing of the Lyme disease spirochete carried by ticks, and may potentially reduce Lyme disease prevalence by cleansing pathogenic organisms from ticks. Despite this, little is known about host-parasite dynamics in alligator lizards. My goals were to 1) assess patterns of tick presence (i.e. parasite load) on alligator lizards and 2) investigate potential negative effects of ticks on alligator lizards. I sampled lizards during the summer of 2019 near Catherine Creek, along the Columbia River Gorge in southern Washington. Ticks were counted on all lizards captured, removed with tweezers, and stored for later analysis. Lizards were weighed, measured (snout-to-vent length, tail length), and released on the study site. A "body condition index" was determined for each lizard and compared to its parasite load to test the hypothesis that ticks are associated with reduced lizard fitness. Parasite load averaged 0.4 ticks/lizard (range: 0-2), with 25% of 16 lizards sampled having at least one tick. Ticks showed a preference for lizards with longer tails, a result which matches observations of other studies of *E. multicarinata*. I found no relationship between tick presence and lizard body condition. Our research is ongoing, using molecular techniques such as diagnostic PCR to determine the tick species involved (possibly *Ixodes pacificus*, the western black-legged tick) and whether *E. multicarinata* could reduce the amount of Lyme disease and Rocky Mountain spotted fever in Washington's ticks.

Spatial and Temporal Relationships of the American pika (*Ochotona princeps*) in human-modified habitats near Snoqualmie Pass- *Michelle Kakadelis, Faculty Mentor: Kristina Ernest*

Though the range of the American pika (*Ochotona princeps*) extends throughout western North America, individual subpopulations are found in rocky patches that are separated by habitat barriers. These subpopulations face many obstacles to dispersion that can be exacerbated by human-made stressors and barriers. One such barrier is Interstate 90, which is currently under study near Snoqualmie Pass. Data from this study will be used in this project to analyze the temporal and spatial patterns of pika occupancy. The available data contains information on patch occupancy from 2008-2019 as well as the geographic location and patch type as defined by the characteristics of the area (natural vs. anthropogenic). Using GIS analysis and publicly available digital elevation maps (DEMs), slope, elevation, and aspect of each patch will be determined. Spatial statistical analysis will be used to determine whether there is any correlation between pika occupancy and distance between patches, and a time series will be produced to analysis occupancy over time. The results of these analyses will help expand the knowledge of the movement of pika metapopulations and how the presence of anthropogenic vs. natural rocky patches can affect this movement. Pikas are extremely sensitive to high temperatures and as human activity continues to exacerbate both climate change and habitat fragmentation, the ability to understand the pika's movements will be valuable to its conservation efforts.

Effect of synthesized organic compounds against the parasite *Leishmania major* - *Christy Krischano, Faculty Mentor: Blaise Dondji*

Leishmaniasis is a collection of diseases that arise from the protozoan parasite *Leishmania*. The parasite is transmitted to humans from the bite of a sand fly, the initial host of the parasite. Leishmaniasis has three clinical forms: cutaneous, mucocutaneous, and visceral. In the lab, we work with *Leishmania major*, which causes the cutaneous form of leishmaniasis and results in ulcers at the site of the sand fly bite. Over 350 million people are at risk of being infected with leishmaniasis in southern Europe, Africa, Central and South America, the Middle East, and India. However, with changes in climate and the environment it is possible that sand fly vectors and *Leishmania* parasites could spread to other parts of the world. An estimated 12 million people are currently infected. Drugs currently used to treat leishmaniasis are toxic, which demonstrates the need for developing a safer treatment for leishmaniasis. Organic compounds were tested for anti-*Leishmania* properties to determine their potential as a drug treatment for leishmaniasis. In vitro assays were performed to evaluate the effect of the compounds on the *Leishmania* parasites. 1% DMSO was used as the negative control as it is used to dissolve the compounds being tested, and Amphotericin B was used as the positive control because of its current use for treating leishmaniasis. The activity of the compounds was assessed by using Alamar Blue dye, which turns red and increases in fluorescence in the presence of live cells, allowing the optical density to be measured from spectrophotometer readings.

Identifying Microplastic Sources and Longitudinal Patterns in the Yakima River-

Erica MacKenzie, Faculty Mentor: Clay Arango

People generate an estimated 275 million tons of plastic waste annually, with about 8 million tons entering oceans. Significantly more is known about the abundance and effects of microplastics in marine environments, but less than 4% of microplastic studies have been in freshwaters. Microplastic, one of the most prevalent forms of plastic pollution, presents a danger to wildlife and organisms since it can enter the circulatory systems and food web. In this study I investigated the abundance and type of microplastic in the Yakima River by collecting water column and sediment samples from Snoqualmie Pass to Benton City. Every water column sample contained microplastics, including samples collected near the Alpine Lake Wilderness Area, averaging 37 fibers and 1.2 fragments per liter. Although wastewater treatment plants are known sources of microplastics, there was no difference in fiber or particle abundance up or downstream of treatment plant outfalls (paired t-test, $p=0.38$, $p=0.32$ respectively). While reservoirs may either be a sink for plastics or an entry for aerially deposited plastic, there was no difference up or downstream of reservoirs for fibers or particles (paired t-test, $p=0.17$, $p=0.74$ respectively). We did not find an upstream to downstream trend in microfiber or fragment abundance, but we did find a positive correlation between microfibers and particles (regression, $p=0.02$). Although this research establishes that microplastics are present, but more research is needed to understand the sources and fates of microplastic in the Yakima River.

American Pikas and Climate Change: Occupancy and Temperature along an Elevational Gradient in the Eastern Cascade Range - Bridget Smith, Faculty Mentor:

Kristina Ernest

American Pikas (*Ochotona princeps*) have a narrow range of temperature tolerance and are a climate-sensitive species. The primary goal of this project was to investigate whether environmental temperatures are associated with pika presence at rocky habitat sites along two elevational gradients on the eastern slope of the Cascade Range in Kittitas Co., Washington. We selected three sites along the Palouse to Cascades State Park Trail and four in Manastash Canyon. Paired data loggers at each site recorded surface and subsurface (60 cm deep) temperatures every 15 minutes from late summer through early fall. We conducted pika occupancy (presence) surveys during October 2019. Surveys included focal (visual and auditory) and walking observations (search for haypiles and latrines). Generalized linear models (GLM) were used to model the probability of pika presence as a function of various derived temperature measures. Over the duration of the study, subsurface temperatures at all sites did not rise above 25.5°C, pikas' critical upper temperature. GLMs suggested that both surface-level mean maximum temperature and number of hours above 25.5°C reasonably predicted pika occupancy. Contrary to our expectations, sites with higher temperatures were more likely to be occupied than sites with lower values for both models. Other studies suggest that snowpack and winter temperatures may be more important determinants of pika presence than are summer temperatures. Our small sample size prohibits generalization about summer temperatures, but the results suggest that further research is needed to explore the impacts of temperature on pika occupancy at low-elevation sites.

In vitro Assessment of synthesized organic compound activity against Leishmania major, the causative agent of human cutaneous leishmaniasis. - Cameron Smith, Faculty Mentor: Blaise Dondji and Timothy Beng

Leishmania are protozoan parasites and causative agents of leishmaniasis, utilizing female sandflies (a blood sucking parasite) as their vector for transmission. A bite from an infected female sand-fly to vertebrates (notably humans and canines) is where infection of leishmaniasis begins. Today, it is estimated that leishmaniasis is prevalent in over 88 countries with more than 15 million infected globally and 400,000 cases emerging annually. Prevalence of this parasite is seen predominantly in tropical to sub-tropical regions throughout the world and prevails in underdeveloped nations thus earning the nickname "poor man's disease." This disease exists in three clinical forms: cutaneous, mucocutaneous, and visceral, with visceral being the most lethal especially if left untreated. Our lab has developed in vitro assays to assess the activity of organic compounds against the causative agent of leishmaniasis. This project is of great public health importance considering the toxicity of currently available drugs. Some bridged lactam-lactones have offered evidence of activity against Leishmania parasite being similar or better than Amphotericin B, one of the drugs of choice. Successful compounds will be screened for toxicity on mammalian cell and additional compounds will be assessed with potential in vivo treatment of leishmaniasis.

Microbiome of Transgenic Non-Steroidal Anti-Inflammatory Drug Activated Gene 1 Mice- Chase Snodgrass and Safyre Reese, Faculty Mentor: Holly Pinkart

Recent research has shown that the composition of the gut microbiome influences obesity. A transgenic mouse model with the human non-steroidal anti-inflammatory drug (NSAID) activated gene 1 (known as NAG-1) has demonstrated an increased metabolism and obesity resistance when compared to the original strain of mice, C57BL/6, termed wild type (WT). The sequencing of the gut microbiome of the WT and the NAG-1 mice is important to further understand metabolic diseases. In this study, we are examining the microbiome of NAG-1 mice to better understand their resistance to diet-induced obesity and increased metabolism. The NAG-1 mice were compared to their WT littermates and gender differences will be examined. Preliminary comparisons were conducted to analyze metabolism and include measurements of body weight, glucose tolerance and residual organic matter in feces (a measure of energy extraction from food). The WT males were observed to have the largest change in weight and a higher mean weight than the other groups. The NAG-1 males and females were the leanest. Glucose tolerance was observed to be greatest in the NAG-1 mice. Within the combusted fecal sample data there was no significance between any of the groups, though the average remaining organic matter was consistently higher in the NAG-1 mice. At the conclusion of the experiment, caecal and colonic microbial DNA was extracted and subject to 16S rRNA sequencing. Alpha and Beta diversity analysis revealed significant differences between the microbiome of the NAG-1 and WT mice. Microbial community differences between male and female mice are significant.

Effects of Adding Stream Wood to Indian Creek, a 2nd Order Stream (Teaway Valley) - Student Presenters (Wahluk High School): Christopher Galvan, Fernando Pazaran, Daisy Barajas, Michelle Miranda, Richie Torres, Aylar Elias, and Juliana Navarrete, Faculty Mentor: Mike Bosko

In the early 1900s, logging practices have caused our focus stream to straighten. We are just now noticing the negative effects this has on the ecosystem. The stream's temperature is vital for the ecosystem to function, straight streams are shown to be warmer, causing organism survival to decline. Yakama Nation Fisheries is adding stream wood (SW) to streams to solve this problem. We hypothesize that adding SW into the streams will not only improve the water quality in the streams but the ecosystem around the stream. Our study investigates the effects of adding SW to streams.

Effects of Adding Stream Wood to Indian Creek, a 2nd Order Stream (Teanaway Valley) - Student Presenters (Wahluke High School): Christopher Galvan, Fernando Pazaran, Daisy Barajas, Michelle Miranda, Richie Torres, Aylar Elias, and Juliana Navarrete, Faculty Mentor: Mike Bosko

In the early 1900s, logging practices have caused our focus stream to straighten. We are just now noticing the negative effects this has on the ecosystem. The stream's temperature is vital for the ecosystem to function, straight streams are shown to be warmer, causing organism survival to decline. Yakama Nation Fisheries is adding stream wood (SW) to streams to solve this problem. We hypothesize that adding SW into the streams will not only improve the water quality in the streams but the ecosystem around the stream. Our study investigates the effects of adding SW to streams.

Chemistry - Oral Presentations

Identification and of Qkl-6 Binding Partners - Amanda Lewton, Faculty Mentor: Todd Kroll

The neocortex is the largest portion of the cerebral cortex, which deals with conscious mental functions within the mammalian brain. The neocortex contains four primary areas that process specific types of information (motor, auditory, somatosensory, and visual). These areas are formed during embryonic development through a process called neocortical arealization. Neocortical arealization is mediated in part by graded expression of the transcription factor Emx2. Utilizing the fact that many proteins work in cooperation with other proteins, a yeast two-hybrid screen was used to identify proteins that interact with Emx2. Three major isoforms of a protein called Quaking (Qkl-5, Qkl-6, and Qkl-7) were found to interact with Emx2. Qkl-6 was selected for further testing using a second yeast two-hybrid screen. This screen provided approximately 3200 yeast colonies each containing plasmids encoding potential Qkl-6 binding partners. The DNA from many of these colonies have been isolated and sequenced, revealing proteins such as Rack1, CacyBP, and β -actin as potential Qkl-6 binding partners. These results need to be verified as true interacting partners for Qkl-6, and the proteins eventually tested for their ability to bind to Emx2 and other Emx2-binding proteins.

Chemistry - Poster Presentations

Synthesis of novel antibiotic compounds derived from lasalocid- Luke Allan, Faculty Mentor: Paul Swain

Frequent and improper use of antibiotics has led to an increasing occurrence in antibiotic resistant infections. This trend demonstrates a very serious risk to the global wellbeing, making the development of new antibiotic compounds imperative. However, the typical means of developing novel pharmaceutical antibiotics from naturally occurring sources is finite and dwindling. Thus, new methods of generating novel antibiotic compounds to combat the rise of resistant infections is of high priority. The objective of this project is just that. Lasalocid is a structurally diverse ionophore antibiotic. By cleaving this antibiotic, reactive scaffold can be obtained; allowing for further synthesis and the creation of novel compounds. These compounds will then be tested for antibiotic activity through various assays. While slight modification of preexisting antibiotics is a common and effective practice, the approach of this research allows for seemingly infinite possibilities of novel compound generated. Thus, hopefully yielding compounds of not only varied structure, but completely different antibiotic activities.

Investigating Mitochondrial Dynamics and Cell Life Cycles through Induced Stress -

Natalie Biddix, Bethany Eaton, and Sydney Galbreath, Faculty Mentor: Carin Thomas

Mitochondria are organelles that produce energy rich molecules called ATP through cellular respiration. Mitochondria have been implicated in numerous disease states and could be an attractive drug target. We hypothesize that mitochondrial shape, reactive oxygen species (ROS) generation, and cell death are interrelated. During respiration, ROS are produced and can react with cell components which causes damage. Stress induced by ROS likely causes mitochondrial shape change, and in extreme cases, leads to cell death. Cell death was investigated by using a WST-8 cell viability assay on cultured mouse liver cells exposed to the oxidative stressor, menadione, which produces ROS. It was found that increased concentrations of menadione led to increased cell death. To monitor mitochondrial shape changes, a protein-based fluorescent probe was used to mark mitochondria in cells. A mitochondrial green fluorescent protein (GFP) plasmid was transfected into the mouse liver cells, so that the cells could express the mitochondrial targeted fluorescent probe. Fluorescence microscopy was used to qualitatively compare imaged mitochondria, and their shape under different conditions. In our initial experiments, very few cells showed fluorescence, which meant that transfection occurred with very low efficiency. Transfection efficiency will be optimized before further studies are performed to observe changes in mitochondrial shape as menadione is introduced. Further studies will be established to measure ROS production using a CellROX to compare ROS generation induced by the toxicants menadione and antimycin A. Our results will be used to describe the relationship among ROS production, mitochondrial shape changes, and cell death.

Intramolecular Benzylic sp³ C-H Oxy-functionalization of Lactam-bearing Alkanoic Acids- Jorge Garcia and Meagan Smith, Faculty Mentor: Timothy Beng

Leishmaniasis is one of the world's most problematic diseases in developing countries. Current medicines, including the frequently prescribed medicine, amphotericin B, have serious side effects. The existing medicines also exhibit significant parasite resistance problems. In recent years, medicinal chemists have become increasingly keen on exploring the spatial orientation of molecules. Thus, three-dimensional N-heterocycles and O- heterocycles (e.g., morpholines, piperazines, and piperidines) are valuable targets for pharmaceutical companies. In this proposal, a chemoselective and stereoselective strategy for the formation of the aforementioned compounds is described. This versatile, efficient, and cost-effective process will take advantage of the more acidic nature of the benzylic carbon. Through collaborative efforts, the leishmanicidal activity of these novel compounds against *Leishmania major* will be tested.

Plant- Versus Petroleum-Based Plastics - Hayley Gower, Faculty Mentor: JoAnn Peters

In recent years, the amount of plastic waste has become a huge environmental issue. This paper describes the history of plastics, the pros and cons to its uses, how plastics are made and how they degrade, and finally to describe solutions to the problem of growing plastic waste. Most plastics are made by one of two chemical syntheses: addition (chain growth) or condensation (step growth) polymerization. Most common plastics are derived from petroleum, but some are derived from plants. Biodegradable plastics can be derived from petroleum or plants, but they are more expensive to produce and can be lacking in performance. Arguably the most impactful solution to the problem of increasing plastic pollution would be to implement the use of reusable packaging and containers. Other solutions include implementing more recycling facilities and using shorter-lifespan materials, such as biodegradable plastics or paper, for single-use purposes.

Ethanol as a solvent in pharmaceutical toxicity testing should be used with caution.

- Phuong Luong, Faculty Mentor: Carin Thomas

Mouse liver cells have a vital role in many scientific fields as they are used to test for toxicity of pharmaceutical compounds. Additionally, ethanol is usually used as the vehicle control to dissolve those compounds. Different concentrations of ethanol were investigated to find the optimal amount to be used for cells grown in vitro. Vector transfected Hepa-V mouse liver cells were grown in 25 cm² flasks using a complete media solution containing DMEM/F12, Nu-Serum and 1% Penicillin-Streptomycin. After reaching 80% confluency, the cells were exposed to either the vehicle control (0.83 to 3.34% of ethanol) or the xenobiotics (5 to 20 μ M of Antimycin A) for 24 hours. WST-8 was added to the cells and absorbance of the solution was measured at 450 nm using Synergy 2 plate reader. The readouts showed a decreasing trend in the amount of living cells in both final solutions of vehicle control treatment and xenobiotics treatment. However, those treated with just ethanol observed a more linear relationship ($R^2 = 0.96$) compared to those exposed to Antimycin A alone ($R^2 = 0.68$). Cell viability of cells treated with Antimycin A reached a threshold after 10 μ M while those introduced to ethanol experienced more cell death as percent of ethanol in the vehicle control increased. This results confirm that ethanol has a noticeable effect on cell viability and it should be used no higher than 2.5% in cell culture.

Characterization of silica nanoparticles formed in a complex coacervate environment by polyelectrolyte molecular weight-

Rory MacFarland and Matthew Rimpler, Faculty Mentor: Dion Rivera

When introduced into an aqueous solution of potassium bromide within a well-defined concentration range, poly(diallyl ammonium chloride) (PDADMAC) and poly(sodium-4-styrene sulfonate) (PSS) polyelectrolytes can form a biphasic state known as a complex coacervate. The coacervate divides into low polyelectrolyte concentration (lean) and high polyelectrolyte concentration (dense) phases. While many researchers have proposed these complex coacervates can provide unique environments for chemical reactions the number of practical examples is limited. The research presented here employs a novel use of the Stöber synthesis to create silica nanoparticles within the complex coacervate environment. Multiple reaction mixtures were composed from silane reagents and/or amino-terminated amino silane reagents. These reactions were controlled by the molecular weight of the PSS, using 70,000 Dalton and 1,000,000 Dalton mean molecular weights. The presence of these nanoparticles was confirmed with infrared spectroscopy and their size and morphology was determined with scanning electron microscopy. From this data, differences in silica nanoparticle product by polyelectrolyte molecular weight for several reagent compositions is discussed.

Voice-over poster - Victoria Shearer, Faculty Mentor: Timothy Beng

Climate change is a daunting predicament the world has found itself in, leading to an added pressure on chemists to synthesize products in a manner that is not harmful to the environment. This is known as green chemistry. A green chemistry technique that utilizes C-H bonds is desirable considering that carbon and hydrogen are the most abundant elements in organic molecules. We herein propose a sustainable, cost-effective, and selective carbon-oxygen bond forming lactonization (production of a cyclic ester) using amido acids. The only byproduct of the reaction will be molecular hydrogen, which in turn will be collected and used as clean fuel, thus, rendering the process environmentally benign. Such a synthesis of oxygen-containing cyclic compounds is of great importance to pharmaceutical companies since they have beneficial biological activities. Through collaborative efforts, the produced lactones will be screened for potential bioactivity on G-protein coupled receptors (GPCRs).

Investigation into the Structure and Function of I-Mgm1 in inner mitochondrial membrane fusion - Kollin Trujillo, Faculty Mentor: Derek Ricketson

Mitochondria are key components of the cell as they provide energy in the form of ATP through cellular respiration. A balance of fission and fusion maintains a dynamic, inter-connected mitochondrial network, which is important for overall function. When fusion is disrupted, the mitochondrial network becomes fragmented, mitochondrial genomes are lost, and respiration ceases. Mitochondrial inner membrane fusion is mediated by the GTP hydrolase Mgm1 (Mitochondrial Genome Maintenance 1) in yeast. Yeast make an excellent model system to study mitochondrial physiology since they are not dependent on respiration for growth. Mgm1 exists as a membrane embedded long isoform (I-Mgm1) and a soluble short isoform (s-Mgm1). Both I-Mgm1 and s-Mgm1 are required for inner membrane fusion, but the role of I-Mgm1 remains unclear. Our goal is to determine the regions of I-Mgm1 that are important for fusion activity. To do this, we employed a polymerase chain reaction (PCR) splicing by overlapping extension (SOE) technique to make versions of I-Mgm1 with regions removed. Once constructed, we will test the mutated I-Mgm1 proteins with yeast physiology assays to determine effects on mitochondrial fusion, mitochondrial genome maintenance, and respiration. Construction of the I-Mgm1 mutants has proven challenging. I am currently optimizing the PCR conditions to complete this phase of the project. In the meantime, I am becoming familiar with yeast culturing techniques and physiological assays.

Synthesis of Boron-Containing Structural Building Blocks For Use in Potential Protease Enzyme Inhibitors- Andrew Wilson, Hannah Huber, and Sean Dawson, Faculty Mentor: Levente Fabry

1,3-Azaborines have good potential to function as dual-mode, both associative and competitive, inhibitors of protease enzymes, which are involved in the development of several disease states, including the Human Immunodeficiency Virus (HIV) infection/acquired immunodeficiency syndrome (AIDS), malaria, Alzheimer's, and some forms of cancer. In our syntheses boron-modified amino acids (including boronated phenylalanine and isoleucine) are being developed as chemical precursors, which are then incorporated into larger boronates in order to obtain the biologically relevant 1,3-azaborines. The target 1,3-azaborines were designed to complement the structure of the enzyme's chiral active site. In our synthetic schemes pinacol and (1R,2R)-1,2-dicyclohexyl-1,2-ethanediol are both used as protecting groups, while (1R,2R)-1,2-dicyclohexyl-1,2-ethanediol is also used as a chiral director. The target boronates have the potential for greater affinity towards protease enzymes, dual-mode of action, increased bioavailability, and fewer adverse side effects. Many studies have shown that boron-modified inhibitors have a higher inhibitory affinity for protease enzymes than the corresponding non-boron analogs. The non-boron analogs are experiencing high resistance rates, low bioavailability, and patient noncompliance due to adverse side effects. As a result, there is a higher demand for the development of new compounds to combat these diseases.

Two-Step Synthesis of Novel Boronates; Structural Building Blocks of Therapeutically Relevant Compounds - Brett Vagt (School of Graduate Studies),

Faculty Mentor: Levente Fabry

Every year the number of multidrug-resistant bacteria and viruses increases, sparking a tremendous need for the development of more powerful countermeasures. Modification of current drug therapies is a short term solution, but the need for novel medicinal compounds is critical for long term defense. The use of boron-modified compounds (those containing a strategically placed boron atom), as potential antibiotics and antivirals, has been investigated and have shown potential to be powerful therapeutic agents. There are currently three boronmodified FDA approved medications, which indicates that there is tremendous potential for further discovery and development. Currently, the Fabry Research Group focuses its efforts on boron modified inhibitors of HIV-1 aspartic protease. The group's interest in the broader application of these compounds, however, extends far beyond this single virus. The goal of this project been create a diverse library of functional novel boronate analogues. All of these structures provide potential starting points or building blocks for therapeutic compounds that could aid in the fight against multi-drug resistance. The properties that make boron a powerful addition to inhibitory compounds, also provide difficult synthetic challenges. The synthesis of this novel boronate library will contribute to further understanding some synthetic limitations within boron chemistry.

Computer Science - Oral Presentations

Detecting Forged Images with Machine Learning- Lubna Alzamil, Faculty Mentor:

Razvan Andonie

The issue of forged images is now a global problem which mainly spreads via social network. Image forgery has weakened people's confidence in digital photos. Many researchers have devoted extensive research contributions in recent years to the development of new techniques to combat various image forgery attacks. Automatically detecting fake images may protect people from being victims of forged photos that can deceive and cause harm to others. Our contribution is a hybrid method which combines Error Level Analysis and deep learning for detecting manipulated images. According to our preliminary experimental results, the combination of image pre-processing and machine learning techniques is an efficient approach detecting image forgery attacks.

CWU Parking Application - Kevin Bertelsen, Paul McCafferty, and Corey Johnson,

Faculty Mentor: Szilard Vajda

One of the most frequent complaints from students attending Central Washington University is the ever-diminishing availability of parking spots on campus. We created a system that attempts to utilize machine learning object-recognition to provide residents real-time data related to the number of open parking spots at selected parking lots at any given time, delivered right to them with a custom-built mobile application. This solution will provide a much-needed relief for students in the form of saved-time, as well as improve campus sustainability through a decrease in the net idling time of vehicles circling campus in an attempt to find an open parking spot.

2020 U.S. Democratic Nomination: Analysis - Paul Collet (School of Graduate Studies), Brad Reeves, Cheng Su, and Justin Phan, Faculty Mentor: Donald Davendra

An election for the President of the United States happens every four years and is the largest political event in the USA. Leading up to the general election, most of the candidates running for president go through a series of state primaries and caucuses. Although these primaries and caucuses are run differently, they both serve the same purpose. They allow every party to choose their nominee for the general election. The campaigning process lasts a year for most candidates and cost millions of dollars in advertising, outreach, and traveling. As the Republican Presidential Nominee in 2020 is guaranteed to be President Donald Trump, we will only focus on Democratic nomination process. In this research, the focus will be monitoring polling data for Democratic Party candidates, analyzing data from fundraising and advertising spending, and number of delegates awarded for candidates. This report takes real-time data to determine if opinion polls, fundraising data, and advertising expenses truly predict how people will vote. To find the correlation between fundraising, advertising spending and number of delegates awarded for candidates, basic statistical methods to the 2019-2020 Democratic Primary election cycles were applied.

Optimizing Pollution Routing Problem- Shivika Dewan, Faculty Mentor: Donald Davendra

Pollution has been a big problem all over the world. Despite the growing use and impact of commercial vehicles, recent research has been conducted with minimizing pollution as the primary objective to be reduced. The objective of this project is to implement different optimization algorithms to solve this problem. A basic model is created using the Vehicle Routing Problem (VRP) which is further extended to the Pollution Routing Problem (PRP). The basic model is updated using a Random Sequence Generator (RSG). The data set contains 180 data files with a combination of 10, 15, 20, 25, 50, 75, 100, 150, and 200 groups of cities. The optimizing techniques applied are the Discrete Differential Evolution (DDE) and, Particle Swarm Optimization (PSO) with a Python Tkinter frontend. The objectives to be optimized are the fuel consumption rate and distance traveled and a statistical comparison is done between the two.

Sentiment Analysis of Donald Trump's Tweets using Machine Learning - Andrew Dunn, Faculty Mentor: Razvan Andonie

With social media websites growing in popularity every day, there is much untapped potential in leveraging this public information to learn many new things. Twitter alone has a huge user base of over 330 million active monthly users. This huge volume of tweets coupled with the informal nature of text makes processing this information very difficult. In recent years, the combination of Natural Language Processing (NLP) with Machine Learning (ML) has become increasingly prominent. The understanding of natural language by machines is still an open and challenging task in spite of the huge recent progress in man-machine interaction using deep learning. Twitter is a great choice for ML analysis due to its text-based nature and limited tweet length. For example, one could analyze Twitter for early reporting on big events that have not been reported or hit the news cycle yet.

We apply state-of-the-art ML and NLP tools to Donald Trump tweets, with the goal of analyzing their sentiment. This approach, called Sentiment Analysis, attempts to determine if a text contains a positive or a negative sentiment. A clearly positive sentiment is something like "I love cake", while a clearly negative sentiment is something like "I hate mosquito's". While these examples are obvious, that is not always the case. Analyzing Donald Trump's tweets turns out to be a very complex task. As a result, our computer model can determine with a reasonable accuracy if a Donald Trump tweet is positive or negative.

Waterbody detection from satellite SAR images using deep learning - Chao Huang

Lin, Faculty Mentor: Razvan Andonie

Nowadays, Synthetic Aperture Radar (SAR) images have been widely used in the industry and the scientific community for different remote sensing applications. The main advantage of SAR technology is that it can acquire images from night time since it does not require sunlight. Additionally, it can penetrate the cloud which can capture images where the traditional optical sensor is limited. One of the remarkable applications of SAR image is water detection since the water body reflects off all the energy from the radar so it appears in a SAR image as dark pixels. The traditional way to mark out water from SAR image is using the threshold method where each pixel is classified as water when its value is below a certain threshold. This method works fine in a plain rural area but the complex features of urban areas make it more challenging, for example, highways and buildings shadows can be easily misclassified as water. To solve this problem, we propose a deep learning solution to detect water from SAR image. The implemented convolutional neural network will not only identify water by the intensity of each pixel, it also learns the spatial information of neighborhood pixels. To train the network we used so2sat dataset which is processed from Sentinel-1 satellite SAR images. After training, we tested the neural network in many real SAR images and it gave us promising results that are more clear and better than the thresholding method. Moreover, to speed up the proposed solution, we were able to update it with the convolutional sliding windows.

Visualization for solving non-image problems and Saliency Mapping - Divya

Chandrika Kalla (School of Graduate Studies), Faculty Mentor: Boris Kovalerchuk

Integration between visualization, visual analytics, machine learning, and data mining are the key aspects of data science research. This project proposes a new CPC-R algorithm used to convert non-images into images by visualizing data using paired coordinates. Powerful deep learning algorithms open an opportunity and solve the problem of transforming non-image machine learning problems into image recognition. The main idea of CPC is splitting attributes of an n-D point to consecutive pairs of its attributes.

High-dimensional data play an important role in knowledge discovery. This experiment is performed by using the Ionosphere and Glass datasets from the UCI machine learning repository. Reported the results obtained in the computational experiments with Ionosphere and Glass data with CPC-R for different CNN architectures, and a different number of pixels per cell, which represents each pair of attributes. The Accuracies for the Ionosphere and Glass dataset are 94.44% (2 classes and 34 dimensions). and 95.90% (6 classes and 10 dimensions).

The second technique for this project is Saliency Mapping. The saliency models take an input test image and generate a saliency map that predicts which regions of the image will be most likely to draw a human viewer's attention. The efficiency of the CPC-R algorithm is tested, and further optimization needs to be performed.

Central Connect - Riley Krall, Emily Bodenhamer, Patrick Perkins, Jack Van Well, and Tyler Huson, Faculty Mentor: Szilard Vajda

In the recent years, voice enabled devices became more of a norm in people's lives. These devices (like Apple's Siri, Google assistant, Amazon Alexa, and many more) have the primary use to make people's lives easier and perform tasks for the user. Nowadays, about 40% of all internet users have access to one of these assistants. While these devices become much more common, students at CWU have not had a way to access school related information by just asking for it. For this reason, we propose an Amazon Alexa skill that can be used by CWU students with Amazon Alexa devices. All the student has to do, is tell Alexa to "Open Central Connect", and Alexa will be ready to answer CWU related questions. Possible questions include building hours, club descriptions, sport event times, assignments that are due, classes the student is taking, and more. In addition, the skill requires student authentication for tasks that use personally identifiable information (PII), in order to keep their private information secure from being accessed. The skill was developed using Amazon Web Services (AWS) as the backend, utilizing serverless functions, database management, API access, and custom API creation; all implemented onto the cloud. The goal of this skill is to make the life of students in the dorm easier, allowing them easy access to CWU information. This project was mentored and supervised by Bob Rapp and Dr Szilard VAJDA and created for Andreas Bohman and University Housing.

Using CUDA to Enhance Data Processing of Variant Call Format Files for Statistical Genetic Analysis - Heather McKinnon (School of Graduate Studies), Faculty Mentor: Donald Davendra

Utilizing the power of GPU parallel processing with CUDA can significantly speed up the processing of Variant Call Format (VCF) files and statistical analysis of genomic data. A software package designed toward this purpose would be beneficial to genetic researchers by saving them time which they could spend on other aspects of their research. A data set containing genetics from a study of trichome production in *Mimulus guttatus*, or yellow monkey flower, was used to develop a package to test the effectiveness of GPU parallel processing versus serial executions. After a serial version of the code was generated and benchmarked, OpenACC with Portland Group's PGI compiler using CUDA was applied to the parallizable parts and the program run time was recorded to be compared to the serial execution. To create this program more accessible to researchers in the biological field, the accelerated functions of the program are written in the C language and compiled as a driver file to be used from R.

Interactive Data Visualization Using Shifted Paired Coordinates - Sridevi Wagle

(School of Graduate Studies), Faculty Mentor: Boris Kovalerchuk

Multidimensional data are usually visualized by reducing the dimensionality of the data often leading to loss of information. One of the ways to overcome this problem is to represent the data using new Shifted Paired Coordinates (SPC) [Kovalerchuk, 2018] which represent the multidimensional data by a graph in the sequence of pairs of dimensions in the 2-dimensional plane. Interactive SPC is a software system that provides a medium for visualizing multidimensional (n-D) data in Shifted Paired Coordinate system without losing any information. This system is developed on Windows Forms in C++ and OpenGL library. It loads the data from a csv file and visualizes the data in SPC without any loss of information. Apart from the lossless representation of the n-D data, the system also provides user interactive controls like clicking and dragging the user selected graphs on the screen and reversing the user selected coordinates of the data to reorient the data representation according to user convenience. Also, this system provides a feature wherein the mean of the user selected data is calculated and redisplayed to visualize the data along the mean. These features help in better understanding of the data, especially when the data contain two or more classes. Additional options like zooming and panning are provided for user convenience for data exploration. Also, color selection functionality is given where the user can customize the color of data classes. This system works for real world data like iris, breast cancer data, ionosphere data etc.

Generalized Minimum Eccentricity Shortest Path Problem in Tree-Structured Graphs - Rachel Walker, Faculty Mentor: Arne Leitert

The primary objective of our research is to explore a problem in theoretical computer science related to finding particular paths within networks. Specifically, we are interested in finding a set of paths within very large networks such that the distance between any point within the network and one of these paths is as small as possible. This is a generalization of a previously researched problem called the Minimum Eccentricity Shortest Path (MESP) Problem. In this presentation, we give a formal introduction to the generalized version of this problem and its hardness. Additionally, we give an overview of how different classes of networks can have more efficient solutions when we take advantage of particular properties. Using this, we give an efficient +1-approximation algorithm to the generalized MESP Problem for a particular class of networks and describe how our approach could be generalized to work for a broader class of networks. Finally, we discuss the applications of this problem to biology and other areas of computer science.

Automatic Tuberculosis Detection Using Chest X-ray Analysis With Position Enhanced Structural Information - Hermann Yepdijo Nkouanga (School of Graduate Studies), Faculty Mentor: Szilard Vajda

Tuberculosis is a disease responsible for the deaths of more than one million people worldwide every year. Even though the disease is preventable and curable, it remains a major threat to the humanity that needs to be taken care of. More developed countries use advanced techniques such as culture methods or sputum smear microscopy to diagnose the disease. However, since those approaches are rather expensive, they are not commonly used in poor regions of the globe such as East Asia, Africa and Bangladesh. Instead the well know and very affordable chest x-ray interpretation by radiologists is the technique employed in those places. Some of the major issues with this approach are: i) is a tedious task that requires experienced medical personnel, and ii) is performed manually which can be very painful when done for a large population. In order to accelerate the interpretation process and reduce the dependence on qualified radiologists -which is scarce in those countries, many software solutions evolved over the last few years considering computer vision, artificial intelligence and machine learning. The issue with these solutions is that they are either not reliable enough or they are rather complicated. Therefore, we propose a fully automatic software solution that uses only machine learning and image processing to analyse and detect anomalies related to Tuberculosis in Chest x-rays images. Our system has been tested on two benchmark data collections -Montgomery and Shenzhen, and produced state-of-the-art results reaching up to 97% in accuracy.

Computer Science - Poster Presentations

Lossless Visual Knowledge Discovery in High-Dimensional Data in Elliptic Paired Coordinates - Rose McDonald, Faculty Mentor: Boris Kovalerchuk

Large datasets can provide useful information in quantitative fields of study. Data with more than two or three dimensions are difficult for humans to conceptualize and facilitate knowledge discovery. Novel Elliptic Paired Coordinates (EPCs) [Kovalerchuk, 2018] allows for multidimensional data to be represented two-dimensionally by halving the required visual elements in the graph without information loss. This research explores the effectiveness of constructing predictive machine learning models interactively using EPC visualizations. For this research Ellipse, an interactive software system, was developed to process high-dimensional datasets, create corresponding EPC visualizations, and build predictive classification models based on dominance rules. The Ellipse system automatically discovers areas that are located with a high percentage of single-class dominance. The experimental study using Ellipse on data from University of California Irvine's Machine Learning Repository suggests EPC approach is a promising method for discovering predictive models with the following dataset results: (1) 100% coverage and 98.67% weighted average precision (WAP) for Iris plants (4 dimensions), (2) 98.24% coverage and 94.63% WAP on Wisconsin Breast Cancer (10 dimensions), and (3) 100% coverage and 96.26% WAP on Glass Identification with classes 1-6 grouped apart from class 7 (10 dimensions). Further evaluation and development of the EPC approach through machine learning is ongoing. Datasets with dominance rules of high precision and accuracy show promise for correctly classifying data points. This could be useful in many fields, such as medical diagnostics and forensics, allowing for visually-appealing dominance rules to be easily interpreted in the application domains.

Environmental Studies - Oral Presentations

Implementing Nativescaping in Landscaping Policies at Central Washington University and the City of Ellensburg - Savannah Fields (William O. Douglas Honors College), Faculty Mentor: Allyson Rogan-Klyve

Lawns and cultivated landscapes have long been associated with success and the American dream in our culture. But these conventional landscapes are often not adapted to the area's climate and cause problems with resource use, pollution, upkeep, and competing with local wildlife. Moving towards a sustainable future requires us to move past our current landscaping that tells an old story of viewing nature as separate from humans and something that needs to be contained. With the dramatic loss of our native ecosystems, and in response to projected changes in precipitation due to climate change, this project attempts to explain the process of changing landscaping policies to be cost-effective, and reduce water use and maintenance. Nativescaping is a type of landscape designed to use xeriscaping methods that coexists with the surrounding landscape by using native plants that require little water and techniques that efficiently use that water and reduces evaporation. This project provides insights on working closely with the City of Ellensburg and Central Washington University to change their current landscape policies to using nativescape techniques. This study will also serve as a guide for other cities and universities to implement nativescapes suited for their area. The ultimate goal is to cause people to care about their rapidly disappearing native ecosystem by introducing the concept that the natural environment is aesthetically pleasing for landscape use.

Geography - Oral Presentations

CWU Sustainability: Transportation Maps - Pablo Garcia, Faculty Mentor: Sterling Quinn

This project made design improvements and data updates to two maps for Central Washington University(CWU) sustainability website. CWU bicycle map was influenced by other university maps with integrated city and campus bicycle paths that had multi-use lanes. The cartography emphasizes visual hierarchy, legibility of map elements, and accessible color schemes for color blindness. New features added to the bicycle map include: Ellensburg bicycle boulevard, and new paths to CWU campus map. The second map was updated to include fare-free Ellensburg Central Transit service routes because they have been updated since the first edition of the CWU bus map. CWU Central Transit routes bus map was primarily based upon the existing Central Transit route bus map provided by the city. The extent of the Central Transit bus map was zoomed into focus upon the boundary of CWU campus and downtown Ellensburg.

Analysis of Campus Sustainability - Matthew Johnston, Faculty Mentor: Jennifer Lipton
At Central Washington University, there is a lot of disconnect and miscommunication about recycling and composting on campus. Recycling has a lot of issues on campus in terms of how students recycle and how much students are able to recycle on campus. Besides the larger bins by the academic and housing buildings, there are smaller bins that only take cans and plastic bottles. With the lack of recycling all around to being majority of the areas of high traffic on campus, and it is an inconvenience on campus. The research was taken on getting survey information, GIS data points of recycling locations, and taking statistical and quantitative data on all of the geographical data taken.

Comparing RUSLE LS calculation methods across varying DEM resolutions -

Amanda Moody (School of Graduate Studies), Faculty Mentor: Robert Hickey

Soil erosion is a global problem that reduces land productivity and causes environmental degradation. Soil erosion models, such as the Revised Universal Soil Loss Equation (RUSLE), are used to estimate the severity and distribution of erosion. The topographic factor (LS), which combines slope length and angle, is an important part of RUSLE. This work compared two methods of L calculation, the grid cumulation (GC) and the contributing area (CA) methods, and two methods of S calculation, the neighborhood (NBR) and maximum downhill slope (MDS) methods. These were compared across digital elevation models (DEMs) of 1, 5, 10, and 30m resolutions. This study rectifies the lack of direct and consistent testing these methods across multiple sites and DEM resolutions. The CA method produces higher mean, median, and max values of L than the GC method across all landscapes, especially along drainage channels where the greatest area accumulates to produce extremely high L values. The GC method, unlike the CA method, accounts for decreases in slope steepness that initiate deposition and reset accumulated values. Differences between these methods occur most from different treatments of convergence. The CA method combines flow paths but the GC method only continues the one longest flow path. The NBR and MDS method produced similar mean and median S values. However, maximum values using the NBR method are more sensitive to DEM resolution and decrease more with coarser resolutions. The NBR method produces lower S values along ridge lines and higher S values along drainage channels and concave depressions and slopes. This is due to the averaging of calculating slope angle in the NBR method. The neighborhood method smooths landscapes and reduces the ability to capture erosion variability related to S.

Geography - Poster Presentations

Using GIS to Map Resource Availability in the East Saddle Mountains, Grant

County, WA - Mars Galloway (School of Graduate Studies), Faculty Mentor: Sterling Quinn

Humans have found ways to extract resources from the resource rich upland landscape of the Mid-Columbia Plateau for at least the last 11,000 years. However, due to a century of inconsistently managed projects in the uplands of the Mid-Columbia Plateau, the large datasets required to examine resource extraction methods are uncommon. In order to address this, Central Washington Archaeological Survey (CWAS) produced ten years of methodologically consistent field data from 1998 to 2006 and 2008 while surveying in the East Saddle Mountains. My research will use Geographic Information Systems (GIS) to identify both Lomatium habitat and quarry pits within the study area of CWAS field surveys in the East Saddle Mountains. By combining slope, aspect, soil data, and solar analyst, I will create a predictive model for Lomatium habitat. I will also interpret LiDAR data to identify quarry pits, alongside geologic interbeds containing raw toolstone. This information will then be made available for further spatial examination of the relationship between the extensive archaeological record of the East Saddle Mountains created by CWAS and precontact resource extraction.

Memorializing Russia's Past - Heather Stewart, Faculty Mentor: Sterling Quinn

My research is being done in association with the book *It Was a Long Time Ago, and It Never Happened Anyway: Russia and the Communist Past* written by David Satter. Through the use of this book and my outside research, I will seek out the information that Russia has not released on their Soviet past, specifically in the times of Stalin's Purges, the Gulags, and the Siege of Leningrad where too many deaths took place to record. These unrecorded deaths can be found in mass gravesites scattered around present-day Russian Federation. Through mapping these locations, I will be telling the story of the people who never came home.

Geography - Creative Works Projects

The Political Geography of Yakima, Washington: Latino Voters and their Representation - Bradley Esparza, Faculty Mentor: Sterling Quinn

I am cartographically visualizing in the form of an ArcGIS Online Story Map demographic information describing certain features of the population of the City of Yakima, and, more specifically, how Latino voters are represented in relation to the seven council districts. Within the boundaries of the city limits, the Eastern District Court of the United States ordered the partition of Yakima from a city-wide at-large voting system to a district voting system to better represent Latino residents living within one of seven city council member voting districts. Using public and proprietary data I will show the sharp geographic and demographic differences specific to Latino voters. I will employ ESRI proprietary software to cartographically symbolize the contrasts between the older, higher-income west side of the city and the younger, lower-income east side of Yakima.

Geological Sciences - Oral Presentations

A Half Century of Channel Changes in the North Fork Teanaway River at a Large Wood Restoration Site - Austin Halstead, Faculty Mentor: Lisa Ely

The Yakama Nation's Yakima-Klickitat Fisheries Project (YKFP) and Mid-Columbia Fisheries Enhancement Group (MCF) placed large logs and woody debris along a 1.5 km stretch of the North Fork Teanaway River channel and floodplain in the summer of 2019. Historically, large woody debris was common in the Teanaway River. The purpose of the current wood emplacement is to maintain and restore natural river processes and enhance aquatic habitats. Adding woody debris increases channel complexity, which helps fish by creating spawning areas, scouring pools and lowering water temperature, increasing food availability, and reconnecting floodplains to the river. During the winter of 2020, I georeferenced aerial photographs and drone images from 1954, 1978, 1998 and 2019 to document changes in the Teanaway River over time in the area of the large wood restoration. I outlined and overlaid the channel positions from each time period in ArcGIS Pro, and created topographic cross sections of the channel and floodplain. The greatest changes were between 1954 and 1998. The stream channel notably migrated laterally from the 1954 to 1978 aerial photos, and again from 1978 to 1998. There appears to be a general increase in vegetation along the side of the channel over the study period, which could partially explain the decreased rate of channel change in the last two decades. With the addition of large woody debris to the sides of the channel, the flow of the main channel will slow, and the water may seek alternative/additional routes, possibly in the previously abandoned channels.

Law & Justice - Oral Presentations

Gun Violence Concern in Washington State: Approachable and efficient procedure to constrain mass shootings - Saffana Ahmed, Faculty Mentor: Christine Henderson

In the United States, gun violence is a public health crisis. Every day nearly 100 people are killed due to gun violence. Some are by suicide, domestic disputes, and community violence. Still, people continue to sell assault rifles and other powerful, dangerous weapons. In Washington State, a person owning an assault rifle must be 21. RCW 9.41.240 sets out the requirements for the possession of a pistol or semiautomatic assault rifle for a person between 18 and 21 years of age. Also, in Washington, there is not a law directly related to the AR-15 rifles, regardless of age. Furthermore, in 28 states, there are no age restrictions in owning a rifle.

Age restrictions matter. Unfortunately, in the United States, mass shootings have increased. Surprisingly, most of the gun violence has occurred in high schools; the attackers are teenagers. There must be an age restriction of at least 21 to purchase an assault weapon. Secondly, necessary knowledge and psychological tests could assist in deciding if a person is eligible to take care of an AR-15 weapon properly. Thirdly, there should be a universal background check and a valid and reliable reason why the individual needs to buy an AR-15 rifle or high-powered dangerous weapon. The government needs to prioritize AR-15 rifles and other high-powered weapons as an essential policy to implement. Through interviews and secondary analysis, I provide a policy analysis that is timely and relevant to the mass shootings, age restrictions, and high-powered weapons in Washington State.

Seattle City Council Oversight of the Seattle Police Department - Kerry Bleakney, Faculty Mentor: Christine Henderson

Since 2011, the SPD has operated under the oversight of the Department of Justice (Civil Rights Division). The oversight occurred as a result of claims of excessive force. The DOJ had federal judge James Robart in charge of the proceedings. Things were rough in the beginning, and Judge Robart became frustrated with the political infighting that cluttered the negotiations, which have become commonplace in Seattle. Despite resistance from a group of 100 officers who filed suit against the reforms, the DOJ offered a clear path to reform centralized to Judge Robart and the DOJ. According to the Seattle Times as of January 10, 2018, the SPD was deemed in full compliance with the consent decree. The SPD has taken and executed the necessary steps for reform. Case closed? No. Enter the Seattle City Council, and the oversight continues. It is essential to explore the Seattle Police Department's organizational nature, environment, responsibilities, communication climate, and consequences of legislation. Seattle Police Department is working to overcome some of its professional paralysis to ensure the safety of Seattle citizens. Through secondary analysis, I provide an organizational review and recommendations for the Seattle Police Department's future coordinated efforts.

Domestic Violence is a Universal Issue - Jenny Castro, Faculty Mentor: Christine Henderson

Domestic violence is a universal issue that has detrimental effects on society. People who experience intimate partner violence are prone to long term effects, which include mental, social, and physical problems. Victims face everyday challenges and obstacles that may prevent them from working, keeping a stable income, and remaining safe in their environments. There are resources available to help victims of domestic violence, but the legislation still lacks the power to help prevent domestic violence. Current legislation helps protect victims of stalking, violence, and sexual violence. Also, the legislation includes restraining and protection orders, domestic violence advocates, domestic violence courts in certain jurisdictions, sex offender registries, shelters, counseling, and non-profit organizations. Restraining orders work and can be useful in reducing fear and violence, and national sex offender registries allow the public to be aware of violent sexual offenders who live and work in their communities. At this time, the United States does not have a registry for violent offenders in domestic violence like the convicted sex offender registry. Protection and restraining orders are available anywhere in the country at the local courts and have been utilized, but they need to be enforced by law enforcement, especially when it comes to parental kidnapping of young children. This policy analysis provides alternatives to improving domestic violence, lobbying for registries for repeat violent offenders, and more preventable solutions to aid victims before their lives are at risk and in danger.

Analysis of EHB 2242 - Marcus Dawkins, Faculty Mentor: Christine Henderson

Washington State was sued by a coalition of advocacy groups for failing to fund the public-school system adequately. Washington State Legislature passed Engrossed House Bill (EHB) 2242 to appease the courts and provide Washington state public schools with ample funding. EHB 2242 increased state property levies and taxes. EHB 2242 also placed a cap on local levies to minimize the state's reliance on property owners to fund the public-school system. Local levies were capped at the lesser of \$2,500 per student or \$1.50 for every \$1,000 of assessed property value. Several districts were negatively affected by the cap placed on local levies and were no longer able to fund their basic needs. The state responded by passing ESSB 5313, increasing the state's public-school budget to an all-time high, but it exacerbated existing problems within the public school system. Schools in high-income districts receive more in funding than schools in low-income districts because high-income districts have higher property values. The disparity in funding has left students in low-income districts at a disadvantage and schools without the funds to compensate their teachers adequately. The State can remove funding at the local level and adopt a system that distributes funding at the state level, equally disbursed in districts. Also, the state could create a statewide school voucher program that would give the funding directly to the families. This would give the power to choose the child's institution for learning. Both alternatives provide suitable solutions to the problems with Washington's funding policy.

Safe Injection Sites, Overdoses, and Disease - *Rose Dolloff, Faculty Mentor: Christine Henderson and Kurt Ikemeier*

Safe injection sites (SIS) is a controversial topic. The opioid epidemic and overdose death rates keep rising in Seattle, even with solutions, such as safe injection sites and access to treatment services. Further exacerbating the epidemic and sensitive nature of SIS's, many legislative bodies are placing SISs on hold. Also, many people oppose the opening and operation of safe injection sites in the United States and, more importantly, in Seattle. Furthermore, citizens in Seattle likely know a person who has an opioid use disorder. However, how can the rate of deaths and the spread of infectious diseases be decreased if officials will not accept SISs as a possible solution to the crisis? Major cities in the United States, such as Philadelphia and Seattle, are trying to gain support to open SISs. The prospect of the connection could be higher, where SIS is needed to reduce the rate of people with opioid use disorders. More resources are needed to provide treatment and help for people experiencing addiction, which gives rise to this timely policy analysis. The purpose of this policy analysis aims to assess how safe injection sites would affect drug overdoses, enrollment in detox treatment, and prevention of infectious diseases.

The Law and Social Distancing - *Mariah Hogan, Faculty Mentor: Robert Claridge*

It goes without saying that we are in an unprecedented time, both American as well as global history amidst the COVID-19 outbreak. Of the innumerable changes the virus has affected within our lives, perhaps the most prevalent has been in the utilization of "social distancing" protocols enacted in most states, which serve to protect against the continued spread of the virus by greatly restricting our ability to gather publicly. However, despite the altruistic nature of the protocols, we have heard repeatedly stressed throughout the news and media that all have not been in total compliance. With some jurisdictions going so far as to attempt to enact policies that would allow for fines or other modes of punishment of being found in violation of the protocols, many states and other local governments have been scrambling to do what they can to encourage mass compliance without having to go so far as to enter "shelter in place"-like orders.

The purpose of this project is to evaluate the extent to which civil liability beneath a theory of negligence for persons found to be in violation of the social distancing suggesting could serve as an effective remedy to this rapidly evolving public health problem. Negligence is grounded by four key elements in civil law: duty, breach, causation, and damages. Within this project, we want to apply this framework to individuals who refuse to observe social distancing. For example, beginning with duty, we are interested in assessing where exactly it is that the threshold of duty may become implicated – such as in the enactment of social distancing orders, or perhaps even sooner. We will then continue our analysis through each of the elements of civil liability beneath a theory of negligence for individuals who violate the social distancing protocols enacted in their jurisdictions to determine if and how effective of a remedy civil law may be able to provide in the face of these confusing and tumultuous times.

Policy Analysis of Assault Weapons & High-Capacity Magazine Bans - Christopher Miller, Faculty Mentor: Christine Henderson and Kurt Ikemeier

In the United States, one of the main arguments is gun control rights and gun control legislation. Many people claim more gun control will mean less crime, while others believe more guns can reduce crime. One side argues that guns are the main reason and causation of the uprise of mass shootings in the United States, and the others argue that the cause of mass shootings is more complicated than gun ownership. One of the main reasons for the push of assault weapons ban and high capacity magazines is the claim of high capacity weaponry is used more in mass shootings more than any other firearm. Another claim is that high assault weapons are different from regular hunting rifles. Others believe there is a Constitutional right to own any firearm and, therefore, should not be able to be outlawed because, by doing so, disarms law-abiding citizens, not criminals. While there is disagreement, most people can agree there is a need to look at other issues that could be causing mass shootings and why there has been an uprise in mass shootings. I propose a second look at firearm type research, analyzing statistics behind gun violence and exploring opinions from experts. I use interviews with law enforcement and secondary analysis of United States gun violence scholars to demonstrate the irrelevance of weapon types used in crimes. Exploring other types of legislation to end gun violence, especially mass shootings, without taking away the rights of law-abiding citizens, is relevant and timely.

Police Use of Force - Brittney Murphy, Faculty Mentor: Christine Henderson and Kurt Ikemeier

The issue facing the police departments nationwide is the on-going issue of police use of force. Many Law enforcement agencies have come under scrutiny for their use of force practices. Police agencies are facing challenges in community policing due to the issues of use of force and the lack of training in de-escalation techniques used by law enforcement personnel. The lack of community policing has impacted law enforcement because the public generally sees interactions with officers as not positive, lacking in an overall partnership with the community, and officer's inability to solve problems without the use of force.

I-940 is a new policy that has not been fully implemented into law enforcement agencies. There is currently no statistic data proving the usefulness of I-940. The data collected is from interviews of policing agencies across Washington State and the Washington State Criminal Justice Training Center.

Are Specialty Courts the Key to Reducing Recidivism - Adrian Negrete, Faculty

Mentor: Christine Henderson

With the increase in population across the United States, the justice system has become backlogged. The prosecutor's office is overwhelmed with incoming cases, probation departments do not have enough probation officers to keep up with the influx of clients, and the jails are incredibly crowded. There is a drug epidemic in the nation, and what we had been doing before has been ineffective. Ignoring the drug epidemic and raising the minimum amount a person can have in their possession is not the solution. Drug courts allow offenders the opportunity to receive treatment and have their felony charge(s) dismissed upon successful completion of the program. In order to increase the effectiveness of this program, we need to expand the eligibility requirements.

Many counties have started using specialty courts such as DUI court, Family court, and Drug court. The focus for drug court is to give those who have committed a drug-related crime another opportunity, a second chance. Rather than simply entering them into the system and becoming another statistic, drug court was established to prevent the cycle. Drug court is a system set in place to help those who have committed drug-related offenses and wish to seek help rather than spend time in a jail cell. Those who wish to and qualify for the program are required to enter a contract with the court and treatment facility. Through interviews and secondary analysis, this policy analysis recommends future actions concerning equitable entry into drug courts, the expansion for data collection, and analysis.

Violence De-escalation and Mental Health Training in Law Enforcement - Mark Otton,

Faculty Mentor: Christine Henderson

In this day and age, police officers are pointed out for their mistakes more often than not, mainly for their abuse of power and authority or escalating situations to a point where things get out of hand. Law enforcement personnel are supposed to serve and protect their communities, but communities cannot trust local officers if they are scared that there is a potential they will die or be mistreated in some way when approached by an officer.

Trust is an ongoing problem throughout the country, that when officers have to go to court because they shot and killed someone. This problem throughout the communities matters because there could be a mere difference in what is right and wrong. For police to be able to create a safe environment, there needs to be communication between citizens officers. For new and upcoming officers or officers that have been doing their job correctly and positively, it would prove to be demeaning for officers or at least make them hesitant to what they have been taught or have been doing for so long if more and more restrictions are put on what they can or cannot do.

RCW 43.101.455 requires law enforcement to receive violence de-escalation, mental-health, and first-aid training, provide first-aid; change standards for the use of deadly force, adding a "good faith" standard and independent investigation. This policy analysis reviews the current violence de-escalation and mental health training required for all Washington State law enforcement.

The Juvenile Justice Act of 1977 - *Marin Rocha, Faculty Mentor: Christine Henderson*

The Juvenile Justice Act of 1977 is the guideline for sentencing youth offenders. Handling youth delinquency can be done in a multitude of ways, and new efforts are necessary in order to deter future crimes. Many programs are available to juveniles. Some programs are to prevent future crime and guide the individuals down a more positive path. There remains a need for amendments to the Juvenile Justice Act.

As juveniles commit crimes, police officers who are present at the time of arrest typically have a hand at determining where the young offender goes (crime dependent). Every county being different. There is a need for a standardized form of assessment to meet with an individual's needs is imperative in overall child development and well-being, post crime.

Many alternatives are available with offenders, which explains the positive change over the recent years in the juvenile justice systems, yet juvenile delinquency is still a problem. With the use of the diversion program more prevalent in means of rehabilitation, detention facilities have decreased. This policy analysis includes interviews, secondary analysis, and recommendations that could help with juvenile offenders who are slipping through the cracks of the justice system.

Medication Assisted Treatment: Solution or New Epidemic - *Benjamin Valdez, Faculty Mentor: Christine Henderson*

The opioid epidemic is rapidly impacting individuals across the nation. The rates of overdose have increased significantly, resulting in healthcare providers, government workers, law enforcement, and other individuals in professional standing to take action. The illegal use of narcotics has caused devastation throughout communities across the United States, which has resulted in policies and procedures being implemented as possible solutions to the opiate epidemic. A solution that many are currently advocating for and encouraging the addicted population to pursue is medication-assisted treatment (MAT) services and the encouragement of the Substance Use-Disorder Prevention that Promotes Opioid Recovery and Treatment for Patients and Communities Act (SUPPORT) of 2018 which allows physical health providers the ability to prescribe medication for MAT services.

Unfortunately, there is a disconnect between addiction treatment providers and the medical community regarding MAT services, which cause oversight to new problems emerging with the addicted population that include dependence on the MAT services medication and inconsistent compliance standards. By implementing a standard protocol for providers to follow with the encouragement/requirement of alternative treatment solutions to address the behavioral components, the likelihood, an individual will be successful at maintaining abstinence increases.

Sanctuary Laws - *Whitney Williams, Faculty Mentor: Christine Henderson*

There is an unfortunate crisis happening in the United States due to immigration laws and the travel ban. People are being discriminated against, fear for their lives and wellbeing of their families. Washington State and the City of Seattle have stated that the state and city are both very welcoming of immigrants. In 2019 Governor Jay Inslee enacted a law to protect immigrants - RCW 10.93.160 prohibits law enforcement agencies from inquiring about an individual's immigration status and cannot report their status to immigration enforcement.

This law is important because undocumented immigrants are being displaced from their homes. Their families are being uprooted and sent back to countries that they no longer consider home. The solution to this problem would be for every state to follow the lead of states that are in support of these laws. So far, California, Oregon, and Washington are the three states that are considered sanctuary states on the west coast of the United States, but there are many more states and cities which have these policies. Helping people that are in need and not pushing them out because of where they come from. Making people feel welcome and feel like they have a home, and not make them feel like they continuously have to look over their shoulder. Also, having a law in place like this could help reduce arrests made by law enforcement that are strictly based on discrimination.

Mathematics - Oral Presentations

The Dense Orbits of the Quiver - *Adara Andonie, Faculty Mentor: Danny Lara*

A quiver is a quadruple consisting of sets of vertices and sets of arrows with two maps which associates each arrow's source and target respectively. Quivers provide a way to visualize finite dimensional algebras. To study algebras, one may study its modules, which are generalized versions of vector spaces. Modules are difficult to study so we look at special types of modules called indecomposable modules; they are modules that cannot be broken down and are used to build other modules. If modules were legos figures, indecomposable modules would be the base pieces. There are three types of finite dimensional algebras: finite algebras, tame algebras, and wild algebras. A finite representation type algebra only has finitely many indecomposable modules, metaphorically, there are finitely many lego pieces to work with. A tame algebra has infinitely many indecomposable modules but can be described by a single parameter. We will be working with wild algebras, where a wild algebra has infinitely many indecomposables with infinitely many parameters and there is no possible way to describe the indecomposable modules. We look at specific algebras and show that it is a dense orbit algebra, so if we were to pick a module and the orbit gives us a set of all modules that are "the same", this would be a dense orbit. We are doing this because we have a conjecture that tells us that dense orbit algebras only have finitely many indecomposables that are dense, including wild algebras. Thus we're building evidence towards that conjecture.

Exploring the evidence of climate change through snowfall over the Washington Cascades - *Rebecca Martin, Faculty Mentor: Brandy Wieggers*

This will be a analysis of the historic snowfall on Snoqualmie and Sherman Washington state mountain passes to examine the possibility that Washington is undergoing climate change. I have used numerical and statistical methods to analyze the data, predict outcomes, and look for patterns to explore the evidence, or lack thereof, of climate change. Climate change can be described as the change in the atmosphere on the Earth by human and natural causes. Other scientific reports including patterns in snow melt and signs of climate change were reviewed for this project and will be used to help further the significance of my data and findings. This work is important for the mountain communities as snow provides important environmental and economic support for neighboring cities and towns. Most of the snow pack from the season melts into reservoirs to provide a main source of water. The local winter resorts also benefit from the snow as these businesses are impacted by financial losses with short seasons and lack of snow. If Washington is undergoing some significant climate change, then I predicted that the patterns already found and researched will be mirrored in my snowfall reports. This presentation will share my results, supported with numerical methods and statistical plots to predict and analyze the historic patterns.

Mathematical Modeling of the United States Southern Border Migrant Camp Crisis - *Leonardo Pastor, Vanessa Montano, Ariel Ramos, and Jacob Kauhane, Faculty Mentor: Brandy Wieggers*

As of July 2019, the United States government has reported a 66% increase in migrant children being held in immigration processing detention centers. The increase in migration without evidence based policy is causing concerns such as overcrowding, unsanitary conditions, poor living environments, and decreases in the mental and physical health of those being held in detention centers. We are interested in the financial, social, and health effects that occur in the conditions these children are in. What can math show us about what we can do to alleviate the issues occurring at these Migrant Detention Centers? We investigated the outbreaks in these facilities and determined the extent of infection by utilizing the differential equations in SIR models and analyzed the financial data to determine possible impacts on migrant children.

Physics - Oral Presentations

Quarantine's Hold on Virus Growth - *Devon Bice, Brenden Lawton, and Jackson Bell,* *Faculty Mentor: Erin Craig*

Pandemics can seemingly arise out of nowhere in a moments notice, whether we are dealing with the common cold, or something we haven't experienced before like COVID-19. Being prepared for these pandemics and understanding how to better prevent them is step one for providing better help in the future. We will be investigating how different quarantine strategies influence the spread and growth of viruses over time. In doing so, we hope to learn how quarantine can be used more efficiently in the future. We will evaluate this by incorporating real world data into mathematical models for viral propagation using code in MATLAB. We will create different scenarios using differential equations. We examine how the overall infection rate of a virus can be slowed by different quarantine measures. We also demonstrate that adopting quarantine measures in an effective time frame helps prevent overall spread and growth of the virus. These findings are not a "one size fits all" for any one pandemic. Quarantine is not always required, but knowing when it could be useful is important, just as much as knowing when to lift quarantine restrictions once the peak of spread has passed. Hopefully this information can help contribute to pandemic response strategies in different regions.

Runaway Stars as Possible Sources of the Elliptical Ring Structures in NGC 7538 - *Josie Fenske, Faculty Mentor: Cassandra Fallscheer*

Two large, elliptical ring structures have been identified in the high-mass star-forming region NGC 7538. Both of the rings have a mass of ~ 500 solar masses. The origin of these ring structures is unknown, making this an exceptional case as we normally would see a high mass star or stellar remnant driving a ring's expansion. We investigate the possibility that a runaway O- or B-type star may have originated in or passed through the region and created either one, or both of the ring structures via stellar winds. In testing this hypothesis, we identify one candidate star that may have formed the northern ring. This star, BD +61 2408, is a B3e star with a mass of ~ 8 solar masses, and a surface temperature of $\sim 20,000$ K. Its position, motion, timescale, and spectral type are all consistent with the star being a candidate for having formed the northern ring structure in NGC 7538.

Computational Model for Electromagnetic Gradient Cues Promoting Induced Growth Cone Turning - *Kahmina Ford, Faculty Mentor: Erin Craig*

The present study seeks to develop a computational model to investigate a method of neural regenerative treatment for neurodegenerative diseases such as Alzheimer's, multiple sclerosis, and sleep disorders. During neural development, growth cones of neurons respond to physical and chemical cues to turn and move along the correct path. After reaching its destination, the neuron connects with a neighboring nerve cell to create an intricate circuitry of neurons. Dysfunctional neural activity occurs when a neuron becomes injured or connects to a cell that is unable to receive electrical impulses. Recent studies have explored the use of near infrared (NIR) lasers to rewire neural connections and promote regeneration in damaged neurons. The electromagnetic field of a NIR laser provides a gradient to induce a repulsive and/or attractive response in the growth cone. Studies have shown that this method is highly effective for encouraging permanent turning of the growth cone, without damaging the neuron and the substrate necessary for motility. A key hypothesis of our study is that the growth cone structure interprets optical "turn signals" by growing in the direction of increasing electromagnetic field intensity. As an initial first step in predicting the success of NIR-based treatment of neurodegenerative diseases, we have created a model that defines the relationships that govern the dynamics of electromagnetic guidance cues. An expected outcome of this project is to produce new testable predictions for neuronal response to tunable features of an electromagnetic gradient, yielding insight into the potential effectiveness of different neural stimulation strategies.

Single-Cell Macrofluidics - *Mason Heath, Faculty Mentor: Nathan Kuwada*

Analysis of gene function in bacteria commonly involves perturbing or removing a gene product with chemical treatment and analyzing the phenotypic effects that result. Commonly this process involves using expensive and technically challenging microfluidic devices that have microscopically etched channels that deliver liquid media to individual cells. Our lab worked over Summer quarter 2019 to produce a new device called Single-Cell Macrofluidics, an inexpensive and flexible platform that still allows for fluidic control. Our main focus was to refine device design and collect data to characterize the effectiveness of delivery. We performed a variety of experiments to achieve these goals, including analyzing diffusion of fluorescent dye, estimating max rate of media exchange, and timed diffusion of media to live cells. This was a preliminary study with promising results, but more work is needed to refine our delivery system and overall structure of the fluidic device.

Design of an apparatus to measure mechanocaloric effects - William Lenderink,

Faculty Mentor: Benjamin White

The temperatures of some materials change in response to external stimuli including applied pressure, electric fields, and magnetic fields. These are examples of i-caloric effects and they are potentially useful for designing solid-state cooling technology. Such technology could supersede traditional vapor compression refrigeration, which is energy inefficient. Refrigeration and cooling/air-conditioning constitutes approximately 20.7% of US annual electricity consumption in the residential sector and 25.8% in the commercial sector according to 2018 data from the US Energy Information Administration. Solid-state cooling, which is more energy efficient, could reduce this consumption. Uncovering new i-caloric materials with suitable properties for use in new refrigeration technology necessitates measuring their i-caloric properties. In this presentation, a design for an apparatus to measure mechanocaloric effects is discussed. Mechanocaloric effects, which are a subset of i-caloric effects, occur when a material is either under applied pressure or stress. The apparatus is designed to measure the temperature of the sample material while compressed in a hydraulic press. Meaningful measurement of the temperature change of the sample requires it to be housed within a thermally insulating, but compressible cell. In addition, temperature measurements must be taken such as to allow for the calculation of entropic change due to the mechanocaloric effect, by minimizing change in temperature due to measurement. Measurements performed with such an apparatus could potentially lead to the discovery of new mechanocaloric materials that could be used in developing practical cooling methods with less energy consumption than conventional methods.

Computational Model for Growth Cone Motility Guidance Using Laser-Induced Electromagnetic Gradients - Desiree Ramirez, Faculty Mentor: Erin Craig

Many neurodegenerative diseases are caused by the disruption of processes vital to neurons and their surrounding networks, including communication, metabolism, and repair. Damage to nerve axons can result in loss of nerve function and cell death. In order to repair these neurons *in vivo*, the ability to regenerate the damaged axons and then guide the axons along paths that will result in functional connections is necessary. This requires the development of noninvasive, highly efficient tools to guide the movement of a structure called the growth cone, which facilitates axon growth and guidance. Using purely optical repulsive and attractive guidance techniques with low power and near infrared light provides a noninvasive and efficient tool to repair neurons and restore their vital processes. While the experimental data demonstrates the ability of optical cues to guide growth cone motility, computational models are needed to provide new insights and to suggest which variables are most important in future experiments. Computational models lead to a new and better understanding of the system being investigated. The goal of this project is to create a computational model that complements published experimental data, providing a novel understanding of growth cone motility and how it can be used in the treatment of neurodegenerative diseases. Initial simulations using custom Matlab code demonstrate that an optical guidance cue can induce growth cone turning.

Design of an apparatus to measure mechanocaloric effects - William Lenderink, Faculty Mentor: Benjamin White

The temperatures of some materials change in response to external stimuli including applied pressure, electric fields, and magnetic fields. These are examples of i-caloric effects and they are potentially useful for designing solid-state cooling technology. Such technology could supersede traditional vapor compression refrigeration, which is energy inefficient. Refrigeration and cooling/air-conditioning constitutes approximately 20.7% of US annual electricity consumption in the residential sector and 25.8% in the commercial sector according to 2018 data from the US Energy Information Administration. Solid-state cooling, which is more energy efficient, could reduce this consumption. Uncovering new i-caloric materials with suitable properties for use in new refrigeration technology necessitates measuring their i-caloric properties. In this presentation, a design for an apparatus to measure mechanocaloric effects is discussed. Mechanocaloric effects, which are a subset of i-caloric effects, occur when a material is either under applied pressure or stress. The apparatus is designed to measure the temperature of the sample material while compressed in a hydraulic press. Meaningful measurement of the temperature change of the sample requires it to be housed within a thermally insulating, but compressible cell. In addition, temperature measurements must be taken such as to allow for the calculation of entropic change due to the mechanocaloric effect, by minimizing change in temperature due to measurement. Measurements performed with such an apparatus could potentially lead to the discovery of new mechanocaloric materials that could be used in developing practical cooling methods with less energy consumption than conventional methods.

Computational Model for Growth Cone Motility Guidance Using Laser-Induced Electromagnetic Gradients - Desiree Ramirez, Faculty Mentor: Erin Craig

Many neurodegenerative diseases are caused by the disruption of processes vital to neurons and their surrounding networks, including communication, metabolism, and repair. Damage to nerve axons can result in loss of nerve function and cell death. In order to repair these neurons in vivo, the ability to regenerate the damaged axons and then guide the axons along paths that will result in functional connections is necessary. This requires the development of noninvasive, highly efficient tools to guide the movement of a structure called the growth cone, which facilitates axon growth and guidance. Using purely optical repulsive and attractive guidance techniques with low power and near infrared light provides a noninvasive and efficient tool to repair neurons and restore their vital processes. While the experimental data demonstrates the ability of optical cues to guide growth cone motility, computational models are needed to provide new insights and to suggest which variables are most important in future experiments. Computational models lead to a new and better understanding of the system being investigated. The goal of this project is to create a computational model that complements published experimental data, providing a novel understanding of growth cone motility and how it can be used in the treatment of neurodegenerative diseases. Initial simulations using custom Matlab code demonstrate that an optical guidance cue can induce growth cone turning.

Physics - Poster Presentations

Testing Rocket Grain Mixture and Designs with Sucrose Propellant - *Kourtney*

Adkisson, Faculty Mentor: Darci Snowden

A solid rocket motor is composed of a cylinder full of fuel which typically has a hollow core. After being ignited with a fuse, the fuel at the surface of the hollow core burns and produces hot gas that is released through the nozzle of the rocket in order to produce force. The surface area of the burning propellant affects the thrust force and pressure output of the motors; the more fuel that burns at one time, the more thrust and pressure is produced. The purpose of this project was to investigate the effect of surface area on thrust and pressure. In order to accomplish this, a safe technique was devised and carried out in order to make motors with potassium nitrate and sucrose propellant. Four different surface areas were tested, each with different geometric shapes of propellant, which is called the propellant grain. The motors were tested on a thrust table, which is an apparatus that measures the pressure and thrust output while the motor is burning. Sixty percent of the tested motors had a short burn time that averaged 0.5s. Due to the collection rate of data, the short burn time resulted in minimal data points. As a result, the project pivoted towards creating grains that burn for longer by reducing the oxidizer to fuel ratio from 65:35 to 60:40 and investigating more efficient ways to mix the fuel.

Measuring Betelgeuse's Unexpected Dimming With U and B Filters - *Connor*

Bronson-Doherty, Faculty Mentor: Cassandra Fallscheer

The red supergiant star, Betelgeuse, was first reported to be dimming beyond its usual fluctuations in October 2019. Since then, many professional and amateur members of the astronomy community have been observing the star, analyzing the data, and trying to determine the cause of its dimming. From 28 January to 27 February 2020 we observed Betelgeuse using the CWU 0.6-meter research telescope with Bessel Blue and Ultraviolet filters. Our magnitude data were submitted to the American Association of Variable Star Observers' (AAVSO) database where we found our magnitude trends to be consistent with the trends from other submissions while exhibiting a slight offset in actual values. Our data, along with other AAVSO data submissions, and recent findings by other AAVSO partners have found that Betelgeuse has ceased dimming and is slowly rising in magnitude in line with its variable cycle putting some theories to rest but creating even more questions as to why Betelgeuse exhibited the anomalous dimming behavior.

Modeling Waves in Titan's Upper Atmosphere - *Joseph Buxton, Faculty Mentor: Darci*

Snowden

Titan is the largest moon of Saturn and is the second to the largest moon in our solar system. Titan's atmosphere is unique since it is the only moon that has a dense atmosphere. Due to Titan's low gravitational pull, Titan's atmosphere extends ten times further than Earth's atmosphere. To understand this sophisticated atmosphere, we used data from 52 flybys collected by Cassini's Ion Neutral Mass Spectrometer to characterize wave-like features in the density and temperature of Titan's upper atmosphere. Python code was developed to import and plot density data. Perturbations in the data were fitted with spherical harmonic wave functions that gave the wave amplitude, wavelength, and decay rate; which were compiled into histograms to find the mean. The amplitudes and wavelengths were plotted to look for systematic trends in latitude, time, and solar EUV flux. A model of Titan's atmosphere was then created with a specific wave pattern, and the density was extracted along the trajectory of Cassini. This wave amplitudes and wavelengths can be adjusted in this model to try to replicate the actual perturbations. The next step will be to compare the simulated perturbations with the real data.

Goniometer Implementation for HPGe Gamma Spectrometers - David Godinez,

Faculty Mentor: Michael Braunstein

The goal of this project was to design and assemble a low-cost apparatus for performing angular correlation measurements of gamma rays using the two HPGe gamma spectrometers owned by the CWU Physics Department. Angular correlation measurements evaluate the angular relationships between multiple gamma rays emitted in nuclear decay. These gamma rays have an associated angular momentum that determines the angular distribution of a second gamma ray. Measuring the angular correlation of gamma rays emitted by a particular isotope uses two gamma ray detectors set up equidistant from a source and oriented relative to each other over a range of angles. A feasible design that could be fabricated in the CWU Physics shop was designed using SOLIDWORKS and coordinated with the principal end user and the Physics Technician. Unfortunately, this project was unavoidably interrupted in-progress and has not yet been completed. The steps of the design process, final design, and future steps and plans will be presented.

Physics Demonstration Repository - Maranda James, Faculty Mentor: Bruce Palmquist

The purpose of this project was to collect and organize first quarter calculus-based physics (PHYS 181) demonstrations into an online repository that could later include demonstrations from other courses. Sharepoint was used as the website builder because of its consumer friendly interface and the ability to have different levels of access to view and change aspects of the pages. Physics faculty and staff were surveyed to determine the optimal organizational scheme. Based on this, each demonstration has its own page that includes a descriptive title, related image, summary, key concepts with inquiry questions, instructions, and safety considerations. During the allotted time frame 25 demonstrations were cataloged. An outcome of this project is the standardization of demonstrations between instructors. With this repository as a reference, instructors can make sure their students are receiving the same quality demonstrations as a peer in another section. The inclusion of inquiry based questions also helps instructors lead students in the discovery or application of scientific phenomenon. This project has the potential for growth in the number of demonstrations and in the number of people it can reach. Currently professors here at Central have access to edit this repository, however it can later be set so CWU students can view this to supplement their learning. There is also the possibility of sharing this with other other colleges and high schools.

Multiple-Planet System Simulation for Measuring Radial Velocity of a Star - Josh

McRae, Faculty Mentor: Darci Snowden

With the addition of a spectrograph to the Central Washington University Science Center II Observatory 0.6-m Telescope, the detection of extra solar planets using the radial velocity method is possible. As such, tools are needed to help students interpret and understand the data collected. A program was constructed in Python 3.7 that utilized Newton's law of gravitation to animate an n body simulation and measure the radial velocity of one body. With the radial velocity data, a measurement of an orbiting body's mass and orbital period can be determined. Students will use the model to simulate theoretical systems to compare with data. Using the simulation allowed for the recreation of measured data from the 51 Pegasi system and calculate data for a simplified Solar System. The next step for the program is to code an algorithm capable of reducing the data from the radial velocity to its components so that multi-planetary systems can be analyzed more efficiently.

Synthesis of Vanadate Materials BaCo₂V₂O₈, SrMn₂V₂O₈, BaMn₂V₂O₈, and SrCo₂V₂O - *Ryan O'Connor, Faculty Mentor: Benjamin White*

BaCo₂V₂O₈ is a quasi-one dimensional material, and, along with a few other similar materials including SrMn₂V₂O₈, BaMn₂V₂O₈, and SrCo₂V₂O₈, it provides a platform with which to study magnetic interactions in reduced dimensions. Experimental studies on these materials are only made possible by preparing samples, but they are not easy to synthesize. Most published studies that successfully prepared samples used procedures and equipment that are not available to student researchers at CWU. In this study, we attempted to synthesize BaCo₂V₂O₈, SrMn₂V₂O₈, BaMn₂V₂O₈, and SrCo₂V₂O₈ using a standard solid state synthesis approach. Our procedure involved weighing out stoichiometric amounts of the chemical compounds necessary to produce 1 gram of the desired compound, mixing the components, and grinding them via mortar and pestle. The resulting powder was reacted in a box furnace and heated at a 930°C for several hours. We reacted the powder four times with several intermediate grindings to promote chemical homogeneity. The resulting powder was then pressed into a pellet using a die kit and hydraulic press so that it could be cut into the appropriate sizes for experiments. Powder x-ray diffraction measurements were performed and analyzed to determine the sample purity and to characterize impurity phases. Using this method, we determined that BaCo₂V₂O₈ and SrMn₂V₂O₈ were successfully synthesized; on the other hand, attempts to synthesize BaMn₂V₂O₈ and SrCo₂V₂O₈ were unsuccessful. Once the laboratory is available for use again, measurements of heat capacity and magnetization will be performed on BaCo₂V₂O₈ and SrMn₂V₂O₈ to study their magnetic states.

Assembling a Spontaneous Parametric Down Conversion Source - *Eric Pritchard and Martin Mattes, Faculty Mentor: Michael Braunstein*

Spontaneous parametric down-conversion (SPDC) is a process in which a nonlinear crystal is used to convert an incident photon into a pair of photons. This pair of SPDC photons conserve the energy and momentum of the incident photon and is a quantum entangled state. We assembled an optical apparatus that was designed to produce SPDC photons from a beta barium borate crystal. We used a computational program to model the propagation directions of the SPDC photons. Collimators coupled to photon detectors were positioned according to the model and then we made small adjustments to the positions until high count rates were measured. We established further evidence that SPDC photons were being detected by a coincidence measurement between the photon detectors. These findings suggest that this apparatus can be used in the future to perform additional experiments on non-degenerate down-converted photons, quantum entangled state, anti-bunching experiments, and experiments involving Bell's Inequality.

Hanle Effect Photomultiplier Tube Characterization - *Nicolas Puentes, Faculty Mentor: Michael Braunstein*

The CWU physics department is implementing a mercury Hanle effect experiment. A Hanle effect apparatus uses the varying spatial dependence of photons emitted from atoms as a function of magnetic field strength. This project characterized the photomultiplier tube (PMT) that will detect the UV photons in this apparatus. Characteristics of the response of the PMT were measured using a mercury lamp, NIM electronics, optical hardware and components, and an oscilloscope. The project was unavoidably interrupted in progress. Preliminary results and a plan for completing the project will be presented.

Magneto Optical Trapping of Rb-87 - Macarena Santillan, Faculty Mentor: Michael Braunstein

Magneto Optical Traps (MOT) are systems used to investigate the behavior of atoms at very low temperatures. This project was focused on trapping Rb-87 atoms in a MOT with the goal of counting the number of atoms trapped and characterizing their temperature. The MOT system uses a magnetic field along with saturated absorption spectroscopy techniques to control laser beams that cool down and trap the atoms. A scientific grade CCD camera and MaxIm DL's imaging software were used to obtain clear images of the cluster of atoms trapped in the MOT. These images contain information that is key for performing measurements of number and temperature of the atoms. Work on the project was unavoidably interrupted and preliminary results and suggestions for future efforts will be presented.

Building a Michelson Interferometer for a Saturated Absorption Spectroscopy

Apparatus - Wyatt Schuldheiss, Faculty Mentor: Michael Braunstein

Saturated absorption spectroscopy is a method of observing atomic state transitions that are normally obscured by Doppler broadening of the atomic spectral absorption lines. The goal of the experiment was to build a Michelson interferometer for the laser in a rubidium saturated absorption spectroscopy apparatus for improving the resolution of measurements of atomic transition frequency separations. Progress on aligning the interferometer was held back by an interference pattern of unknown origin in the saturated absorption signal. The likely cause of the interference was determined to be the probe beam of the laser interfering with the pump beam of the laser at the detector due to reflections inside the rubidium cell. Plans were developed to realign the pump beam of the laser. Preliminary results obtained before the project was unavoidably interrupted and plans for future work will be presented.

Poisson Spot: Single Photon Interference - Connor Toulou, Faculty Mentor: Michael Braunstein

In the Poisson Spot experiment electromagnetic waves obstructed by a circular object display a localized bright spot centered in the shadow. Classically this demonstration is explained by interference due to the wave nature of light; however, photon interference should exhibit the same effect. In this experiment a novel method was introduced for the investigation of the Poisson Spot phenomenon under the constraints of a source of single photons. Utilizing spontaneous parametric down conversion, two photons were detected in coincidence by avalanche photodiodes. The path of one of the photons was then obstructed by a small ball bearing. Preliminary data obtained exhibits evidence of a Poisson Spot constituted by single photon interactions similar in form to the classical phenomenon.

Assembly and Assessment of an Alpha Spectrometer - Brooklyn Wheeler, Faculty Mentor: Michael Braunstein

Alpha spectroscopy is used to characterize and measure alpha particles emitted in the decay of certain radioactive isotopes. The purpose of this project was to assemble and assess the performance of an alpha spectrometer apparatus for the CWU Physics Department. This apparatus consisted of a vacuum pump system connected to an ORTEC Alpha Aria detector chamber containing a silicon surface barrier detector. The Alpha Aria chamber and detector connect to a computer using ORTEC MAESTRO software that operates the system and presents spectra of radioactive isotopes. For this project, we obtained two alpha particle sources, Americium-241 and Radium-226. The spectra observed for the Radium-226 source were consistent with its characteristic decay scheme; however, the spectra observed for the Americium-241 source were not. Further investigation suggested that the observed inconsistencies could be explained by the straggling effect due to the casing of the Americium-241 source.

Physics - Creative Works Projects

Biomimicry of Biceps Contraction on the Forearm - Charles Recaido, Faculty Mentor: *Erin Craig*

One of the most important and complex biological systems is muscle, which is a tissue synthesized by the body that has the ability to produce force and motion. Currently, there are two primary engineering applications based on the imitation of human movements: medical applications such as prosthetics and commercial applications such as exoskeletons and general robotics. A limitation in the field of biomimetics – where machines are designed to mimic biological systems to carry out tasks – is that many prosthetic designs are based on preexisting mechanical concepts that accomplish the intended function, but lack the fluidity and versatility of human-like movements.

The overarching goal of this project is to develop a computational model and a semi-complex experimental prototype of the human arm doing a bicep curl, and to characterize the mechanical performance of the model under systematically applied load forces. Computational models based on published muscle physiology data were used to simulate length contraction of the muscle fiber as well as tension under different weights. A mechanical model was then designed and constructed to meet the criteria set forth by the computational model.

This project has demonstrated the effectiveness of a very simplistic design of the sarcomere – the smallest unit of muscle tissue – being used to lift different amounts of weight. The long-term motivation of this project is to contribute to design improvements in neural prosthetics and hopefully contribute to making biomimetics more commonplace in research and development.

Political Science - Oral Presentations

Education, dissent, and voter apathy in Iran and Saudi Arabia. - Mohsen Asadalla, *Faculty Mentor: Salam Awad*

Saudi Arabia and Iran are two regional powers that excessively limit their population's access to information and place dominant controls over their educational sectors, with religion and obedience being the prime focus of discourse. The control over information has been conducted through K-12 school systems. As a result of the control over information, it has led to an environment of political apathy. The political apathy is helping the states maintain their authoritarian control over the people. Moreover, dissent is not welcomed or tolerated in Iran and Saudi Arabia. Dissidents in both states have faced harsh consequences. Exiles and persecutions are a common punishment for dissidents. Because of the brutal crackdowns on dissent, political socialization has been suffered. In both countries, the state claims one truth and that is absolute. Hence, the claimed truth is propagandized through education systems. In recent cases, both countries have illustrated their ruthlessness in dealing with dissidents. In Saudi Arabia's case, the killing of a dissident journalist, Jamal Khashoggi, proved that the state does not tolerate dissent from its citizens. Although Khashoggi was living in exile, the Saudi government targeted him and executed him. Similarly in Iran, the recent uprisings that were triggered by an increase in fuel prices, was an example of the state's intolerance towards dissent. The indiscriminate killing of protestors in Iran was an extent that the government was willing to go to, in order to discourage dissent. In both states, the country's dominant control on information coupled with harsh responses to citizens who challenge the status quo, have heightened political apathy

Solidarity between the Israeli Black Panther Party and the Palestine Liberation

Organization - *Alex Harrington, Faculty Mentor: Salam Awad*

The Black Panther Party in America had a far reaching impact internationally due to the importance they placed on intersectional solidarity between various movements. A notable example of this solidarity was between the American Panthers and the Palestine Liberation Organization (PLO). One group that was impacted profoundly by the American Panthers was formed by young Mizrahi Jews (Jews from Arab and North African countries) a generation after the foundation of the State of Israel. They took on the name Ha'Panterim Ha'Shchorim ('Black Panthers' in Hebrew). This research analyzes the solidarity between the Israeli Panthers and the PLO, comparing it to the solidarity between the American Panthers and the PLO. The research utilizes the established literature on the American Black Panthers and the Israeli Black Panthers, as well as historical archives and interviews with subjects familiar with the Israeli Black Panthers and their activities.

Primate Behavior & Ecology - Poster Presentations

Estrus and Wounding in Captive Chimpanzees (*Pan troglodytes*) at Chimpanzee

Sanctuary Northwest - *Miranda Cays, Faculty Mentor: Jessica Mayhew*

Wild chimpanzees (*Pan troglodytes*) lead complex social lives in fission-fusion communities, with diverse behavioral repertoires, including the capacity for violent aggression. Female chimpanzees also display dramatic anogenital swellings, which aid in synchronizing mating with ovulation, and, in the wild, mating is one of the most common sources of agonistic interactions. In human care, chimpanzees retain their social and behavioral complexity although their environment is drastically different than that of their wild counterparts. Human control of breeding in a captive group can greatly increase the amount of time females spend in estrus; potentially increasing the impact of female swellings group behavior. Although aggression is a natural feature of chimpanzee behavior, it can escalate to serious wounding, and reduce welfare. In a captive environment, where maximizing chimpanzee quality of life is paramount, understanding the causes and correlates of serious intragroup wounding informs husbandry decisions, and aids in the reduction of wounding events. In this study I collected archival wounding and estrus data on seven chimpanzees housed at Chimpanzee Sanctuary Northwest (CSNW). Preliminary analysis of this data indicates that wounding and the presence of estrus females are negatively correlated, contrary to my predictions and what the literature indicates. Additionally, I did not find a correlation between long-term group stability and reduced wounding, as predicted by the literature. These findings indicate that other factors may be more salient predictors of group wounding rates, and further research is required to determine what factors put chimpanzee groups at risk of a high rate of wounding.

Persistence of Lexicon in Signing Chimpanzees - *Emily Patton (School of Graduate Studies), Courtney Garzone, Jenna Skinner, and Emilie Rich, Faculty Mentor: Mary Lee Jensvold*

Chimpanzees Tatu and Loulis use signs of American Sign Language (ASL) to communicate (1,2,3,4,5). They lived with other chimpanzees at the Chimpanzee and Human Communication Institute (CHCI) from 1980 to 2013 and then they moved to Fauna Foundation (FF). At CHCI all caregivers and chimpanzees used ASL. At FF only some caregivers and none of the chimpanzees used ASL. Tatu and Loulis continued to sign at FF (5). Caregivers at both CHCI and FF kept daily records of the chimpanzees' use of signs in sign checklists. The current study is an analysis of 2018 and 2019 sign checklists. Tatu's mean number of signs used per day ($M=12$) in this sample was lower than in the previous years at FF ($M = 14$) and Loulis' was the same at both samples ($M=4$). Tatu's lowest range of signs used per day in the previous years was 1–32 in 2016 and this sample was comparable in 2018 but lower in 2019. Loulis' range was lower in this sample than his lowest range in previous years (1-8 in 2015). The total number of vocabulary items per year was similar to previous years at FF, with a slight increase for both chimpanzees as compared to 2015 and 2016. High frequency signs were nearly identical to previous years at FF. While Tatu's and Loulis' vocabulary use changed slightly in their transition from CHCI to FF, it remained consistent during their time at FF. ASL lexicon and use in chimpanzees is a robust behavior that persists throughout environments.

Psychology - Oral Presentations

A Tale of Three Skin Tones: When Brown Skin Determines Citizenship and Immigration Policy - *Patrizia Chirco (School of Graduate Studies), Faculty Mentor: Tonya Buchanan*

Across two experiments we examine how skin tone influences social categorizations involving immigration and legal status, and explore whether specific patterns of categorization predict support for stringent immigration policies. In Study 1, we presented undergraduate participants ($N=209$) with photographs of people with light vs dark skin and asked them to rate the likelihood, 1(Extremely unlikely) to 5(Extremely likely), that the individual was an immigrant. Supporting our hypothesis of a connection between skin tone and perceived immigration status, participants rated individuals with dark(vs light) skin as more likely to be immigrants, $F(1,97)=11.59$, $p<.001$, $n^2=.11$. In Study 2 (data collection ongoing), we further investigated the influence of skin tone on social categorization, showing participants computerized images of the same man with either brown, white, or black skin. Participants rated the likelihood of that individual being an immigrant and undocumented. Additionally, participants rated their support for several hostile immigration policies (Marshall & Shapiro, 2018) using a 7-point Likert scale. We expect that participants will rate individuals with brown skin as more likely to be immigrants and undocumented than individuals with white/black skin. In addition, we expect that participants who identify the individual with brown skin as more likely to be an immigrant and undocumented will be more inclined to support stringent immigration policies. As highlighted by recent events, associating skin tone and immigration status can have dangerous implications (e.g., being stopped to provide identification, run over with a car for "looking Mexcian").

Defying Gravity: Experiences of Students with Challenges - *Katie Paccia and Ambree Hollenberry, Faculty Mentor: Wendy Williams*

The current investigation explores the influences and attitudes associated with university students with disabilities and those students studying abroad in the United States. Thirty students from two Pacific Northwestern universities were recruited from disability service and international program offices. Respondents self-identified as being served by the one office, or the other, or both. An anonymous, online Qualtrics survey consisted of ten statements in each of six broad categories related to the transition to university (specifically, seeking help, family dynamics, interpersonal issues, teacher relations, grades, and studying). Categories consisted of ten questions: five positively and five negatively worded statements to encourage the full use of the Likert scale. Participants rated their degree of agreement/disagreement on a 1-6 scale.

Descriptive statistics (means and standard deviations) were calculated for the broad categories for both the positively and negatively worded statements across three groups. ANOVAs were calculated when group means differed by more than one point. Results indicate that students in all three groups tended to agree with positively worded statements in all six categories. However, negatively worded statements revealed potentially meaningful differences between the groups. Statistically significant differences were found for negative teacher statements and negative statements about grades. Results suggest that students with disabilities and international students do share some similar transitional experiences in some areas (seeking help, family dynamics, interpersonal issues, and studying) and could benefit from interactive interventions. However, differences do exist in key areas (specifically regarding challenges with teachers and grades) that might require more targeted intervention efforts.

Relationship between prefrontal cortex asymmetry, mental health, and stress - *Monica Sewell (School of Graduate Studies), Faculty Mentor: Ralf Greenwald*

The prefrontal cortex (PFC) is an intricate region of the brain. It is involved with decision making, cognitive performance, disposition, and affect. As a result of these facets, the PFC is always active and firing. A large component to the function of the PFC is stress or more importantly, the lack of stress. When processing emotions or trying to make decisions, stress can be a large inhibitor and obstructer. As a result, stress makes it harder to make sense of circumstances or to think clearly. This is because stress is directly affecting the prefrontal cortex. When stressed for long periods of time, mental health becomes a concern. Both stress and mental health effect the prefrontal cortex in the same ways. People who are high in stress or have a mental disorder, have greater right prefrontal cortex asymmetry. This short review will delve deeper into prefrontal cortex asymmetry and how it relates to mental health and stress.

Psychology - Poster Presentations

The Effects of Human Observers on the Consistency of GBI Gorilla Personality Profiles and Behavior - *Courtney Aucoin (School of Graduate Studies), Faculty Mentor: Megan Matheson*

The research into non-human primate personality has been limited but growing. Most of the research in this field is focused on chimpanzees, so there is a need to expand the research. The Gorilla Personality Index (GBI) is the only current model of gorilla personality and is based on the trait theory of personality. The GBI consists of four traits (dominance, fearfulness, understanding, and extroversion) which together create a holistic image of a gorilla's personality. This poster will discuss the author's proposed study to examine the effects of human visitors at a zoo on the behavior changes of gorillas with different GBI personality profiles in the summer of 2020.

Behavior in Zoo-Housed Captive Ring-Tailed (Lemur catta) and Red Ruffed (Varecia rubra) Lemurs at Woodland Park Zoo, Seattle, WA - *Rhiannon Belcher (School of Graduate Studies), Selene Huckell, Daniel Camacho Hernandez, Cetacea Stanton, Faculty Mentor: Kara Gabriel*

Literature on zoo visitors' effects on animal behavior has yielded conflicting findings regarding the potential detrimental impact, with some studies positing that noise levels, rather than visitor numbers, are stressful to captive mammals. The current study observed behavior of red ruffed lemurs (n = 3) and ring-tailed lemurs (n = 5) living in adjacent outdoor habitats at the Woodland Park Zoo, from July to October, 2019. For both lemur groups, vigilance to external sources, including overhead flight paths and construction noises, occupied the largest proportion of activity budgets after resting behaviors. Red ruffed lemurs spent a smaller proportion of their activity budgets on vigilance compared to ring-tailed lemurs; a surprising finding given research showing that vigilance is higher in smaller groups. The high levels of vigilance suggest that the zoo enclosures, which include waterfalls designed to mitigate the impact of external sounds, are not fully ameliorating potentially stressful environmental stimuli.

High Tides, Low Donations: Metaphors May Influence Donors' Willingness to Donate - *Patrizia Chirco (School of Graduate Studies), Faculty Mentor: Tonya Buchanan*

Although overtly racist language is no longer tolerated in most public settings, racist concepts about immigrants are still manifested through dehumanizing metaphors in the public discourse and in the media (Santa Ana, 1999; Marshall & Shapiro, 2018). Dehumanizing metaphors are still used as a form of social control (O'Brien, 2002) and carry negative connotations as they push consumers of information to associate immigrants with natural disasters, bothersome insects, and illnesses that need to be eradicated (Marshall & Shapiro, 2018). Indeed, metaphors are so powerful that they influence anti-immigration attitudes and voter behavior (Marshall & Shapiro, 2018). Prior research has overlooked the effects of dehumanizing metaphors on charitable giving. To address this gap in the literature, we investigated whether the use of dehumanizing metaphors in donation requests regarding immigrants lowers the likelihood of an individual's willingness to donate. We recruited 200 participants via Mechanical Turk and informed them that they could participate in a raffle and win \$50. Participants were randomly assigned to read an excerpt either containing a dehumanizing metaphor or not and asked how much of the potential monetary win they were willing to donate. Data analysis revealed that, while the presence of the dehumanizing metaphor did not influence charitable giving, political leaning did. The findings suggest that the manipulation may have been too subtle or that the effect of the metaphor chosen for this study may not apply to the current sociopolitical context.

Homework, Organization, and Planning Skills: Effectiveness With Middle-School-Aged Students - *Damian Culver and Madison Hatfield (School of Graduate Studies), Faculty Mentor: Richard Marsicano*

The Homework, Organization and Planning Skills (HOPs) intervention is behavioral intervention with a token economy system that rewards students for improvements in organizing their school materials, homework management skills, and using a planner and schedules. When students improve these skills they are more prepared to do well academically. This study takes a multiple-baseline design approach to examining the intervention's effectiveness when implemented one-on-one and in a small group with an interdependent contingency for reward. There are 17 sessions. Students who could benefit from improved organization, homework management, and planning skills were recommended for the intervention by local middle school teachers. Interventionists are gathering weekly data on the percent of organizational skills met on a checklist, the number of missing assignments, and the percent of time management skills met on a checklist. Preliminary visual analysis is revealing that the organizational skills have generally improved with the implementation of organizational binder systems with the students. The number of missing assignments data is more mixed. Time management skills have yet to be introduced and the data during baseline appears mixed.

Default nudges: The impact of decision context and default source on perceptions and behaviors related to default options - *Logan Davis, Faculty Mentor: Tonya Buchanan*

Default options (e.g., preselected choices) powerfully impact decision-making outcomes ranging from shipping methods to organ donation, increasing retention of the options set as defaults. Decision-makers often assume that defaults reflect recommendations, however, the rationale behind default selections is often unexplained. We therefore explore the effectiveness of defaults, their perceived basis, and if such perceptions depend on the context of the decision. That is, might people believe defaults represent expert opinions for complex decisions, but most popular options for social decisions (default-context fit). In Study 1, participants selected how student fees should be allocated at a university. The decision-context was described as being either complex or social in nature. Participants were then randomly assigned to receive information about how the default options were selected: by an expert, by popularity, or no information. Participants then decided how the student fees should be used (e.g., renovation, transportation) with randomly selected default options included. They then reported how they thought defaults were determined. Replicating the classic default effect, participants chose the default option more than chance, with this effect most pronounced in the complex-context condition. Interestingly, rather than a default-context fit, we instead found that participants were more likely to believe the default represented the popular option (vs. expert opinion, random, profitable) regardless of context. Given these findings, in Study 2 we examined a more individualized, less socially-relevant decision: laptop customization. Results replicate Study 1 and additionally suggest that participants were more likely to choose the default when told it represented the popular option.

Framing and student perspectives; Grede- versus Learning oriented class

descriptions - *Nicole Douglas, Faculty Mentor: Kara Gabriel*

This research evaluates student's preference for and perceived self-efficacy in courses framed as either Grades Oriented (GO) or Learning Oriented (LO). Students did not demonstrate a preference in the framed class descriptions, but preference for class type was significantly mediated by student's growth mindset ratings. These findings may alert educators as to the importance of learning outcomes when describing classes. Additionally, this research demonstrates the importance of a students' growth mindset in taking and considering perceived difficult classes.

Keep Calm and Carry On: Mood Effects on Emotion Regulation Strategies - *Elsa Mastico (School of Graduate Studies), Faculty Mentor: Ralf Greenwald*

Emotion regulation is a phrase used to describe individual's ability to efficiently calm themselves down when faced with distressing stimuli. Two frequently studied strategies are reappraisal (reassessing a situation as something positive) and distraction (thinking unrelated positive thoughts in order to remain calm). Past research has shown that these two strategies are so effective that they can even be seen in recorded brainwaves using an electroencephalogram (EEG). In order to add to the previous literature, the current research looked at daily mood as another potential external factor that may influence the efficiency of reappraisal and distraction. The brainwaves from a negative stimulus analysis task of twenty-five undergraduate participants from Central Washington University were analyzed and compared to self-report data on their current mood and prior knowledge/practice of utilizing these strategies. The researchers hypothesized that individuals who reported to be in a particularly pleasant mood would show greater efficiency in their reappraisal task. For distraction, the researchers hypothesized that individuals would be able to distract themselves regardless of mood. Primary results indicated that most of the participants were in a pleasant mood, so statistically overall mood had no effect on reappraisal ($F(2,22)=.678, p=.518$) or distraction ($F(2,22)=.193, p=.892$). There was however a significant difference in participants overall ability to distract vs. reappraise ($t(24) = 2.156, p<.05$) indicating that even though mood may not influence individual's ability to reappraise or distract, distraction may still serve as a more efficient way to regulate emotions overall.

Forgive Them, Forgive Them Not: The Role of Remorse and Empathy in Interpersonal Forgiveness - *Molly Mortensen, Faculty Mentor: Mary Radeke, Tonya Buchanan, and Meaghan Nolte*

In this study, the independent variables of empathy and remorse were presented to participants through four hypothetical transgression scenarios using an online survey. A convenience sample of 422 participants from psychology course at a North-western university were randomly assigned to one of four conditions (1-Remorse and Empathy, 2-Remorse and No Empathy, 3-No Remorse and Empathy, and 4-No Remorse and No Empathy). Participants were prompted to select an individual from their own life to use as a basis for a hypothetical scenario which depicted a betrayal of trusted information that leads to humiliation as the information is spread beyond the trustee. Participants were then presented with a scenario outcome (ending) describing both the victim (the participant) and the transgressor's reactions to the situation, corresponding to the participants' assigned condition.

The Mystery of Mandalas: The Effects of Coloring on Stress Reduction and Mood -

Olivia McDougall, Faculty Mentor: Mary Radeke, Meaghan Nolte, and Allyson Rogan-Klyve

Art therapy is commonly used across many different situations. Prior research has found that art, including painting and drawing, can improve mood and reducing feelings of stress and anxiety. Specifically, research has found that coloring mandalas can reduce stress more than coloring other prints or drawing on blank paper. However, the reason for mandala's stress and anxiety reducing properties has yet to be entirely discovered—is the design of the mandala the cause, or some other factor? The author is curious if the effects of watching coloring are comparable to the effects of physically coloring, specifically in the case of mandalas. The present study will attempt to uncover part of the mystery behind mandalas by following the procedures of previous research on the topic. Through an online study, participants will answer mood and stress questionnaires (PANAS and SSSQ) and be subjected to a stress inducing activity. Following the stress activity, participants will either watch a video of someone coloring in a mandala, freely drawing on blank paper, or passively observing visual artwork. After the videos, participants will again complete stress and mood questionnaires. The author hypothesizes that the mandala condition will show the greatest reduction in stress in participants. Contributing to the research on art therapy and stress reduction is important to further help the individuals who can benefit the most from the effects of coloring on stress.

Impact of the CSI Effect and Authority Bias on Juror Decisions - Meredith Scruggs,

Faculty Mentor: Danielle Polage

The recent increase in number of crime drama television shows raises the issue that these fictional portrayals may impact real proceedings in the justice system. This phenomenon has become known as the CSI effect. This includes the concept of authority bias, by which laypeople place higher value on information provided by those that they perceive to be in positions of authority. 289 college students completed a survey comparing their likelihood to match an unknown fingerprint to a suspect's, after actors portraying evidence technicians either confirm the match or provide no conclusion. Results showed no significant interaction between the confirmation condition and participants' likelihood to say that the fingerprints matched.

#Chimp: An analysis of primate depictions on Instagram and user engagement -

Taylor Tabor, Kameron Kissel, and Madalyn Rantala, Faculty Mentor: Kara Gabriel

The way in which primates are portrayed on social media has become a topic of controversy, with welfare agencies contending that inappropriate imagery is fueling the exotic pet trade. Previous research has shown that chimpanzee use in entertainment materials can threaten conservation efforts by influencing personal beliefs related to ownership rights and species abundance. There is currently little understanding of how these effects carry over to social media, and what depictions of primates are prevalent on Instagram. Our study aimed to systematically categorize how primates are presented on Instagram and evaluate public interaction with various types of content. We extracted and recorded data for 1,381 videos and images of primates under the hashtags #chimp, #chimpanzee, #monkey, and #ape. To determine which visual characteristics received the most attention from Instagram users, we assessed primate age, human presence, human interaction, environment, primate clothing, posing, and object manipulation. These categories allowed us to capture species typical and anthropomorphic representations throughout the imagery. Preliminary analysis shows no relationship between human interaction and increased user engagement through likes, comments, or views. Imagery showing primates who appeared to be young, were wearing clothing or pet accessories, were interacting with objects designed for human use, or were in what appeared to be an indoor environment received more positive attention. This suggests that although the general public is not directly reinforcing human engagement with primates, they are still viewing and interacting more with imagery that depicts primates as human or pet like in nature.

Anticipating Regret: The role of affect vs cognition and construal level on the forecaster's impact bias -

Annie Zimmerman, Faculty Mentor: Tonya Buchanan

Affective forecasting errors are common, regularly influencing motivation and behavior (Wilson & Gilbert; 2003, 2005). Forecasting errors of regret specifically suggest that more anticipated regret encourages decision avoidance (Zeelenberg & Pieters, 2007). However, recent research delineates two elements of regret: an affective (feelings following a negative outcome) and cognitive (thoughts/decisions related to the outcome) component, which predict maladaptive and advantageous outcomes, respectively (Buchanan et al., 2016).

Across 3 studies, we examined forecasting errors of these components of regret. In Study 1, using the Regret Element Scale (Buchanan et al., 2016) to measure each component, we examined anticipated and experienced regret in response to a manufactured negative outcome. Supporting our hypotheses, participants anticipated more overall/affective regret than was experienced (impact bias). No forecasting errors occurred for the cognitive component. Therefore, in Study 2, we examined if focusing on cognitive aspects of regret could reduce forecasting errors. Participants either experienced failure (as in Study 1) or forecasted failure while focusing on affective or cognitive aspects of the situation. Replicating Study 1, forecasters anticipated more regret than experiencers felt. However, errors were eliminated for forecasters focused on cognitive aspects. In Study 3, we examined the role of construal level in explaining the elimination of forecasting errors by replicating Study 2 while adding a state measure of construal level. Although previous research suggests abstract construals contribute to forecasting errors (Ayton, Pott, & Elwakili, 2007), we found no significant difference in construal level between experimental conditions. Implications and applications of this work will be discussed.

Science Education - Poster Presentations

WorldWide Telescope In The Classroom - *McKenzie Bailey, Faculty Mentor: Bruce Palmquist*

Earth Space Science can be a difficult concept for students to grasp because it is a topic they can't see in their everyday lives. The software used in Central Washington University's Lydig Planetarium, WorldWide Telescope, can easily be implemented into any classroom; however, most teachers don't know how they could use it to benefit their students' learning. The WorldWide Telescope software allows teachers to provide their students with access to hands-on software that educates them about space and how it is relevant to them and Earth.

CWU's STEM Teaching Program STP 306 (Project-Based Instruction - PBI) course asks student candidates to develop a PBI curriculum where students then produce a culminating public product. Project-Based Instruction is about connecting content areas together and working as an instructional team to connect our students' learning from class to class. Through the WorldWide Telescope students can create a virtual tour where they explain their learning and understanding of different Earth Space Science content. For my PBI lesson, I used the standard, "Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun" to engage my students in a hands-on activity through WorldWide Telescope. Project-Based Learning is about connecting content areas together and working as a team to connect our student's learning from class to class. Throughout my PBI curriculum, I have incorporated science, math, literature, and technology content. This provides students with the opportunity to comprehend the different content areas at a higher level because they can connect them with the other content areas. This connection allows students to broaden their view of how math, science, technology, and literature are all important for a successful proficiency in the content areas.

Engaging Local Students and Aquarium Visitors through ROV Technology - Jessica Lotz and Russ Higley, Faculty Mentor: Vanessa Hunt

The Highline Marine Science and Technology Center (MaST) is the marine biology and aquarium facility of Highline College in Des Moines, Washington, located on the south-central Puget Sound. Dedicated to expanding knowledge about Puget Sound, a central mission of the MaST Center is fostering a culture of marine stewardship by engaging the community through interactive learning, personal relations and exploration. The development of program curriculum designed around Remotely Operated Vehicles (ROV) targeted at elementary and middle school students, summer camp students, and aquarium guests exemplifies these efforts. The MaST Center has been hosting informal educational programs linked to National Science Standards and Ocean Literacy Principles since 2008. ROV technology has become more popular due to its science and engineering principals that school aged children can learn. Due to this high demand for hands-on education featuring ROVs, the MaST Education staff has designed curriculum for an after school elementary school club, a three hour on-site middle school program, a week long summer camp program, and public involvement during open aquarium hours. The overarching objective of these programs is to have students gain experience designing and assembling their own ROVs, students, aquarium volunteers, and members of the public have the opportunity to use a high-tech ROV to explore the underwater habitats of Redondo Beach, WA with video streaming capabilities. This poster presentation details how a small marine facility engages school students and the public about ROV technology and ocean exploration. We also discuss the successes of our students and their completed projects

Sea Turtle Spotter: A collaborative citizen science project to enhance awareness and data collection for marine turtle conservation - Stephanie Russo and George Shillinger, Faculty Mentor: Vanessa Hunt

Upwell uses Sea Turtle Spotter (STS), a free, international online citizen science project on the iNaturalist.org platform to collect and analyze incidental observations of sea turtles and enhance knowledge of marine habitat use. STS compiles sighting data on a global scale, complementing national sea turtle citizen science initiatives, such as the NOAA sea turtle hotline (swfsc.turtle-sightings@noaa.gov) managed by the Southwest Fisheries Science Center. Upwell's outreach, currently focusing on five of the world's seven sea turtle species, began in the eastern Pacific and recently expanded to the western Pacific. Sea turtles rely on various marine habitats at different life cycle phases. While nesting beach protection has significantly improved, many sea turtle populations remain critically endangered levels due to pernicious at-sea threats. Telemetry, capture-recapture methods and stable isotope analysis can contribute a wealth of information on habitat use, yet time and funding shortages limit wider application. Combining citizen science data with the aforementioned research techniques can yield valuable data at decreased cost while improving conservation awareness. Upwell encourages sailboaters, surfers, sportfishers, SCUBA divers, snorkelers, artisanal fishers, kayakers and other ocean enthusiasts to register incidental sightings of sea turtles at sea. STS provides a user-friendly, accessible platform to aggregate additional data needed to characterize habitat, predict patterns of usage, and prioritize conservation actions to reduce at-sea threats to marine turtles.

Sociology - Oral Presentations

Collegiate Sport Cultures: Mental Health within Student-Athletes - Jaida-Keleni

Kafovalu, Faculty Mentor: Connie Robinson

Various collegiate sport cultures across the nation have created a stigma around mental health creating a toxic sports environment for interdependent and dependent sport teams. Hence, creating pressure on collegiate student-athletes while enduring high expectations of carrying the role of a full-time elite student-athlete, in which can result in emotional stressors, depression, anxiety and many risk factors that can become severe on an athlete's mental and physical health as a college student. Throughout many different institutions, the development of mental health resources has grown but are not universal. While some institutions seem to lack resources for student-athletes, a unique population have turned to the media for motivation and influence from professional or other collegiate athletes in the same routine as them. The author presents finding balance in athletic success as a college student while providing effective mental health tools through social media and outreach as a resource for student-athletes mental health.

Intersectional Feminism and Media Portrayals of Missing and Murdered Indigenous Women and Girls in U.S. Cities - Bayan Saied (*Women's, Gender & Sexuality Studies*),

Faculty Mentor: Griff Tester

Living free from violence is a fundamental human right that all persons should be granted, but this is not the case for many Indigenous women in the United State (U.S.). Data from the Department of Justice (DOJ) (2008) demonstrate that Indigenous women are two and a half times more likely to be raped or sexually assaulted than other women, and Amnesty International (2007) reports that 86% of reported crimes against Indigenous women in the U.S. are committed by non-Native men. According to The National Crime Information Center, in 2016, there were 5,712 reports of missing American Indian and Alaska Native women and girls, of which, only 116 were logged in the DOJ database. In this work-in-progress, I present the statistics on media representation of missing and murdered Indigenous women and girls in 71 U.S. specified in the Urban Indian Health Institute's 2018 report and situate them in a historical and ongoing context of settler colonialism and structural inequality. I do this by using an intersectional feminist lens and controlling images, outsider within, and politics of disposability as conceptual tools.

Family Relations and Criminal Career - Marcus Schimmelfennig, Lindsey Brown, and Mackenzie Gardner, Faculty Mentor: Cynthia Zhang and Dominic Klyve

The objective of this research project is to delineate the mechanisms through which ex offenders' criminal identity and familial relations interact. Three in-depth interviews with three individuals who have a criminal record are analyzed. There are two major findings. First, family influence is vital for an individual to start a criminal career. Through "altercasting," a process in which a person's identity performance is to signal and respond to others' behavior, the interviewees assimilated to their environment full of hardships, which eventually led to a criminal career. Second, behavioral change often follows a conscious decision to stop a criminal career as anticipated by an identity theory of criminality. That is, only after a person entertains identity change can identity behavioral alteration begin. For the three interviewees, the change of the criminal identity was often (or believed to be) reinforced by social relations, particularly familial connections.

Sociology - Poster Presentations

Crime by Race by Punishment - *Guadalupe Martinez, Faculty Mentor: Sandra Galta*

It is difficult to deny that race or the color of someone's skin does not affect the way people may judge them. Ideally, the criminal justice system in the U.S. would judge people not according to their race, but by their actions. We explore the question, do white males get different sentencing than males of color in the U.S criminal justice system? The research took place in Ellensburg WA where the findings from this observational research indicate that although there may not be a substantial difference in sentencing between white males and males of color, there is a substantial difference in the number of charges each person carried when receiving their sentencing. This suggests that white males with more charges received a similar sentence to males of color with fewer charges of the same severity. This research, in the end, shows the importance to continue future research looking into a larger sample of courts and judgment across the country.

Congratulations to Mentor and Scholar of the Year Nominees!

The James and Katie Gaudino Scholar of the Year Awards (One award for Creative Expression and the other for Scholarly Research) and the Graduate Student Scholar of the Year Award are designed to acknowledge and reward those students who present at SOURCE and whose work, activities, and accomplishments provide examples of exceptional dedication to the scholarship experience.

James and Katie Gaudino Scholar of the Year Awards

Rachel Walker, Computer Science

Mariah Hogan, Law & Justice

Kevin Cassidy, History

Bart Hasz, History

Alex Muetze, History

Jonah Kathlean, Anthropology & Museum Studies

Jasmin Washington, Health Sciences

Graduate Student Scholar of the Year Award

Jordan Ryckman, Biological Sciences

Hermann Yepdjio Nkouanga, Computer Science

Katie Omans, History

Amanda Moody, Geography

Mentor of the Year Nominees

Dion Rivera, Chemistry

Jill Hoxmeier, Health Sciences

Darci Snowden, Physics

Christine Henderson, Law & Justice

Arne Leitert, Computer Science

Jamie Gilbert, Communication

Lene Pedersen, Anthropology & Museum Studies

Yukari Amos, Education, Development, Teaching & Learning

Razvan Andonie, Computer Science

Kara Gabriel, Psychology

Tonya Buchanan, Psychology

Acknowledgements

Director, Office of Undergraduate Research

Griff Tester

Program Coordinator, Office of Undergraduate Research

Erin Cone

Graduate Assistant, Office of Undergraduate Research

Brooke Writer

SOURCE Planning Committee

Julie Carmen, Erin Craig Ricketson, Patrick Dizney, Volha Isakava, Carla Jellum, Gabrielle McNeillie, Alyson Rogan-Klyve, Maureen Rust, Steve Wenger

Des Moines Campus Coordinators

Kurt Ikemeier, Mishel Kuch, Monica Medrano,

Human Subjects Review Committee(HSRC) and Institutional Animal Care and Use Committee(IACUC)

Sandy Martinez, April Binder, Leslie Hunter, Griff Tester, Brooke Writer

SURC Scheduling and Coordination

Drew Carter, Bonnie Hendrickson, Mackenzie Carter, Cassidy Bennet, Michelle Han

Student Opportunity Center Consultant

Abdullah Syed

Make sure you vote for your favorite to help select the poster for SOURCE 2021!
 You can submit your vote here: <https://cwu.studentopportunitycenter.com/vote-for-source-2021-poster/>

