20th Annual CSURF

COLORADO SPRINGS UNDERGRADUATE RESEARCH FORUM

Redefining research with undergraduate presentations from students within the Pikes Peak Region.

COLORADO COLLEGE

PIKES PEAK STATE COLLEGE

UNITED STATES AIR FORCE ACADEMY

UCCS University of Colorado Colorado Springs

SATURDAY | APRIL 27, 2024

Student Presenter Registration Feb. 1 - April 8

HOSTED BY UCCS

Information & Registration at www.uccs.edu/csurf

Welcome to the Colorado Springs Undergraduate Research Forum

(CSURF)

CSURF is a collaborative venture designed to highlight the research and creative works of undergraduates from **Colorado College** (CC), **Pikes Peak State College** (PPSC), the **United States Air Force Academy** (USAFA), and the **University of Colorado Colorado Springs** (UCCS). Each year the conference rotates between these institutions.

We hope you find this book of abstracts helpful in planning your day.

2024 CSURF Planning Committee

UCCS

Nancy Marchand-Martella
Provost & Executive Vice Chancellor for Academic Affairs
Dr. L. Lynn Vidler
Professor and Dean College of Letters, Arts & Sciences
Jennifer Poe
Susan Vandergriff
Margie Oldham

CC

Lacy Karpilo
VP for Student Life and Dean of Students
Lisa Swartz

PPSC

Glenn Rohlfing

USAFA

Brigadier General Linell A. Letendre
Dean of the Faculty
Major Daniell Saunders
Amy Berg

UCCS Land Acknowledgement

The University of Colorado Colorado Springs (UCCS) commits to acknowledging the land on which we reside. We honor our Native Indigenous communities past, present, and emerging, and recognize the original inhabitants and traditional guardians of what is now Colorado Springs.

We honor this land as the ancestral home of the ‘Nuuchiu’, which includes the Northern Ute, the Southern Ute, and the Ute Mountain Ute Peoples. The ‘Nuuchiu’ originally referred to Pike’s Peak as ‘Tava-kaavi’, or Sun Mountain, being the first peak of the Shining Mountains to see the sun’s rays.

We also recognize the many Indigenous Peoples in this region, including the Apache Nation, the Arapaho Nation, the Cheyenne Nation, the Comanche Tribe, and the Kiowa Tribe, and their historical and continuing relationships as stewards of this land.

Land acknowledgments do not exist in the past or as historical context. Colonialism is a current and ongoing practice, and thus we remain mindful of its present impacts. As an institution of higher education, we share the responsibility to actively listen, reflect, and center the histories and lived experiences of Indigenous Peoples.

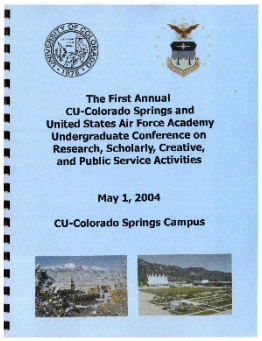
In community, we will work to dismantle the tragic and oppressive systems that displaced Native Peoples and commit to promoting Indigenous visibility and re-indigenizing our spaces.

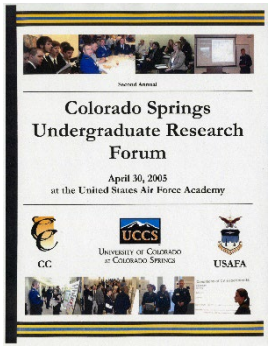
Nuuchiu is pronounced (New-chew), meaning “the people”

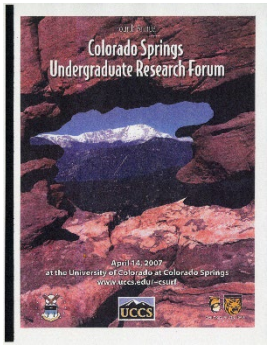
Tava-Kaavi is pronounced (Tah-vah Kaav), meaning “sun mountain”

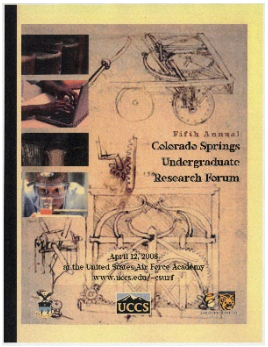
20 Years of CSURF!

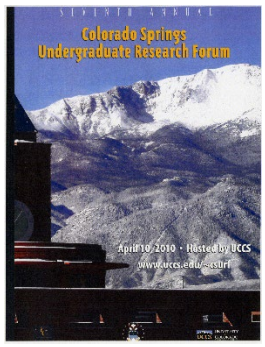
(CSURF 2021 was not held due to the pandemic)

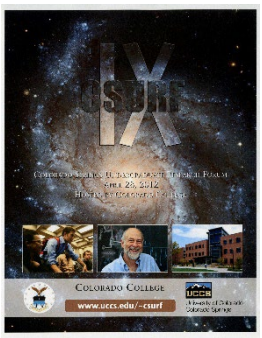


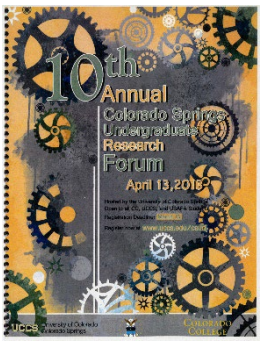


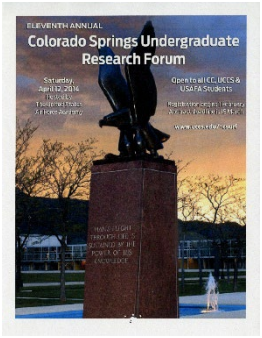


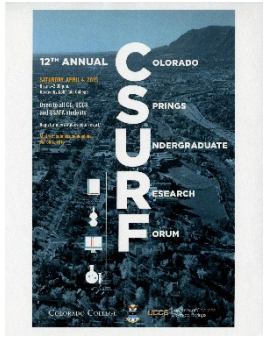


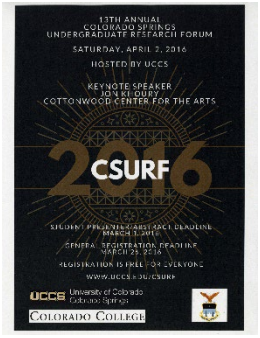


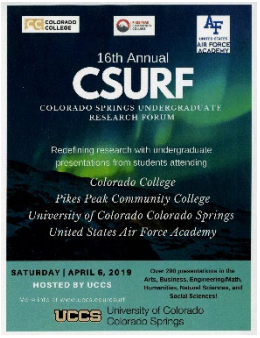


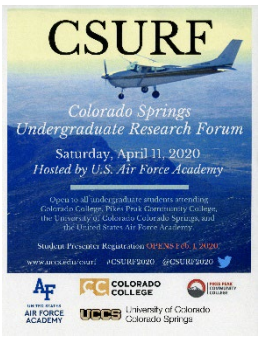


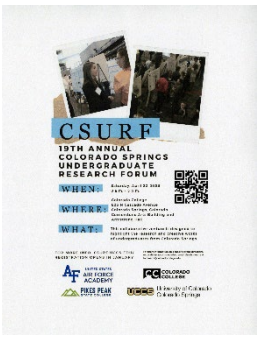


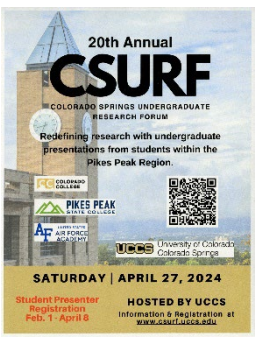












CSURF 2025 (date TBD) will be hosted by the United States Air Force Academy.
Please watch the website for an announcement – https//www.csurf.uccs.edu.

Table of Contents

Keynote Speaker

Dr. Jessi L. Smith

Vice Provost & Associate Vice Chancellor for Research, Research Integrity Officer, and Professor of Psychology

11:45-12:30
Dwire Hall Theatre

Lab Rats and Lab Mates: The Motivational Push and Pull of Undergraduate Research Experience

Faculty research labs are essential to inspiring their students' passion for discovery and innovation. That lab setting is a vibrant and immersive "microculture" where students exchange ideas, norms, and values with their fellow lab mates and faculty mentors. In this presentation, we will learn how the undergraduate research experience is a key social context in which students come to understand what it means to be a researcher. We will review findings from a series of national longitudinal and experimental studies with over 1,000 undergraduates to illustrate how the research experience pushes and pulls students' identity-development, motivation, and career aspirations. We end by reviewing evidence-based strategies for creating and sustaining an inclusive and diverse research microculture to shape the next generation of scholars and advance the frontiers of knowledge.

Oral Session 1

Dwire Hall

Challenges in Education

Dwire Hall 106

Strategic Organizational Essence

Bryce Parsons
Dr. Steve Green, Faculty Mentor
United States Air Force Academy

In this paper we discuss the precarious intersection of organizational survival and identity preservation in the wake of external challenges. Organizations, including institutions of higher education, plan and react differently to major upheavals such as the risk of war, global warming, social unrest, technology disruption, and pandemics. But even less comprehensive and more punctuated disturbances such as dramatic budget reductions or significant decreases in enrollment, can still impact a host of organizational issues involving image, brand, reputation, and stakeholder perception; what makes an organization unique and different – what we refer to as their "strategic organizational essence." Our use of strategic organizational essence captures the executive mindset that decision-makers should cultivate to best maintain their unique identity when responding to major punctuated external challenges. Observing our institution's reaction to a significant external threat in the form of an unusually severe budget reduction, encouraged us to create a model that introduces the idea of strategic organizational essence. This particular punctuated external challenge resulted in an immediate need to understand and communicate operations, processes, and the use of resources; while prompting a longer-term evaluation of our organization's performance. It also required us to make abrupt strategic decisions that potentially had long-lasting impact on our identity, image, and reputation; while simultaneously motivating us to examine what we felt made us unique and different from other similar institutions. We offer a suggested approach that moves away from *ad hoc* responses to environmental stimuli, to a more strategic executive mindset. We present relevant literature and provide a model that introduces the construct of strategic organizational essence that focuses on strategic intent, executive mindset, and organizational capabilities; not predominately on the external environment during challenging periods. We hope our approach will inspire further research aimed at enabling the sustainment of strategic organizational essence when responding to future punctuated external challenges.

We Can Do Better: Reviewing and Applying Social-Cognitive Engagement Research for Discussion Boards

McKenna Argo
Dr. Ann Amicucci, Faculty Mentor
University of Colorado Colorado Springs

Discussion boards have been a cornerstone of online learning but do not often receive high praise from students and professors alike. Are discussion posts an effective mode of learning, or are online learning platforms using them out of a sense of tradition? After reviewing the latest research around social-cognitive engagement and role-based learning, a real solution to expand discussion post effectiveness in the online classroom is now evident. What roles do students assume in discussion boards and how engaging are their posts? What roles could students possibly assume so they develop more connections with peers in class and expand their critical thinking? Students, professors, or anyone interested in online education can expect to learn about the latest scholarly discussion and practical application for social-cognitive engagement in online discussion boards.

Using general strain theory to explain the disproportionate punishment of Black American primary and secondary students

Hannah Wingo
Richard E. Niemeyer, PhD, Faculty Mentor
United States Air Force Academy

The national media in recent years has increasingly called attention to data indicating that K-12 students of color are disproportionately punished compared to their white peers (e.g., cite; cite). Although such an increased focus is both warranted and important, a journalistic lens is severely limited in its ability to identify and explain the data's underlying causes and consequences in an accurate and precise way, at least when compared to a scientific approach. As such, the purpose of this paper is to draw upon and integrate insights derived from social scientific theory to improve the accuracy, precision, and overall utility of these previous journalistic accounts. Toward this end, this paper will proceed as follows. First, we will present a general overview of the journalistic accounts that describe and attempt to explain how and why K-12 students of color are disproportionately punished compared to their white peers. We will then present a brief overview of a social scientific framework called general strain theory and illustrate how general strain theory improves society's understanding of the problem. Finally, based on this theoretical analysis, we conclude with a discussion of possible solutions.

Crossroads:
The Power of Sustainability in Higher Education and Regional Influence Toward an Alternative Future

MJ Johnson
David Havlick, Faculty Mentor
University of Colorado Colorado Springs

Higher education institutions are in a critical position to advance sustainability through action, and UCCS fuels success by inspiring the next generation to imagine and invest their education toward an alternative future. By developing students, professionals, and leaders across disciplines equipped to contribute solutions to the changing climate and face evolving grand challenges globally, “Higher education establishes the mindset of adult people and is considered a ‘changing agent’ towards sustainability development” (Žalėnienė & Pereira, 2021). It is not only true that universities have transformative power in the global effort to meet United Nations Sustainable Development Goals (SDGs) by prioritizing Education for Sustainable Development (ESD) and reflecting SDGs in university strategic planning, but today’s students care enough about sustainability that 45% will “consider environmental sustainability in their enrollment decisions” (Ezarik, 2023). To meet the new generation of learners concerned with creating and integrating solutions to our grand global challenges, such as poverty, climate change, inequality, clean energy, social justice, and many others, higher education institutions provide unique advantages to sustainability education through research, teaching, and experiential knowledge. In this presentation, I will analyze UCCS’ unique positionality to leverage this transformative power and influence a more sustainable future for our region. Using a current literature review of sustainability in higher education, data from the most current STARS Assessment, university programming, the 2030 Sustainability Strategic Plan, and participatory research, I will identify our strengths and opportunities to further advance sustainability education and practices. With a rich history of influential educators and innovation at UCCS that reaches into the region, we can leverage our position as leaders in sustainability education and rise to meet grand challenges.

Unchartered Identities

Dwire Hall 112

Exploring Gender Roles:
Women in the Bible and in the Popol Vuh, the Mayan Bible

Madison Arflack
Dr. Ismênia Sales de Souza, Faculty Mentor
United States Air Force Academy

This paper critically examines the portrayal and role of women in two foundational religious texts: the Bible and the Popol Vuh. While these texts emerge from vastly different cultural contexts—Judeo-Christian tradition and Mayan mythology respectively—they both offer insights into the social construction of gender roles and the representation of women. Through comparative analysis, this study seeks to elucidate the similarities and differences in the depiction of women, shedding light on the

complexities of gender dynamics within religious narratives. In the Bible, women occupy a multifaceted yet often marginalized position, with characters like Eve, Mary, and Deborah embodying both virtuous and problematic archetypes. Their roles range from nurturing mothers and faithful wives to temptresses and scapegoats, reflecting patriarchal norms and attitudes prevalent in ancient Near Eastern societies. In contrast, the Popol Vuh presents a more balanced and empowered portrayal of women, with figures such as Xquic and Ixchel embodying strength, wisdom, and agency. Women in the Popol Vuh are depicted as creators, healers, and spiritual guides, playing central roles in the narrative, and shaping the destiny of humanity. Through analysis of textual passages, cultural contexts, and scholarly interpretations, this study aims to interrogate the underlying ideologies and power dynamics that inform the representation of women in religious literature. By exploring the roles of women in the Bible and the Popol Vuh, this research contributes to a deeper understanding of gender dynamics in ancient societies and their enduring influence on contemporary attitudes towards women and femininity.

The Coral Tree: Chinese Students at Colorado College and their Racial-National Identities in the Early 1920s

Hongli Zeng
John Williams, Faculty Mentor
Colorado College

Conducted by Hongli Zeng ‘24 at the Special Collection of Tutt Library at Colorado College, this research focuses on the lived experiences of Chinese students at Colorado College as racial minorities in the early 1920s. As a product of the Boxer Rebellion at the turn of the century in late Qing China, the Boxer Indemnity Scholarship Program sponsors Chinese students’ study abroad mission in the United States. The returned students in the first half of 20th century played an irreplaceable role in China’s quest for scientific, political, and social modernity in the past century. The discourse of Sino-US transnational history spans from the earliest Chinese immigrant workers during the Western Expansion/California Gold Rush to the intricate East Asian geopolitics during the Second World War and its aftermath. As a significant yet under-discussed episode of this larger discourse, the study of Boxer-Indemnity Chinese students in the United States in the early 20th century provides us with a unique transnational perspective of cultural, political, and social movement and communication between the two national entities. The research essay first reviews the modern discourse of race and racial identities in the world and in China. Using archival materials, including personal reminiscences, letters, and college publications, it then investigates the development and transformation of those students’ racial-political identities from China to the U.S in the late 1910s and early 1920s. In particular, the research suggests that as a generation politically and socially active before their study abroad journey, Chinese students at Colorado College in the 1920s were able to, to a limited extent, speak for and defend themselves. For some of them, experiences such as mistreatment or verbal provocation as racial minority in the United States became sources of their future political initiatives.

Patriarchal Challenges as Development Drivers of Feminine Strength: A Look at Gender in *The Power of Love*

Isobel Dernlan
Dr. Ismenia de Souza, Faculty Mentor
United States Air Force Academy

The life of a woman has never been easy, especially several centuries ago, but María de Zayas y Sotomayor obtained an important place in history. This feminist Spanish writer lived during the majority of the 17*th* century. She challenged many stereotypes during her life. For example, she was the first Spanish woman who published under her own name. The protagonists in her stories also fight against the chains imposed by the male sex. In her work *The Power of Love*, the protagonist, Laura, has to make several large decisions in her life. Instead of being passive, as is the expected role for women, Laura takes action. Meanwhile, the majority of the men are not as brave as Laura. She almost always pursues a goal actively. And so, Zayas emphasizes that women are accustomed to challenges and thus they can conquer problems more easily. In a patriarchal society, the author comments that it is more probable that the men are going to flee in the face of difficulty, because they usually do not have to worry about their security and position.

From Glen or Glenda, Some Like it Hot and Pink Flamingo; how early portrayals of Drag, and the LGBTQ+ Community influenced the normalization and acceptance of Queer Culture today

Chirag Ponnada
Dr. James Byrne, Faculty Mentor
United States Air Force Academy

Throughout the 20th century, despite facing challenges from Hays Code and anti-gay sentiments, early portrayals of drag have made important contributions and served as precursors to the normalization of drag and LGBTQ+ portrayals in today's media. Early portrayals of drag have paved the way for the more contemporary and normalized representation of these communities in modern media, allowing for more open and free expressions. This paper explores the groundbreaking portrayals of drag in mid-20th century media, starting with "Glen or Glenda," a major turning point in the depiction of the LGBTQ+ community in popular media. Moving on, we'll examine the 50's classic "Some Like It Hot," a landmark in gender expression and drag, looking at the challenges presented by the Hays code, along with the queer coding of certain scenes. These early portrayals laid the foundation for a more liberal representation in popular media, exemplified by works like "Pink Flamingo" and "Rocky Horror Picture Show.", where the representations of Drag are more open. Moving through time, this paper will also examine how these early groundbreaking portrayals have influenced modern portrayals in film and on television. These contemporary examples represent a new era of more progressive and inclusive media.

Cultural Heritage

Dwire Hall 204

Rhythms of Brazil:
Exploring Cultural Influences in Dance and Music

Jacob Nelson
Dr. Ismênia Sales de Souza, Faculty Mentor
United States Air Force Academy

Cultural Heritage and Diversity: Brazil's dances and music are a vibrant reflection of its multicultural heritage, blending indigenous, African, European, and global influences into a captivating mosaic of rhythms and melodies. From the pulsating beats of samba, born in the Afro-Brazilian communities of Rio de Janeiro, to the lively accordion tunes of forró, originating in the Northeast, and the acrobatic movements of capoeira, rooted in African martial arts, each dance form carries with it centuries of history and tradition.

Socio-Political Context: The evolution of Brazilian dances and music is deeply intertwined with socio-political narratives, serving as both expressions of resistance and celebrations of identity. In the rhythms of samba, we hear the echoes of Afro-Brazilian resilience against oppression, while funk carioca channels the voices of marginalized communities in the urban peripheries. Through dance and music, Brazilians have asserted their cultural pride and solidarity, forging connections across social divides and advocating for social justice.

Globalization and Innovation: In today's globalized world, Brazilian dances and music continue to evolve, embracing new influences and innovations while preserving their cultural roots. Urban genres like funk and hip-hop blend international styles with local flavors, creating hybrid expressions of Brazilian identity. Meanwhile, electronic music festivals showcase Brazil's prowess in EDM, attracting audiences from around the world and fostering cross-cultural exchange and collaboration.

Conclusion: As we conclude our exploration of Brazil's rhythmic heritage, let us carry with us a deeper appreciation for the cultural richness and diversity encapsulated in its dances and music. From the drumbeats of carnival to the soulful melodies of bossa nova, Brazil's rhythms resonate not only with its own people but also with audiences worldwide, inviting us to celebrate the universal language of music and dance.

Exploring Universal Truth in Religion: A Study of Faith in selected Religions in Latin America

Erin Brzusek
Dr. Ismênia Sales de Souza, Faculty Mentor
United States Air Force Academy

This paper delves into the complex inquiry of whether there exists a universal truth in religion, focusing on the diverse and culturally rich landscape of Latin America. In a region marked by a mosaic of religious beliefs, including Catholicism, indigenous spiritual practices, Protestantism, and syncretic faiths, understanding the concept of universal truth becomes particularly intriguing. Through an interdisciplinary approach drawing from anthropology, sociology, and religious studies, this study aims to unravel the nuanced relationship between faith and truth. Latin America serves as an ideal case study due to its historical and contemporary religious dynamics, shaped by colonization, cultural exchange, and socio-political transformations. By examining religious syncretism, rituals, and belief systems across various Latin American countries, this research seeks to identify common threads that may hint at the existence of universal truths transcending cultural and religious boundaries. By critically examining the notion of universal truth in religion within the context of Latin America, this study aims to shed light on the multifaceted nature of faith and its role in shaping individual and collective identities in a rapidly changing world.

Pronunciation Modeling by Presenters of Various Backgrounds in Spanish

Marisela Molina, Sebastian Arenas, Isai Prezas
Capt Michael Richey, Faculty Advisor
United States Air Force Academy

ACTFL proficiency guidelines establish a requisite of advanced levels to be understood by native speakers not accustomed to nonnatives (ACTFL, 2012). A review of relevant literature indicates that the nativeness of the teacher may not have a statistically significant effect on participants' success in acquiring L2 (Levis, 2016). Frequently, native and heritage speakers may be placed in a class of their own heritage language for lack of reading or writing aptitudes (Correa 2011). The researcher assesses non-native speaker participants' (n=115) progress towards nativeness in their pronunciation of Spanish using the implementation of pronunciation instruction and the background of instructors as variables. Participants underwent a pre-test. The experimental group then received phonetics instruction addressing phonemes and combinations present in the target language but not in American English, such as the trilled "r" and the interdental "d". Within the experimental group, four classes of participants received pronunciation modeling from a peer heritage speaker, two classes from native-speaker teachers, and two classes from non-native speaker teachers, while two classes in the control group did not receive concentrated pronunciation instruction. Results are pending from a post-test at the end of the instructional period and a final test at the end of the semester. Relevant literature shows that participants tend to prefer that native instructors teach them pronunciation (Hertel 2009). With that in mind, participants' perception will be measured through a survey to gauge preference of teacher or peer instructor background. The researcher hypothesizes that peer heritage speaker instructors will have slightly less favorable results than NNSTs and NSTs, and that participants' perceptions will be parallel. This research has implications for teachers of all backgrounds in they could potentially be able to provide heritage- and native-speaker students with instructional leadership opportunities without a sacrifice in instructional quality.

Meaning Within Music

Austin Medina
DeLyn Winters, Faculty Mentor
University of Colordao Colorado Springs

Music is a universal constant in media. Whether it shows up within movies, shows, games or even just on the radio itself, there is a cultural dynamic when it comes to listening to music that everyone has experienced at some point in their lives, however there are deeper mechanics to how music is created and the context within it. Music can be analyzed through more than just its explicit value but has implicit meanings which can be analyzed through the composer's creative choices, the narrative implications and psychological self-importance. This side of music is widely ignored in daily life. Looking at music through this lens there is much more that can be appreciated, and a greater connection can be created. Composers create music to have meaning which can be analyzed and further explored to create a deeper appreciation for the creative processes and the music that applies these processes.

Impacts on Climate

Dwire Hall 303

Climate Change in Zimbabwe vs Colorado, how different are the impacts?

Ben Curry
Lisa Schwartz, Mentor
Colorado College

In the film “Climate Change in Zimbabwe vs Colorado, how different are the impacts?” I explore how a lower-income family in Colorado Springs and a middle-income family in Bulawayo, Zimbabwe experience climate change differently. While climate change, and the widespread impacts are well known, I find it easy to separate the individuals from the statistics. To foster understanding, I set two families juxtaposed, asking the exact same research questions to two individuals in very different positions. The interview reveals shocking disparities in climate change vulnerability. To provide background context to the issue, I explain the history of the fossil fuel industry and how the U.S. became one of the largest contributors of greenhouse gasses in the world. To provide background on the perpetrators of climate change, I give insight into the discovery of the greenhouse gas effect, Lee Raymond, and Exxonmobil. Overall, this film is made to spark introspection and to bring personal awareness to how climate change impacts us at the individual level.

Multinational Air Pollution Data Transparency

Alison Berman-Lyons
Irina Kopteva, Faculty Mentor
University of Colorado-Colorado Springs

Air pollution has been a threat to human health and the environment for decades resulting in legislation and scientific monitoring to inform the government and public about its effects. Through these efforts the data transparency of air pollution should enable the public to make well informed decisions, have an awareness of the issue, and contribute to policy. This project is examining the available data present to the USA and Russian public. Russian citizens face a complicated relationship with the data. Aware of the air quality concern they remain largely uninformed despite having legislation that is alleged to aid the issue. USA citizens seem to have an excess of information and legislation to follow the issue, however the barrier for Americans is finding accurate information and the government production of effective environmental legislation. To examine the air pollution transparency for both countries the scientific community and journals will be examined as well as government sources, and mass media. The data collection will remain within the years of 1970-1972 as well as 2022 throughout both countries and analyzed to identify differences in air pollution data transparency between Russia and the USA. In conclusion, this project aims to identify the shortcomings and avenues of improvement within air pollution data transparency in both the USA and Russia to maximize the effectiveness of data-based approaches to managing and communicating air quality management.

Stealing Paradise:
How the Cruise Ship Industry is Destroying Coral Reefs and Island Livelihood in Cozumel

Sophie Dellinger
Eric Perramond, Faculty Mentor
Colorado College

In Cozumel, Mexico, the Ministry of Communications and Transportation (SCT) began accepting bids by private development companies for the construction of “piers for tourist cruise ships” in 1989 (CEC). Motivated by the alleged economic prospects that cruise tourism could bring to the island, the Mexican government has rapidly developed Cozumel’s coastline with both onshore and offshore projects. Nearly 35 years later, Cozumel has become the largest cruise destination in the Western Caribbean with an expected increase of 30 million visitors annually. However, the expansion of tourism in Cozumel has had a net negative impact on local Cozumeleñas. This research seeks to argue that cruise tourism in the Riviera Maya is a form of uncontrolled neoliberalism and colonial enclosure (Curley, 2019). There are four primary areas this research investigates: 1. The exploitation and destruction of the coral reef by cruise ships and tourists which locals depend on as their main food and economic source. 2. The erasure of the indigenous Maya nation through the blocking of physical and cultural connections to the water. 3. How cruise tourism has failed to contribute to local development. Revenue from cruise tourism is centralized in large cruise monopolies and is having little benefits to the local community (Palafox-Muñoz & Rubí-González, 2021) 4. The history of Spanish colonization in Cozumel and its connection

to the Molina family, the owners of the largest cruise company in the Riviera Maya region. This research additionally explores solutions to the issues caused by cruise tourism through an evaluation of rebalancing the ecotourism model (Ross & Wall, 1999) in Cozumel.

Cloud and Precipitation Prediction within the GFDL SHiELD Model

Lily Johnston
Dr. Linjiong Zhou (Princeton University, NOAA GFDL), Dr. Allison Lawman, Faculty Mentors
Colorado College

Cloud and precipitation prediction poses considerable challenges in many numerical models. The System for High-resolution prediction on the Earth-to-Local Domains (SHiELD), developed at the Geophysical Fluid Dynamics Laboratory (GFDL), a Unified Forecast System UFS prototype atmospheric model, is used to evaluate the prediction accuracy of clouds and precipitation. In SHiELD, the complexities of cloud and precipitation prediction have resulted in noticeable biases in predicting the geographic distribution of precipitation, precipitation diurnal cycle, ice and liquid water path, and cloud fraction. We assessed the accuracy of the SHiELD model's predictions of clouds and precipitation and evaluated to what extent we could enhance the prediction accuracy by doubling the model's horizontal resolution from 13 km to 6.5 km. We found that the SHiELD prediction system exhibits the potential for improving cloud and precipitation prediction via higher horizontal resolutions. Significant tests help uncover and understand the true biases in the SHiELD system, with the goal of proposing solutions for improving cloud and precipitation prediction.

Poster Session 1

Gallogly Event Center

Isoxazole ring-opening by transfer hydrogenation

Nicole Beitle
Dr. Allen Schoffstall, Faculty Mentor
University of Colorado Colorado Springs

Ring opening of isoxazoles offers pathways to other heterocycles. We have studied the ring-opening of 3,5-disubstituted isoxazole derivatives. Two novel isoxazoles were prepared by cycloaddition of nitrile oxides with terminal acetylenes. Reduction of the isoxazoles was investigated using a transfer hydrogenation process from hydrazobenzene in the presence of a copper on iron catalyst. This goal was optimization towards the reductive ring opening of isoxazoles to form enaminones.

Investigation of the role of *ARI26162* in fertility and the formation and persistence of the insemination reaction in *Drosophila arizonae*

Marissa Benavidez
Jeremy Bono
University of Colorado Colorado Springs

The molecular mechanisms involved in successful reproduction are poorly understood in most organisms. Recent research in our lab has shown that female *Drosophila* translate male-derived RNA that is transferred during copulation. This research sparks the exploration of the functional significance of these male-derived, female-translated proteins (mdFTPs). Our focus lies in understanding the role of these mdFTPS in fertility and the formation of the insemination reaction (IR), an opaque mass that forms in the female reproductive tract after mating. I am using CRISPR to generate a homozygous knockout line with a non-functional *ARI26162* gene. Future assays will investigate the difference in egg-laying, fertilization efficiency, and IR size between females mated to wild-type or knockout males.

Amyloid Beta and Curcumin Interactions With an Anionic Lipid Membrane

Advita Bhatia
Dr. Crystal Vander Zanden, Faculty Mentor
University of Colorado, Colorado Springs

Alzheimer's disease (AD) is a neurodegenerative disorder associated with the development of amyloid plaques and neurofibrillary tangles in the brain. Amyloid plaques are formed by the aggregation of the amyloid beta (Aβ) peptide, which transitions from an intrinsically disordered monomer to a β-sheet rich fibril structure. Anionic lipid membranes are known to nucleate Aβ fibril formation, rapidly accelerating aggregation compared to the solution-state peptide. Curcumin is an anti-inflammatory compound found in the spice turmeric, and it is known to have neuroprotective properties in AD mouse models. The goal of this research was to identify the interactions between membranes and monomeric Aβ, and furthermore, to determine the influence of curcumin on this interaction. Molecular dynamics simulations were performed on a model lipid membrane with and without the presence of monomeric Aβ and curcumin. Quantitative analysis methods such as partial densities and deuterium order parameter calculations were used to determine how curcumin and Aβ impacted the structure of an anionic lipid membrane. Experimental work with a liposome dyeleakage assay was also used to study membrane interactions. Results revealed that the presence of monomeric Aβ reduced the order in the membrane, destabilizing it and causing membrane thinning. Similar results were noted in the presence of curcumin alone. However, when present together, it was observed that Aβ and curcumin interacted with each other, which ultimately reduced the amount of membrane disorder caused by individual molecules in the membrane. The partial density plots combined with the dye leakage assays also revealed similar interactions Overall, these insights contribute to our understanding of curcumin's neuroprotective properties and the potential interactions with Aβ in the context of Alzheimer's disease.

Apple CRISPR-Cas9: A Recipe for Successful Targeting of AGAMOUS-like Genes in Domestic Apple

Natalie Bondarchuk
Dr. Amy Klocko, Faculty Mentor
University of Colorado Colorado Springs

CRISPR-Cas9 can edit genes, and potentially update the genome. This technology can be used to make desired changes in (theoretically) any organism. Application of gene editing requires knowledge of the effectiveness of this approach. The goal of this project was using CRISPR to target the AGAMOUS (AG) genes in domestic apples, while the AG genes are very similar to one another, the project's purpose is to determine how efficient the editing is, and discover the amount of shared function of the AG genes. As a commercial crop, genetically modified apples could lead to improved varieties, disease resistance (such as fire blight), and other practical horticultural improvements. We collaborated with the USDA to create 44 independent genetically modified examples of apple trees. Then, we used gene cloning and sequencings to determine exact changes to each AG gene and gene copy. The compiled data reported several totally genetically modified events, specifically 37% of trees were completely edited. The findings validated our proposal that CRISPR editing is possible and efficient within apple trees, and completed data has been published in the scientific journal '*Plants*'. Trees with complete changes to the AG genes are predicted to produce flowers with petals in place of the anthers

and pistils. Such flowers would be highly ornamental and would also be unable to reproduce by pollen and seeds. As apple trees are propagated by branch cuttings, such trees could still be multiplied by standard methods. Planned future work includes phenotypical characterization of overall tree form, health, and growth.

Growth and Detection of Beneficial Oral Microbes as an Indicator for Mental Health

Emma M. Clark
J. Jordan Steel, Faculty Mentor
United States Air Force Academy

The mouth contains a wide variety of microbes. These commensal oral microorganisms impact human health and it has recently been correlated to mental health, with the presence of *Rothia mucilaginosa* being more abundant in healthy individuals and lower levels in individuals with mental illness and depression. Suicide rates within the US have significantly increased in the past 2 decades with an estimated 17.8% of reported suicides being military veterans. Military medical facilities have shown that depression cases increase with deployments and stress of military life. It is of critical importance to find ways to screen and detect mental health indicators sooner. Therefore, the ability to understand and detect beneficial oral bacteria within individuals may lead to more effective preventative measures. This project aims to detect, grow, and characterize *Rothia mucilaginosa* due to its beneficial impact on the oral microbiome and health of the host. Additionally, an in-house PCR based detection protocol is being developed to detect and quantify this important microbe. Future applications could include the introduction of more efficient tests to detect levels of beneficial microbes. The absence of such microbes could serve as an early indicator of mental health concerns, hopefully leading to rapid and effective preventative solutions.

Surface Microhydrology Drives Self-Organized Vegetation Patterning in Semiarid Grasslands

Jordan Cosgrove
Miro Kummel, Faculty Mentor
Colorado College

Arid grasslands can self-organize into periodic patterns of vegetated groves and bare intergroves via positive feedback where vegetation increases local infiltration rate coupled with feedback where groves deplete downslope sheet flow, creating stripes of bare ground. This study investigated the shift from homogenous to patterned vegetation in its early stages of development in a short grass steppe in South Central CO due to a precipitation change and the recent emergence of period patches. To understand the mechanics behind this transition, we studied patterns in grass mortality, surface and soil properties, and the spatial relationships between these variables, water and sediment transport, and grass health. Intergroves were found to have a higher and smoother slope than groves. There were significant differences in deep soil properties across groups, with the highest mean bulk density in intergroves and the highest mean water content in interstitial pools. Spatial analysis in ArcGIS showed increasing

maximum NDVI with vegetation and decreasing maximum NDVI with intergrove cover, as well as decreasing maximum NDVI with distance from interstitial pools, and vegetation and interstitial pool cover significantly predicted maximum NDVI. Because the residuals are autocorrelated, we proceeded with spatial lag models which suggested strong autocorrelation of error and a neighborhood impact of NDVI on itself. The results suggest that with sheetflow, sediment is eroded from intergroves and deposited in groves, forming a stepped horizontal profile. Runoff collects and infiltrates in interstitial pools, redistributing additional water to the grove. Thus, the emerging self-organization maximizes community water use efficiency, increasing the system's resilience to drought in the face of climate change.

Economic Implications of Abortion Access

Margaret Courtney
Professor Douglass McKechnie, Faculty Mentor
United States Air Force Academy

After the recent U.S. Supreme Court case that overturned *Roe v. Wade* which established a constitutional right of privacy from which followed a woman's choice to have an abortion, *Dobbs v. Jackson Women's Health Organization* gave states the individual power to regulate abortion laws that are not already protected by federal law, stating that the right to an abortion is not protected in the constitution. This means that states are now allowed to outlaw abortion entirely. Currently, abortion laws vary from state to state, some protecting the right to abortion via state statutes or constitutions and others completely banning abortion entirely and deeming it illegal. Abortion access impacts economics drastically through the labor market. This paper will analyze if and how the new abortion laws from *Dobbs* negatively affect the labor market, specifically its impact on employment, wages, and education. This paper will review the history of abortion laws in the United States and their economic impacts. It will then conduct a literature review of relevant statistics, papers, and court cases to analyze the current economic impacts of the overturning of *Roe.* While the right to an abortion is no longer a constitutional right, states need to recognize that abortion access is an economic issue with consequences.

The Backyard Threat: Drugs, Money, and International Cooperation in the Future of American Relations

Moira Croghan
Lt Col Ford
United States Air Force Academy

Drug trafficking and related crimes along the U.S.-Mexico border have risen exponentially over the past 20 years. Effects include an influx of seized fentanyl (a drug that results in the overdose of 110,000 Americans annually) and, according to the Department of Homeland Security, an unprecedented number of immigrants at the border. Central American immigrants typically flee to the U.S. because of government corruption, crime, and violence in their home state that results from cartels that traffic weapons, drugs, and humans. Though each American president of the past 20 years has approached the border issue from many different directions – anywhere from expanding welfare programs for

immigrants to building a wall along the border – the problem is not one-state, and so neither will the solution be. Many people who participate in the production of drugs, transport to cartels, and law enforcement/makers who conceal such activity do so because of personal economic strife. In examining the chain of drugs from supply in Central America to consumption in the U.S., a Pan-American council is needed to oversee the implementation of economic replacement initiatives in Central American countries. I believe this will reduce drug trafficking, related crimes, and the immigration crisis around the U.S.-Mexico border.

Physiological Regulation in Toddlers: Adverse Events and Autonomic Activation

Brenda A. Cruz
Kristen L. Rudd, Faculty Mentor
University of Colorado Colorado Springs

Despite the increasing knowledge of the importance of Autonomic Nervous System (ANS) regulation for physical and mental health outcomes in children, few studies have examined how early development may influence ANS function. In particular, research has examined features of the sympathetic (SNS) and parasympathetic (PNS) branches of the ANS in isolation rather than examining coordinated reactivity responses. Therefore, the current study examined how children's early adverse experiences (ACEs) predict their patterns of ANS regulation at 36 months. ACEs were assessed using the Trauma Exposure Symptom Inventory-Parent Report Revised (TESI-PRR: Ippen et al., 2014) in a low-income racially/ethnically diverse sample (N=66). ANS reactivity was assessed using a continuous collection of SNS and PNS responses during a series of challenge tasks. Average reactivity was calculated for both SNS and PNS, and reactivity responses were categorized into one of four profiles (i.e., coactivation, coinhibition, reciprocal PNS activation, reciprocal SNS activation) based on their patterns of combined reactivity across both systems. Coactivation was defined as competing activation between SNS and PNS, Coinhibition was defined as SNS and PNS withdrawal in response to challenge (i.e., no activation, Reciprocal PNS Activation was defined as PNS dominance with no SNS activation (expected at rest), and Reciprocal SNS Activation was defined as SNS dominance and PNS withdrawal (expected in challenging situations). Logistic regression analysis examined whether ACEs predicted membership in the different physiological profiles, controlling for child age, sex, and maternal prenatal stress. Results showed that for each additional traumatic experience that a child experienced, they were .836 times more likely to demonstrate a reciprocal PNS activation to challenge (OR=.836; 95% CI [1.08, 4.88]). No other profile comparisons were statistically significant. Given that reciprocal PNS activation not expected to be adaptive in challenge contexts, our findings suggest that early ACEs may predict physiological dysregulation in early childhood.

Mental Health and Wellbeing of Undergraduates Based on Financial Aid Status

Violet Datcu
Kristi Erdal, Faculty Mentor
Colorado College

Undergraduate students receive need-based financial aid based on their family's income status, and existing research highlights the relationship between undergraduate's financial aid status and their overall mental health and well-being. Low-income students report vastly different experiences during their undergraduate education than their peers. This study examined the difference between how undergraduate students who receive need-based financial and who do not receive need-based financial aid report their perceived stress, social connection, and likelihood to take advantage of their campus support resources and professional psychological resources during their undergraduate education. Results supported the hypotheses that students on need-based financial aid reported higher rates of overall stress and lower rates of social connectedness on their campus than their peers. The hypothesis that students on need-based financial aid would score differently on campus resource use scales was not supported. However, scores on the campus resource use scale were low for both financial aid status groups, which implies that students overall do not take full advantage of campus support resources. The results of this study highlight how important it is for colleges to prioritize the integration of low-income students into campus life as a means of moderating the disproportional struggles they face at an undergraduate institution.

Costal Erosion in the Florida Keys

Lauren DeLeonardis
Eric Billmeyer; James Baginski, Faculty Mentors
University of Colorado Colorado Springs

Coastal erosion is the process by which local sea level rise, strong wave action, and coastal flooding wear down or carry away rocks, soils, and/or sands along the coast. All coastlines are affected by storms and other natural events that cause erosion; the combination of storm surge at high tide with additional effects from strong waves—conditions commonly associated with landfalling tropical storms—creates the most damaging conditions. The extent and severity of the problem is worsening with global sea level rise, but it differs in different parts of the country, so there is no one-size-fits-all solution. Beaches are dynamic landforms at the edge of the ocean or gulf subject to both natural and human induced erosion. Sand moves along the shore due to breaking wave driven by currents and tides, and storms can cause dramatic changes to the beach. Coastal erosion is caused in part by the creation and maintenance of inlets, where the sand has historically been removed from the coastal system by dredging, and the natural drift of sand along the shore is blocked by jetties, trapped in channels, or moved into ebb and flood shoals. The development and the placement of infrastructure near the shore can also contribute to coastal erosion by limiting the amount of sand stored in dunes and hardening the shore for protection of upland property. Changing sea levels can also contribute to long term coastal erosion along Florida's coastline.

Measurement of the Stark Effect in the 3s23p2 3P1 →3s23p14s1 3P0 Transition of Silicon

Blake Eastman, Julie Simms, Grant Clarno, Luke Phillips, Alina Gearba
Randy Knize, Jerry Sell, Faculty Mentors
United States Air Force Academy

The laser cooling and trapping of silicon would mark an important practical step in the construction of a siliconbased quantum computer. At the United States Air Force Academy (USAFA), a slightly tunable 252.4 nm laser is resonant with the 3s23p2 3P1 → 3s23p14s1 3P0 transition of silicon, providing a transition useable for laser cooling and trapping. In the case of silicon, the atoms must be precooled prior to being introduced to the trap. Generally, magnetic fields are employed in a cooling apparatus to manipulate the energies of atomic transitions so that the laser beam interacts with atoms in such a way to slow them. Furthermore, the cooling process requires cycling transitions at least several thousand times in each atom. However, for the transition accessible by the USAFA 252.4 nm laser, atomic level splitting caused by the introduction of magnetic fields inhibits a cycling transition. Consequently, we look to employ the Stark effect - changes in transition energies caused by external electric fields - to manipulate this transition in silicon. To that end, we must measure the Stark effect in silicon. This will be achieved by intercepting a silicon atomic beam with the laser beam at a perpendicular angle in a uniform electric field. The field will be varied and the laser will be scanned to determine the resonant frequency of the transition at different field strengths. Here, we will present our progress in measuring the Stark effect in the 3s23p2 3P1 →3s23p14s1 3P0 transition of silicon.

Investigation of the functional significance of *ARI00758* on reproductive outcomes in *Drosophila arizonae*

Azahra Forst
Name(s) of ALL Faculty Mentors: Jeremy M. Bono
University of Colorado Colorado Springs

Previously our lab has shown that males transfer RNA transcripts to females during mating in Drosophila arizonae. Since it is seen in many other species, we know that RNA is a common feature of male ejaculates. Recently, we have shown that RNA transcripts transferred through ejaculate are then translated into a protein by the female following copulation. Our current focus is to investigate the functional significance of these male-derived, female-translated proteins (mdFTPs). My research focuses on the mdFTP, ARI00758, which is a serine protease. To investigate the functional significance of this gene, I am generating a knockout mutation using CRISPR gene editing. Mutant male virgins will be mated with wild type virgin females and compared to the mating of wild type virgin males and wild type virgin females. Following the experiment, we will compare egg hatching, egg laying, and insemination reaction size to evaluate any phenotypic changes. The insemination reaction is a mass that forms in the female's reproductive tract after copulation. Because serine proteases have known roles in coagulation, we predict that ARI00758 may play a role in the formation or degradation of the mass. If we observe changes in egg hatching, egg laying, or reaction mass size in females mated to mutant males, this would provide direct evidence of the involvement of this mdFTP in reproductive outcomes.

Comparative Analysis of Silphium integrifolium Extraction Techniques for the Isolation of Oil for the Formulation of Skin Cream and Soap

Brisa Garcia, David Van Tassel
Murphy Brasuel, Faculty Mentor
Colorado College, The Land Institute

Silphium integrifolium (Rosinweed) is a perennial flower native to the Midwest of North America frequently used for medicine because of its antimicrobial properties. The goal of this study was to confirm the presence of squalene in rosinweed oil, to determine how extraction methods would impact the oil profile, and to fabricate skin cream and soap from the extracted oil. In this study, sunflower oil served as the commercially available raw material to which rosinweed oil was compared. Squalene is a fat that is non comedogenic (doesn't clog pores), anti-inflammatory, detoxifying, moisturizing, and anti- oxidative which are all desirable properties in cosmetics, and more specifically skin care. While multiple other extraction methods were attempted, only dichloromethane solvent extraction and Soxhlet extraction with ethanol successfully produced oils, and therefore our focus of this study. GC-MS analysis was utilized for seed oil characterization. Sunflower oil and rosinweed samples from different extraction methods were compared, with special focus put on the quantification of squalene, an oil valuable in cosmetics. Both extraction methods utilized resulted in squalene being confirmed in the rosinweed extracts at between 2 to 10% of the total oil composition. Both sunflower and rosinweed oil skin cream formulations were successful and aligned with industry standards. The soap formulation process is still being optimized.

An analysis of criminal networks in the Brazilian Amazon and how they're aiding in the acceleration of climate change

Allyson Gatchall
Dr. Ismênia Sales de Souza, Faculty Mentor
United States Air Force Academy

The Amazon, currently holding around 150 tons of carbon, is a crucial structure when it comes to regulating climate change. Deforestation, both legal and illegal, beginning in the 70's has decreased the amount of CO2 it absorbs by 30% less than it was in the 1990s. Criminal networks in the Brazilian Amazon are the main culprits to blame for the major deforestation which has occurred in the Brazilian Amazon in recent years. Deforestation is undoubtedly a profitable industry for these criminal networks and it is for this very reason that they are incentivized to continue to chop down more trees. The rate at which these criminal groups are destroying trees in the Brazilian Amazon has detrimental effects on climate change and is accelerating it at an alarming rate. The purpose of this analysis is to explore the impacts criminal networks illegal deforestation in the Brazilian Amazon have on accelerating climate change.

Use of Flow Microscopy as a Screen for Liquid-Liquid Phase Separation in Steroid Receptors

William Gerash
David L. Bain, Margaret A. Daugherty, Faculty Mentors
Colorado College

Liquid-liquid phase separation has been proposed as a transcriptional control mechanism for the glucocorticoid receptor (GR) and other steroid receptor (SR) proteins. SRs contain a disordered amino-terminal domain (NTD), followed by an ordered DNAbinding domain (DBD) and ligand binding domain (LBD). The intrinsically disordered NTD of an ancestral form of GR was previously shown to facilitate LLPS (Frank, F. et al., Proc Natl Acad Sci. 2021 118(30), e2024685118). In accordance, ParSe analysis of the GR primary sequence identifies two regions within the NTD that have potential to drive phase-separation (Ibrahim A. et al., J. Biol. Chem. 2023 299(1): 102801). Flow microscopy was used to examine the function of the NTD in LLPS for a full-length human GR and a chimeric GRER (containing the NTD and DBD of GR, and the LBD of the estrogen receptor). In the presence of PEG8000 to initiate phase-separation via molecular crowding, we find that differences in the LBDs influence LLPS condensate formation. Additionally, glucocorticoid response elements (GRE DNA) decrease droplet formation, and non-GREs have shown the same effect. Finally, we find that DNA can dynamically and reversibly enter preformed coacervates and that potential non-specific associations between non-GREs and protein droplets seem to be facilitated by PEG8000.

Quantifying the Amplification Factor of Silver Nanoparticles for Surface-Enhanced Raman Scattering (SERS) of DNA

Emily Gordon
Dr. Murphy Brasuel, Faculty Mentor
Colorado College

The use of silver nanoparticles in SERS analysis of DNA has the potential to allow for the rapid screening of single nucleotide polymorphisms (SNPs). Rapid screening of SNPs would find significant application in human health. DNA SERS analysis is typically performed with labelled DNA. This research explores label-free DNA SERS analysis allowing for quicker analysis and more practical applications in the medical field. Silver nanoparticles were synthesized and added to solutions of concentrated DNA to determine the amplification factor of the nanoparticles. Parameters of nanoparticle purification and parameters of DNA/nanoparticle solutions were explored to optimize the SERS amplification factor. Results show that the amplification factor of the resuspended nanoparticles treated with isopropyl alcohol before being centrifuged was higher than untreated nanoparticles. The unlabeled DNA RAMAN amplification factor at a 5x objective was 2.01 when using treated nanoparticles and 1.71 when using untreated nanoparticles.

The Effect of Substrate Particle Size on Compressive Strength of Biocement Bricks

Hannah Grover
Nikolas Schwendeman, Melanie Grogger, Victoria Morrison, J. Jordan Steel,
Faculty Mentors
Unites States Air Force Academy

Hannah Grover, Nikolas Schwendeman, Melanie Grogger, Victoria Morrison, J. Jordan Steel
Biocementation uses the biological functions and processes of enzymes, bacteria, and cellular structures to mineralize and bind particles and produce aggregate materials. *Sporosarcina pasteurii (S. pasteruii)* is a ureolytic microbe that can precipitate $CaCO_3$, calcium carbonate, through a process called microbially induced calcite precipitation (MICP). The ureolytic bacteria breaks down urea into carbonate and ammonium. Calcium addition will enable calcium carbonate to link surrounding particles together. The purpose of this study is to determine if substrate particle size affects Biocementation. Based on preliminary work, we hypothesize that a larger starting substrate particle size will produce the strongest aggregate material. The results from this study will be advantageous for future Air and Space Force Operations such as dust stabilization in spacecraft landings and substrate aeration in Lunar and Martian agricultural operations. The Biocementation process has already been used in military operations; however, the most abundant form of Martian regolith is around 50 to 150 μm in diameter. Such sand is much finer than that on Earth which ranges from 0.02 to 2 mm in diameter. For this reason, the question of whether Biocementation is feasible and robust enough to support Space Operations must be explored.

Investigation of HVAC Component Degradation

Caroline Guiler
Lt Col Tim Frank, Dr. Justin White, Lt Col Josh Aldred, Maj Marcus Catchpole,
Faculty Mentors
United States Air Force Academy

Environmental factors degrade civil infrastructure that is critical to humankind's way of life. Sustainable asset management and capital allocation of infrastructure require an understanding of which factors most impact degradation. Heating, ventilation, and air conditioning (HVAC) system inspection records spanning 14 years from 49 locations across the USA were compiled and associated with the environmental conditions to which they were exposed. Nine environmental features were explored in this study: precipitation, minimum humidity, maximum humidity, minimum temperature, maximum temperature, wind speed, radiation, pH, and freeze–thaw cycles. Installation date, or age, was the lone nonenvironmental feature considered. Decreased precipitation, fewer freeze–thaw cycles and moderate temperatures led to lower degradation rates, while higher humidity led to higher degradation rates across the HVAC sections studied. Random forest models revealed that the most critical environmental features in predicting degradation rate were precipitation and radiation. However, feature importance varied in models that only considered subsets of the data based on either HVAC component type, initial condition of the HVAC section, or degradation rate. The results presented herein provide some insights into HVAC asset management, and the methodology used can be applied to other infrastructure systems.

Bridging the Americas: A Comprehensive Analysis of Brazil-US Relations

Max Haas
Dr. Ismênia de Souza, Faculty Mentor
United States Air Force Academy

The enduring alliance between the United States and Brazil, spanning from historical milestones to contemporary imperatives, underscores the need for a revitalized focus on this strategic partnership. Recognizing Brazil's pivotal role in Latin American stability and global leadership, this paper advocates for a tailored foreign policy to elevate Brazil's prominence in decision-making processes. Drawing from scholarly research and governmental sources, it analyzes economic interdependencies, bilateral engagements, and geopolitical dynamics, emphasizing the urgency of recalibrated strategies to fortify Brazil-US relations. By providing decision-makers with a concise yet comprehensive overview, this analysis aims to inform proactive measures for navigating an evolving global landscape.

Whoppshel Spectroscope Integration into the USAFA 1-m Telescope System

Abby Halasi-Kun
Lt Col. Benjamin Roth, Faculty Mentor
United States Air Force Academy

The Whoppshel spectroscope is a high-resolution instrument capable of precise spectra collection and analysis. Paired with the Demetra software, spectra are collected, reduced, and displayed. In this project, an understanding of how to use the instrument and software, including the powerful built-in data reduction processes, is developed by first using a calibration unit with simple light samples. Additionally, investigations of the possible integration designs for the spectroscope in research settings is accomplished. Specifically, understanding the specification of additional components such as a fiber injection and guiding unit (FIGU) is crucial to enable sample collection via a guide camera slot on a one-meter telescope. By testing, calibrating, and designing the integration of the Whoppshel with the one-meter telescope located at the United States Air Force Academy (USAFA), this project will provide another avenue for data collection and research at the USAFA observatory, paving the way for future cadet and faculty astronomical research.

Gambling and its Effectiveness on Historical Preservation in Cripple Creek, Colorado

Peter Harrison, Gabriel Garcia
James Baginski, Faculty Mentor
University of Colordao Colorado Springs

Colorado’s Cripple Creek Mining District was a prosperous gold camp in the late 19th century and early 20th century. As mining was phased out throughout the twentieth century due to fluctuating gold valuations, the economic prowess of the district declined greatly, and the population plummeted. Comparing census data and inflation-adjusted gold prices, it becomes apparent that gold value directly impacted the population of Cripple Creek and the number of operating mines. Cripple Creek has turned

to tourism over time as a way to ease the strain of mining's departure. Specifically, the legalization of gambling in 1991 was a major tourism initiative that shifted the town from its post-extractive shell to a developing tourism spot with the goal of promoting and preserving the town's mining history through funds from the profits of gambling. The town's main source of revenue comes from the number of gaming devices (slot machines, tables, etc.) operating, not as a direct percentage of gross profits from gambling. Thus, even as adjusted gross proceeds (AGP) saw slight declines and remained relatively static between 2004 and 2006, the market share (percent of proceeds going directly to the city) declined at a disproportionate rate in the same time period. This indicates a decline in the number of operating gaming devices available, meaning less direct impact on historical preservation and more corporate profit.

Coevolution of kinetochore protein Cbf2 and budding yeast centromeres

Patrick C Hecht
Mai Nguyen, Tia Peterson, Jennifer F. Garcia, Sara J. Hanson, Faculty mentors
Colorado College

The kinetochore is a protein complex that assembles on chromosomes at a location called the centromere, which ensures correct segregation of chromosomes during mitosis. Identifying the centromere for kinetochore assembly is an essential part of this process. Unlike other organisms, budding yeast have developed two different ways of identifying the centromere. Some species such as Saccharomyces cerevisiae, have a point centromere that binds to the kinetochore protein Cbf2 which then signals for kinetochore assembly. It is believed that in species with regional centromeres, kinetochore assembly happens independently of any Cbf2 function. Using bioinformatics, we identified Cbf2 homologs in a diverse range of yeast species, including those with regional centromeres. Our goal is to test the conservation of Cbf2 function in yeast with regional centromeres. We are establishing a protein-DNA binding assay that will test the ability of Cbf2 proteins in regional centromere species to bind the centromere of S. cerevisiae. In addition, we are testing the ability of these Cbf2 proteins to complement the loss of S. cerevisiae Cbf2. Through these experiments, we aim to better understand the co-evolution of centromere and kinetochore structure and function.

THE DESIRE FOR IMMORTALITY IN THE PROSTHETICS OF MEDIA TECHNOLOGY

Giovanni Huete
Dr. Paul Macdonald, Faculty Mentor
United States Air Force Academy

Michael O'Gorman's book *Necromedia* synthesizes multiple theories regarding the implications of media technology on our contemporary conceptions of death and immortality. O'Gorman states that our "technoculture" often avoids death out of denial, and in doing so, provides avenues to overcome the prospect of death through the advent of advanced media interaction. Central to this concept is Bernard Stiegler's theory that we are undergoing epiphylogenesis, a process that inextricably links our evolution as a species with the technology we produce. The resulting relationship produces in the post-modern world what O'Gorman calls "technoprostheticization," whereby our rapidly advancing media technology creates seemingly infinite avenues for the extension of oneself; an enhancement that

replaces one's own finitude and limited ability with a vast and expansive technological consciousness. It is in this sense that "technoculture" exalts the desire of immortality through the prosthetics of media technology, as through this consciousness one can live forever based on the extent of conformity and investment of existence.

Predicting Effects of External Electric Fields using Gradient Path Curvatures

Nikodemos Hughes
Dr. Amanda Morgenstern, Faculty Mentor
University of Colorado Colorado Springs

Many chemical reactions produce toxic or unwanted byproducts that could be released in the environment. Catalysts are capable of boosting reaction favorability and reducing byproduct production. External electric fields (EEFs) are being investigated as green catalysts. The exact effects of EEFs on charge densities are sometimes non-intuitive, which makes developing an EEF catalyst challenging. Current promising experimental work helps validate theoretical methods of predicting how charge densities rearrange when perturbed by an EEF. Gradient bundle volumes (GBVs) have been shown to correspond to bond energies and polarizability. GBVs are bound by gradient paths (GPs) in the charge densities and their properties can be calculated through integration, which is time consuming and costly. The curvature of GPs bounding GBVs provides information about GBVs and are significantly cheaper to calculate. In this work we explore correlations between gradient path curvature and how the charge density rearranges due to EEFs. For example, the change in the sum of an atom's mean GP curvature in a molecule shows a strong correlation to electron gain/loss when an EEF is applied. Further properties examined include changes in polarizability and bond dissociation energies due to EEFs.

Heterochromatic histone deacetylase loss alters genome organization, histone acetylation, and facultative heterochromatin in Neurospora

Farh Kaddar
Andrew D. Klocko, Faculty Mentor
University of Colorado Colorado Springs

Chromosomes must correctly fold in eukaryotic nuclei for proper genome function. Eukaryotic organisms hierarchically organize their genomes, including in the fungus Neurospora crassa, where chromatin fiber loops compact into Topologically Associated Domain (TAD)-like structures formed by heterochromatic region aggregation. However, insufficient data exists on how histone modifying complexes, including histone deacetylases, affect genome organization and heterochromatin composition. In Neurospora, the HCHC complex (comprised of the proteins HDA-1, CDP-2, HP1, and CHAP) deacetylates heterochromatic nucleosomes, as loss of individual HCHC members increases centromeric acetylation and alters the methylation of cytosines in DNA. Here, we assess if the HCHC complex affects genome organization and the deposition of histone post-translational modifications by performing chromosome conformation capture with high-throughput sequencing (Hi-C) and Chromatin Immunoprecipitation-sequencing (ChIP-seq) in a strain deleted of the cdp-2 gene. We found that CDP-2 loss increases intra- and inter-chromosomal heterochromatic region interactions and causes gains in heterochromatic H4K16 acetylation while smaller heterochromatic regions lose H3K9 trimethylation and

gain inter-heterochromatic region interactions. In addition, we performed ChIP-seq of H3K27 di- or trimethylation, which marks facultative heterochromatin, to address whether another repressive histone mark could be altered in strains lacking heterochromatic histone deacetylation. Here, we present our current results for how the loss of HCHC HDAC activity affects the acetylation and methylation of heterochromatic nucleosomes and the organization of the Neurospora genome.

Deep Turbulence Sensing and Correction Using Digital Holography

Maya G. Mandyam
Tyler J. Hardy, Casey J. Pellizzari, Faculty Mentor
United States Air Force Academy

In this paper we explore the use of a novel imaging system to sense and correct atmospheric turbulence. Atmospheric turbulence degrades the performance of both imaging and directed-energy systems. Characterizing and correcting atmospheric turbulence requires knowledge of the air that cannot be obtained through classical imaging systems. Digital holography systems can measure atmospheric errors in challenging conditions. We design and test an imaging system in an outdoor experiment. This paper expands the design of the existing laboratory-based digital holography system to be more capable of accurately sensing turbulence. The field test provides insight into the ability of a novel system to accomplish sensing and correction of atmospheric turbulence. Our results detail the performance of our imaging system in a field test environment and provide data about the feasibility of integrating this system into real world directed energy and imaging applications.

Addressing spatial autocorrelation in analyses relating environmental variables to undocumented immigrant mortality sites on the USA-MEX border

Luke Matlock
Dr. Justin White, Dr. Steve Radil, Dr. Collin Philipps, Faculty Mentors
United States Air Force Academy

The Tucson Sector of the USA-Mexico border is one of the most active and perilous regions for undocumented immigration into the USA. In previous research, we used a high-resolution terrain surface and geospatial techniques to derive a suite of environmental metrics as terrain is a key determinant of how heat and water move across Earth's surface. We then used generalized linear models to identify that mortality sites (n = 3,427) were situated in areas that were drier ($p < 0.001$), received direct solar radiation for less time ($p < 0.001$), were flatter ($p < 0.001$), and were nearer the USA-MEX border ($p < 0.001$) than random. However, we identified that the analysis contained spatial autocorrelation, which may have impacted results. Here, we present a reconstruction of the analysis while clustering the standard errors: a novel approach to accommodate for spatial autocorrelation. We report on the differences in statistical outcomes and discuss the theoretical underpinnings behind those differences.

The Impact of Construction Material on Levee Durability: A Centrifuge Model Study

John Mauer
Lt Col Vincent Bongioanni, Faculty Mentor
United States Air Force Academy

Levees are a key aspect of the Colorado infrastructure that protects billions of dollars of Colorado property and assets around the state. These protective devices, like Denver's Globeville Levee, play a critical role in protecting more than 4,500 residents, nearly 900 buildings, and approximately $791 million in property. Some of the largest levees in the state protecting these assets are assessed as having a "moderate" risk of failure by the US Army Corps of Engineers. Our research aims to understand how the different materials used in levee construction (specifically clayey soils versus sandy soils) affect their resistance to the erosion process of "head-cutting" on the downstream slopes caused by overflow events. We used an innovative approach to simulate the conditions of a 5m high embankment structure using a 200 mm scale instrumented model in a centrifuge which subjected the model 25 times normal gravity. Utilizing the data from the tests, we modeled the measured flowrates into and out the levee and then compared to existing models. Our results show that levees built from sandy materials undergo a faster erosion process, termed headcut development, than clay levees. Erosion of sandy levees tends to begin near the base, whereas erosion of clay levees is more uniform along the downstream slope. These findings suggest that clay-based designs may provide better durability against the erosive forces that lead to the formation of headcut. For future investments, our study recommends levees being revitalized or built should be made of soils with a high clay content clay to minimize the risk of failure due to headcut.

Choosing Help Leads to Better Help: The role of active learning in help-seeking during a memory integration task

Elisabeth McLane
Diana Selmeczy, Faculty Mentor
University of Colorado Colorado Springs

Active learning is the process of participating in one's own learning through choice and self-regulation, and has been found to increase student's academic performance (Freeman et al., 2014). Help-seeking is a form of active learning as it requires individuals to engage in their learning by actively deciding if they need help and applying the help received (Karabenick & Berger, 2013). However, previous research in help-seeking often uses questionnaires and/or does not casually examine how the active choice of seeking help compares to conditions where no help is available or help is passively provided (Hao et al., 2016; Huet et al., 2011; Karabenick, 2003, 2004). The current preregistered study investigated if active help-seeking during an integration memory task improved free recall in college aged adults ($N = 14$, $N_{females} = 10$, $M_{age} = 22.6$, $SD_{age} = 5.4$). We found evidence that student's long-term retention of integrated knowledge was greater when they could select help on an earlier practice test ($M = .64$, $SD = .48$) compared to when help was not available ($M = .51$, $SD = .50$) or help was provided unsolicited ($M = .46$, $SD = .50$). These results suggest that students adaptively seek help, and that active help-seeking can improve memory integration.

Informant Reports and Executive Function: Diagnosis of Neurocognitive Disorders

Caleb R. Moyer
Dr. Rachel Thayer, Dr. Kelli Klebe, Faculty Mentors
University of Colorado Colorado Springs

Clinical neuropsychological assessments serve a vital role in evaluating cognitive status and formulating recommendations for enhancing patients' quality of life. This study asks if collateral informant reports are associated with neurocognitive disorders (NCDs), specifically regarding impairments of executive function (EF). Participants' data (N = 21, M_{Age} = 64.33, SD = 15.18) were accessed using the Neuropsychological Report Database from the University of Colorado Colorado Springs Aging Center. Chi-squared tests of independence were conducted to explore relationships between variables concerning collateral reports, NCDs, and EF. This study found statistical significance p = .016, as a large effect (Cramer's V = .744) between collateral/patient discrepancies (i.e., whether collaterals had differing observations than patients about their EF) and objectively tested EF impairments, such that cases demonstrating discrepant reports had higher rates of tested EF problems. It also found statistical significance p = .020, as a large effect (Cramer's V = 0.626) between patients diagnosed with an NCD and tested EF impairments, such that NCD diagnosis occurred more frequently for those with EF difficulties. Other analyses found moderate effect sizes but no statistical significance, which is likely related to a small sample size. Overall, results suggest that collateral perspective on EF could be important for future studies interested in NCD diagnosis, such as improving diagnostic accuracy. This study supports that current clinical practices utilizing collateral informants are useful.

Keywords: informant, collateral, executive function, neuropsychological assessment, neurocognitive disorder

Massasoit and Metacom: Different Approaches to the Puritan Problem

Hannah Murray
Barbara Headle, Faculty Mentor
University of Colorado Colorado Springs

When Puritans arrived in what would become New England, their survival was ensured by the Pokanoket sachem, Massasoit, who also benefited from a relationship with the Puritan settlers. His people recently suffered a devastating epidemic during which most died. The Puritans provided Massasoit a needed advantage against more powerful enemies in the region like the Narragansett. Therefore, for several years, the fate of the English Puritans and the fate of the Pokanoket people were intertwined. However, as the Puritans gained strength and were reinforced by converted Pokanoket people and transplants from England, particularly after the Great Migration of the 1630s, Massasoit's accommodation was pushed. After Massasoit and his oldest son, Wamsutta, died, his younger son, Metacom became the grand sachem of the Pokanoket people. Metacom continued his father's tradition of accommodation and a form of assimilation. He took the English name, Philip, as Wamsutta had taken the name Alexander. Metacom practiced the livestock-based agriculture the Puritans considered "civilizing". As he participated in Puritan processes, he realized the systems worked against him and his people. Therefore, after fifty-five years of accommodation and mutual benefit, Metacom declared war, and that war changed the course of native-white relations for the future of colonial New England.

Metacom's War sparks debates about just war, resistance, and results of settler-colonialism. This research contributes to scholarship regarding settler-colonialism and resistance to land dispossession and oppression common to settler-colonial projects. It was not an overnight process, and the path toward war took years to tread. The men involved in Metacom's War grew up together. The path from neighbors and tentative friends to mortal enemies was long and nuanced, but the result was the deadliest war in New England history.

Assessing the Equine Guided Learning and Healing Experience: A Self-Determination Theory Perspective

Luca I. Pieretti
Jason Weaver, Faculty Mentor
Colorado College

This study provided the first psychological assessment of the Equine Guided Learning and Healing Experience (EGLHE) via a Self-Determination Theory (SDT) lens. The study investigated whether EGLHE satisfied or frustrated participants' three basic psychological needs and whether EGLHE served as an autonomy-supportive learning environment such that participants' perceived competence and autonomously motivated learning in their coursework increased. Analyses revealed no significant findings except in one step of the mediation. Whereas previous studies have examined perceived autonomy support provided by an instructor in a learning environment, this study pushed SDT's previous conceptualization of perceived autonomy support in a classroom environment, suggesting that a single autonomy-supportive authority figure may not be the only condition supporting student autonomy. Furthermore, this study is the first, but hopefully not the last, to examine an equine intervention via an SDT lens.

Advancements in Photoacoustic Communications

Carter Potts
Maj Francesco Echeverria, Faculty Mentor
United States Air Force Academy

The application of laser photoacoustics will be used for secure communication. We pulsed a 1.9 μm Thulium fiber laser at various incident surfaces. Through thermoelastic expansion the atmosphere and/or surface absorbed the laser light to produce audible signals. This work builds on Sullenberger, et al (2019), notably by exploring the effects of varying surface type, laser power, and modulation frequency on photoacoustic signal. After successfully generating photoacoustic signals, we found that increasing the frequency caused a smaller signal for dry chamois and a larger signal for saturated chamois. Future works will include testing simulated biological systems and moving the laser power to eye and skin safe levels.

San Basilio de Palenque: The Fluidity of Marronage

Hadit Poveda Morales
Angela Castro, Faculty Mentor
Student Collaborative Research (SCoRe) Program
Colorado College

This research examined marronage (cimarronaje) in the largest maroon community in Colombia, San Basilio de Palenque. Over the years, the interpretation of marronage by several authors has shown this concept as simple terminology that can only be applied to historical and political arenas. However, marronage is not static, it is a fluid and complex concept. After spending several weeks investigating and reading about the different conceptualizations on the interpretation of marronage by authors such as Richard Price, Greg Thomas, and Castriela Hernandez, I went to San Basilio de Palenque to study how this maroon community interprets, practices, and lives marronage. Therefore, I propose that marronage is not exclusively from the past and is still implemented and practiced through oral traditions by maroon communities in the Americas. Currently, I am developing an academic article that challenges the current ideas on marronage to demonstrate that it is a fluid concept expressed through the transformation of oral traditions and culture in San Basilio de Palenque.

Gold-Catalyzed Three-Component Reaction Cascade for the Synthesis of Imidazoles

Isabella Ratzlaff
Dr. Timm Knoerzer, Faculty Mentor
United States Air Force Academy

Gold catalysis has been widely exploited for the synthesis of heterocycles. Of particular interest to our group is the application of gold-catalysis for the intermolecular 3-component construction of imidazole rings. This chemistry allows the transformation of a phenylacetylene starting material to a presumed imino-gold carbene intermediate upon reaction with a terminal azide group. Trapping of the intermediate with a nitrile generates a cyclized product imidazole. Herein, we describe the optimization of a synthetic method development strategy that evaluates the variance in reaction conditions that produces the desired imidazole in acceptable yield. Recent progress indicates that temperature, catalyst loading, solvent, and inclusion of a secondary acidic reagent play a critical role in directing the reactions toward the desired reaction products. Along the way, variations in reaction conditions may also afford production of isoquinoline, indole, and pyrimidine side products suggesting an ability to tune the process to direct product formation. This paper describes the reactions that led to our most effective conditions, as well as the reaction conditions that generate variances in outcome.

Zip it!: What Aspects Affect DNA Base Pair Binding

Hunter Redmon
Amanda Morgenstern, Faculty Mentor
University of Colorado Colorado Springs

Although DNA is an essential building block of life, much is unknown about the strengths of the interactions that hold its double stranded helix (dsDNA) together. Notably, the rate constants of dsDNA separation have a wide range of experimental values ($10^3<k<10^9$ sec^{-1}). The different separation rates may be key in understanding certain dsDNA properties such as where stopping points in separation occur and how to better resolve bands in PCR experiments. Quantum mechanical (QM) models can be used to study the key interactions in these base pairs — hydrogen bonding. The charge densities calculated by these models could be used to predict separation rates. In this work, QM models were used along with the quantum theory of atoms in molecules (QTAIM) to quantify the charge density in AT and GC base pairs and their ionic and tautomeric forms. Preliminary calculations have shown that the difference in charge density between critical points is unique in each base pair conformation. It is hypothesized that the differences in charge density between these points are directly related to the rate of the strand separation — this work seeks to explore and elucidate this relationship.

Arctic Oscillation Index and Volcanic Plume Dispersion

Adam Rouse
Col Hsien-Liang Tseng, Major Louis Cascino, SMSgt Nathaniel George, Faculty Mentors
United States Air Force Academy

The research aims to ascertain a correlation between Arctic oscillation and the trajectory of volcanic ash clouds. Defined as the back-and-forth shifting of air from the Arctic to mid-latitudes, Arctic oscillation influences the airflow in the Arctic, potentially affecting the dispersion pattern of volcanic ash. Analyzing data from climate.gov (2), this study compares Arctic oscillation data with eruptions from the Spurr Crater Volcano near Anchorage, Alaska. Utilizing data from the Alaska Volcano Observatory (3) and the United States Geological Survey (4), the study focuses on the July 9th, 1953, and September 17th, 1992, eruptions. Employing the Ash3D simulation model, eruptions are simulated under different Arctic oscillation conditions to assess its impact on volcanic ash flow. The investigation seeks to establish a correlation between Arctic oscillation and volcanic ash plume trajectory. If identified, this correlation can be utilized to predict potential effects on aviation assets based on current Arctic oscillation conditions. Subsequent research would explore the impact of volcanic activity on Arctic oscillation and the relationship between Arctic oscillation and ashfall deposition.

Sonication for Rate Enhancement of a Cycloaddition Reaction

Alexander Ruiz
Allen M. Schoffstall, Faculty Mentor
University of Colorado Colorado Springs

Bis-triazoles were prepared efficiently using an NHC catalyst in aqueous solution at 80˚C. The reactions were run in aqueous solvent and the yields were generally very good to excellent. However, the

reactions also proceeded in good yield in water at room temperature but took longer to reach completion. Carboxylic acid derivatives gave poor microwave yields, affording an opportunity for a more effective non-microwave procedure. Results on efforts to increase the reaction rates using sonication methodology will be presented.

Optimal Growth Conditions and Stability of *Lactobacillus crispatus* on Medical Gauze for Potential Applications of Vaginal Seeding Following C-Section

Sandra I Sanchez
Dr. Jordan Steel, Faculty Mentor
United States Air Force Academy

Vaginal Seeding has become common method used for post cesarean deliveries to inoculate babies with healthy microbes. The current method for vaginal seeding is to insert gauze into the mother's vagina before and during C-section birth and then the gauze is extracted and wiped on the baby. Vaginal seeding has been a particular interest to babies born via C-section because the baby missed the benefit of passing through the birth canal and receiving the healthy microbes. Despite the benefit of vaginal seeding, many babies born via C-section are not exposed to this protocol because of the invasive nature of collecting the healthy microbes. One of the most abundant commensal vagina bacteria, *Lactobacillus crispatus,* has been shown to have numerous positive health benefits for developing the baby's gut microbiota and digestive processes. We hypothesize that *L. crispatus* can be cultured and prepared on gauze in advance for a non-invasive/effective mechanism to expose newborns to healthy microbes. This study looks at optimizing growth and stability of *L. crispatus* on gauze for potential applications. The benefits of early exposure to healthy microbes for newborns has been clearly shown and providing solutions on how to inoculate babies born via C-section is critically needed.

Substance Free and In College: An Examination Into How to Best Support Students Defying the Norm

Annie Seymour
Kristi Erdal, Faculty Mentor
Colorado College

College student substance use is the norm in the United States. While there is existing research to demonstrate the hardships of those who struggle with substance use issues in college, very little exists on the experiences of substance free students. This research investigated the experiences of substance free students (N = 25) at a small southwestern college in the U.S. through semi structured interviews. This study found that while there are ways in which substance free students feel supported (i.e., through substance free housing and a lack of peer pressure), resources could be improved to best suit the diversity of needs for these students (i.e., not identifying events as for those "in-recovery"). Additional recommendations include improving substance free housing options, implementing late-night alcohol-free programming, and employing a social norming campaign to normalize being substance free in college.

Preschoolers' Early Utilization of Value-Based Selectivity: Considering Factors of Feedback and Age

Miriam Shamess, Heidi Martinez
Diana Selmeczy Ph.D. Faculty Mentor
University of Colorado Colorado Springs

The overwhelming influx of complex information from various sources is a hurdle that children navigate through constantly. Critically, some of the information children encounter may be more valuable to learn (e.g., their parents phone number) compared to other information (e.g., their friend's cat's name). Value-based selectivity is a memory strategy that allows children to be adaptive and preferentially learn information that is deemed more valuable or important (Knowlton & Castel, 2021). Although this skill develops substantially throughout childhood and adolescence (Castel et al., 2011), when this skill first emerges and what processes support its development are largely unknown. In this study, we examined whether feedback that highlights the relevance of value scaffolds the development of value-based selectivity in preschool children. Participants aged 3.5 - 5 years (N = 67) recruited from preschools in El Paso County completed a memory game where they memorized various high and low valued stimuli under one of two feedback conditions (item-specific or global). Results showed that children were selective and recalled more high value items (M = 4.15, SD = 1.67) relative to low value items (M = 3.48, SD = 1.58, p = .02), suggesting that preschoolers can engage in value-based selectivity. Additionally, we found some evidence that item-level feedback helped children engage in valuedirected selectivity more quickly compared to global feedback. Keywords: Value-Based Selectivity, Feedback, Memory strategy, Early Development.

Precision Measurement of the DC Stark Shift of the $5S_{1/2}$ to $6S_{1/2}$ Transition of Rb

Daniel Smith
Rajani Ayachitula, Mark Lindsay, Faculty Mentors
United States Air Force Academy

In this research, we measure the differential polarizability, α, between the $5S_{1/2}$ ground state and the $6S_{1/2}$ excited state of rubidium. A dc electric field is placed across a rubidium vapor cell which is heated to 65 degrees Celsius, and is used to measure the static Stark shift of the $5S_{1/2} \rightarrow 6S_{1/2}$ hyperfine transition. A microwave-driven EOM sideband of a 993-nm laser is locked to a fringe of an ultra-stable cavity, and the laser is tuned across each hyperfine transition. Doppler-free two-photon spectroscopy with this microwave frequency accuracy laser tuning is used to measure the spectra for the four hyperfine transitions. Lorentzian line fits are used to find the frequency line centers of each measured transition. The hyperfine splitting without the field has been determined precisely in previous measurements. The energy shift we measure is proportional to the square of the static electric field through the differential polarizability. Understanding how the DC Stark Shift changes transition energies has applications in the fields of atomic clocks, quantum computing, precision measurement, and fundamental studies of atomic systems.

Triplet-Triplet Annihilation in Gold(I) Conjugated Molecules

Mikhail Stiffler, Nathaniel Srode
Ethan Holt and Kimberly de La Harpe, Faculty Mentors
United States Air Force Academy

Due to their tailorable emission properties, gold(I) complexes are exciting options for OLEDs and non-linear optical materials. This is in part due to their long triplet lifetimes, high intersystem crossing yields, low fluorescence quantum yields, and broad transient absorption spectra. In collaboration with the Air Force Research Laboratory and Case Western Reserve University, the photophysical properties of two gold(I) complexes bearing electron-releasing diphenylamino and electron-accepting N-heterocyclic carbene and triphenylphosphine ligands were studied. Both molecules exhibit room-temperature phosphorescence with intersystem crossing quantum yields above 50%, and excited triplet state lifetimes ranging from 400-500 □s. Similar energies of the single and triplet excited states in these molecules open the possibility of competing decay pathways from the excited-triplet state between triplet-triplet annihilation (TTA) and thermally activated delayed fluorescence (TADF). To better understand these decay pathways, the excited-state dynamics were studied through energy-dependent delayed fluorescence (DF) and time-dependent triplet decay measurements. Initial results indicate that decay from the excited triplet state occurs as a primarily two-photon process. However, complications arise when processing DF data due to overlapping fluorescence and phosphorescence bands. Deconvoluting this overlap will provide more accurate curve integration and improve understanding of the contribution of these decay processes to the DF signal. Herein, we present an analysis of excited state dynamics measurements and interpretation of decay pathways, enhanced by a new method to appropriately deconvolute delayed fluorescence and phosphorescence signals.

Understanding Molecular Interactions of a Novel Lupus Therapeutic Treatment

Camden Trent
Dr. James M Kovacs, Faculty Mentor
University of Colorado Colorado Springs

Systematic Lupus Erythematosus, or SLE, is an inflammatory autoimmune disease and presents in about 200,000 new cases every year. The current treatment plans only focus on the symptoms of the disease and not the underlying biochemical level issues. The compliment system is a target for therapeutic treatments of SLE, given the production of auto-antibodies from mature B cells. Along with our collaborators, we have identified two antibodies that have been shown to halt and reverse the effects of Lupus in mouse models, 3d29 and 3d8b. This therapeutic approach stems from engineering a single chain variable fragment (scFv). The expression of the 3d29 scFv in mammalian resulted in high levels of pure protein after purification. The binding affinities of this protein with C3D, a biomolecule present in Lupus, have been studied.

The Impact of Microplastic Pollution on our Oceans by the Cruise Industry

Lyndsay Weir
Lauren DeLeonardis
James Baginski, Faculty Mentor
University of Colorado Colorado Springs

The cruise industry is an example of one that is consumption based, ambiguously regulated, and far reaching. Cruise tourism is a rapidly growing industry, and at its peak in 2019, the cruise industry catered to approximately 30 million passengers (Cruise Line International Association 2021). Cruise ships produce seven different types of waste: food, greywater, hazardous substances, non-plastic trash, sewage, oil, and plastics (Howusu and Teyssedou 2019). Plastic waste from cruise ships occurs in two forms: solid waste in the form of garbage, and microplastics in the discharged grey and ballast waters (Naik et al 2019). Unlike sewage, grey water discharges are not internationally regulated, and has an estimated waste production rate of 160 l of waste per person per day. Microplastics are small scale plastic pollution that are just now becoming well understood. A particle less than 5mm is considered a micro plastic by the National Oceanic and Atmospheric Administration and can be of primary (purposefully manufactured to be of microscopic size) or secondary (derived from the fragmentation of macro-plastic items) origin (Wright et al. 2013). Microplastics pose risks to human and animal life by transporting bacterial pathogens, harmful chemicals and dinoflagellates that support algal blooms across the continents (Naik et al.2019). By identifying the cruise industry as a major polluter of the ocean from solid and microplastics, and determining the impacts of microplastics on our oceans, less damaging practices can be suggested for future management of this sector of tourism.

Screening Novel Polyfluorinated Compounds for Cytotoxicity on Cultured Cells

Lindsey Winograd
J. Jordan Steel PhD, Faculty Mentor
United States Air Force Academy

Polyfluorinated compounds (PFC) have useful chemical properties, resulting in their abundant use in materials, products, and emergency responses (firefighting foams). However, PFCs have been shown to be resistant to degradation, bioaccumulate within food chains, and have long half-lives within human blood serum, resulting in harmful human and environmental impacts. Novel fluorinated polymers are being synthesized as potentially safer PFCs, but these novel PFC's need to be screened for potential acute toxicity. This project has focused on screening novel PFC's engineered and synthesized in the USAFA Chemistry department for cytotoxicity. We hypothesize that mammalian cell cultures can serve as preliminary indicators for these novel PFC's acute toxicity in eukaryotic cells. We treated cultured mammalian cells with serial dilutions of either a novel or control compound for 24 hours at 37℃. After 24hrs of exposure, the treated media was removed from all wells and replaced with a solution of Resazurin, which is a dye that can be metabolized by healthy cells. 17 novel compounds have been screened, and initial results indicate that certain novel fluorinated polymers do not cause acute toxicity in cultured mammalian cells. Further testing is necessary, but this system provides a valid method to screen compounds for acute toxicity.

Digital Media Consumption Relationship with Qeirat in Iran

Fargol Yeganeh Fathi
Marcela Fernandez-peters, Mohammad Atari, Faculty Mentors
Colorado College

There is a conflictual existence of the traditional values of Iran and the current movement in Iran to fight for women's rights, called Women, Life, Freedom. To address the change in traditional values of Iran, this research examined whether consumption of social media has a relationship with a cultural variable in Iran called Qeirat, closely defined as honor culture with kinship intensity being a potential mediator and a moderator. To examine this, an online survey via Telegram was distributed. Data was collected from a sample of 321 Iranian participants. After a regression, mediation, and moderation analysis of kinship, no relationship between social media use frequency and Qeirat levels were found. These findings might suggest the resilience of Qeirat value. Additionally subscribing and following to certain influencers and their relationship with Qeirat, kinship and social media use frequency was measured. The most significant finding suggests that following pro Women, Life, Freedom platforms and personalities has a negative relationship with Qeirat levels suggesting a shift to Iranian culture. Subscribing to influencers residing in Iran and promoting the Islamic Republic's values has a positive relationship with Qeirat and kinship levels. This research contributes to understanding the nature of the interplay between cultural evolution and digital media consumption, emphasizing the special nature of traditional values despite global exposure to contrasting ideologies. Future directions suggest recruiting Iranians with limited access to social media to examine if there is a difference of Qeirat levels amongst social media users and non-users.

Keywords: Social Media Use, Qeirat, Kinship, Honor Culture

Oral Session 2

Dwire Hall

Borders & Beyond

Dwire Hall 106

The Role of the Brazilian Military in Upholding Democracy

Agatha Flenik Sabino
Lt Col Daniel Jordão, Faculty Mentor
United States Air Force Academy

The essay "The Role of the Brazilian Military in Upholding Democracy," explores the relationship between the Brazilian military and democratic governance. The author argues that the Brazilian Constitution of 1988 serves as a cornerstone for democratic principles, which the military upholds through its adherence to constitutional mandates. However, while the essay highlights instances where the military has contributed to democratic values, such as providing COVID-19 vaccines and food aid during the pandemic, it also acknowledges the complexities of military involvement in civilian affairs. By examining the case of "Brumadinho," which involved disaster relief efforts and citizen rescue operations, the essay delves into the multifaceted role of the military in safeguarding both national security and citizen welfare. Furthermore, the essay critically evaluates the assertion that investing in the military is synonymous with investing in democracy, recognizing the need for nuanced analysis and consideration of alternative perspectives. Through a balanced exploration of the military's contributions to democracy and the challenges inherent in military-civilian relations, this essay offers a comprehensive understanding of the Brazilian military's role in democratic society."

The Integration of a Space Force Reserve Component

Kerri Johnson
Major Melissa Ken, Faculty Mentor
United States Air Force Academy

Recent discussions on establishing a Space Force Reserve have sparked debates regarding its necessity and feasibility. This presentation delves into the financial and resource implications of such a venture, emphasizing its crucial role in ensuring dominance in space warfare. By evaluating Congress's proposed funding options, the aim is to determine whether the investment aligns with anticipated advancements while providing flexibility for personnel commitment. Strategic resource allocation is essential, encompassing finances and personnel to cover training, equipment procurement, infrastructure development, and operational readiness. Recruitment and retention strategies for reserve members must be devised to ensure a consistent influx of skilled personnel. The Space Force Reserve holds the potential to bolster national space warfare dominance by expanding operational capabilities

and increasing manpower without overburdening active-duty forces. Leveraging reserve expertise allows effective response to emerging threats and technological shifts, ensuring operational stability during high-demand scenarios. Establishing a Space Force Reserve offers part-time service opportunities, which facilitates personnel retention by enabling contributions alongside civilian careers or academic pursuits. This flexible approach fosters a diverse, skilled workforce and mitigates burnout and attrition risks, ultimately enhancing national security in the space domain.

Historically Informed Adjustments to Air Force Operational Posturing in the Indo-Pacific

Quintin Kies
Lieutenant Colonel (Lt Col), Peter Euler, Faculty Mentors
United States Air Force Academy

The US Department of Defense is currently orienting its forces to fight against a near-peer adversary in the Pacific, with that environment marred by challenges of distance and lack of land. To adapt to this threat, the Air Force's Air Mobility Command, which is responsible for the Air Force's aerial transport, required historically-informed guidance to best meet this pacing threat, with the Vietnam War serving as an ideal template for historical analysis. This paper focuses on Air Mobility operations during the Vietnam War, and the associated lessons learned from that conflict. It begins with an introduction to the Vietnam War and strategic airlift, discusses the "hub and spoke" doctrine's development, analyses the outcomes of strategic airlift, and provides six lessons learned about strategic airlift during the conflict that can be applied today, concluding with a historical summary of my research. Innovative processes applied to strategic airlift during the Vietnam War led to new aerial routes via the now proven "hub and spoke" doctrine, more robust airfields across the Pacific, and a standardized logistical prioritization system. By applying these lessons, future military operations in the Pacific can benefit from improved rapid response capabilities, enhanced logistics support, and effective deployment of forces to maintain regional stability, protect national security interests, and combat a peer-level threat. The big-picture background of airlift operations relied heavily on secondary sources, primarily from Air Mobility Command's Office of History and the Air War College, with some analysis informed by those documents as well. However, almost all statistics and analysis stem from primary sources located in the Office of History's archive at Scott Air Force Base, Illinois.

Addressing Violence in Brazil: Solutions and Strategies

Owen Peterson
Lt Col Daniel Jordão, Faculty Mentor
United States Air Force Academy

When one thinks of the country of Brazil, what comes to mind? Some may think of the great Amazon Rainforest, others the beautiful beaches, and others the vibrant culture shown by Carnival and other festivities. Unfortunately, it is not just these things that Brazil is known for. Brazil is also commonly cited as one of the most dangerous countries in the world. When foreigners think about going to Brazil, they often fear being robbed or murdered, and rightfully so as Brazil accounts for one-fifth of the murders worldwide. This fear is even worse for those who live in Brazil as they are most affected by this in their communities and homes. In total, the losses from violent crime add up to about 6% of Brazil's GDP annually. Clearly, this is an issue that must be dealt with. This is an issue that stains Brazil's reputation

in the world, and an issue that prevents Brazil from becoming a first world country. In this paper we analyze the various solutions that have been proposed and their viability as well as effectiveness. Ultimately, we make a recommendation to how Brazil may finally rid itself of this plague that has for so long tormented the good people of Brazil.

Protecting Protectors: Military Injury & Misinformation

Dwire Hall 112

From Injury to Intervention: Investigating Delays in Therapy Engagement Following Traumatic Injuries

Sage Hamilton
Dr. Steve Bistricky; Dr. Kellie Klebe, Faculty Mentors
University of Colorado Colorado Springs

This proposed study seeks to explore factors influencing therapy engagement in survivors of physical injury, with a focus on identifying delays in patients engaging in the University of Colorado at Colorado Springs (UCCS) Veterans Health and Trauma Clinic BRIGHT (Building Resilience After Injury: A Growth and Healing Toolkit) program services. Conducted in collaboration with a UCHealth level one trauma center in Colorado Springs, BRIGHT employs a three-phase intervention model encompassing referral, outreach, and treatment. Emergency department patients assessed as having mental health needs undergo referral and subsequent contact by UCCS Trauma-Track Clinical Psychology PhD students, ultimately receiving six brief, no-cost psychotherapy sessions. This study aims to investigate the intervals between each phase, particularly assessing whether the nature of trauma significantly influences the duration of service engagement delays. Specifically, we hypothesize that individuals who experience interpersonally inflicted injuries may demonstrate a prolonged duration between hospital presentation and the initiation of therapy services compared to those with non-interpersonal injuries. This research aims to contribute valuable insights into the dynamics of therapy engagement delays, with implications for optimizing interventions and support strategies for physical injury survivors.

Developing a cognitive security framework to count information warfare: A strategic imperative for the United States military and its allies

Kevin Duong
Richard E. Niemeyer, Faculty Mentor
United States Air Force Academy

Information warfare is a serious threat to global democracies. However, the lack of a universally accepted understanding of cognitive security across different US military branches and allied forces is a critical obstacle in countering these threats effectively. Our research aims to develop a cohesive cognitive security framework that standardizes the understanding of information threats and empowers

the United States and its allies to identify and neutralize misinformation, disinformation, and malinformation-based tactics. By establishing a shared cognitive security framework, the United States can lead a more coordinated and proactive response to information warfare while preventing societal unrest and violence triggered by cognitive attacks on civilian populations.

Musculoskeletal Injury Concealment in the Military

Kevin Yale
DeLyn Winters, Faculty Mentor
University of Colorado Colorado Springs

Injury concealment is a prevalent issue hurting service members throughout all branches of the military regardless of rank or position. Service Members (SM) experience environmental pressures to avoid reporting injuries including needs for career progression and fears of reprimands. In basic training and early technical training SMs have a high rate of injury due to intensive physical activity, with two thirds of recruits concealing Musculoskeletal Injuries (MSKI). Once integrated into active duty greater than 50% of SMs noted a concealed injury and that they would not seek immediate medical care if injured. Special forces also have high rates of MSKI concealment, with SMs citing prior negative experiences a motivation to avoid reporting. Pilots have a greater connection between physical health and career stability, and as such also exhibit high rates of medical concealment with 42.5% reporting misrepresentation or omission of medical information. Despite room for further study remaining, based on current data MSKI concealment is a serious issue that nearly every Service Member will confront at some point in their career.

Developing and Interdisciplinary Cognitive Security Framework: For Policy and Future Operations

Talyor Dunn; Ella Seidel
Richard E. Niemeyer, PhD, Faculty Mentor
United States Air Force Academy

In collaboration with an interdisciplinary team, the United States Air Force Academy is working to develop a cognitive security framework that synthesizes empirical findings from the life sciences, behavioral sciences, and social sciences. This framework combines empirical findings from life sciences, behavioral sciences, and social sciences to understand how cognitive biases, group dynamics, and societal structures contribute to susceptibility to misinformation, disinformation, and other malign influences. Through this integrative approach, we aim to uncover how these factors converge to influence susceptibility to misinformation and propaganda. The culmination of this research will provide a set of cognitive security measures. These measures are developed to offer personalized solutions to reduce vulnerabilities and enhance resilience against future information-based threats. The insights garnered will inform future research, policy-making, and operational planning.

Identity in Textual Analysis

Dwire Hall 204

Abstracto del Papel

Yujin Shim
Dr Ismenia Sales de Souza, Faculty Mentor
United States Air Force Academy

José Martí, known as the apostle of the independence of Cuba, gained fame for his writing pushing for independence and for fighting in independence movements against the Spanish colonists. Yoon Dong Ju was a Korean poet who, through his poems, advocated against Japanese colonialism of Korea despite knowing that most dissidents who vocalized their opinions against Japan were captured and killed. Although the two pertain to different times and parts of the world, they both lived under colonialism and share many similar themes in their works, like the oppression of their people and their desire to see independence. The purpose of the study is to conduct a comparative analysis between José Martí's "Poema I" from his collection *Versos Sencillos* and Yoon Dong Ju's "Prologue" from his book *Sky, Wind, Stars, and Poetry*. I will compare the themes seen in the two poems and how the two poets convey these messages.

Sir John Hawkins and the Origins of the English Slave Trade in the Elizabethan Era

Bradley White
Janet Myers, Faculty Mentor
University of Colorado Colorado Springs

This research examines the origins of the English slave trade during the reign of Queen Elizabeth I. Analyses of the English slave trade typically focus on how England expanded slaving practices following its acquisition of new world colonies. However, the voyages of English slaver, Sir John Hawkins, predated the formation of permanent English colonies in the Americas by over forty years. Hawkins embarked on multiple slaving voyages between 1562 and 1568 and delivered hundreds of African slaves to Spanish colonies in the Caribbean. Hawkins' voyages represented an anomaly for sixteenth century England and brought the English into direct conflict with Portuguese and Spanish. The story of Hawkins' voyages is illustrative of England's desire to expand its maritime authority at the end of the sixteenth century. The same mercantile drive toward expansion and profit that persuaded Hawkins to embark on slaving voyages allowed England to upend the oligopoly of the trans-Atlantic trade established by the Portuguese and Spanish. The voyages of Sir John Hawkins in the sixteenth century exemplified the economic forces that allowed England to eventually challenge Portugal and Spain for dominance in the slave trade and further English expansion into the vast market of Atlantic trade created in the years following the first instances of Spanish and Portuguese colonization. Ultimately, this research reevaluates the role of Hawkins' slaving voyages in expanding the influence of England in the changing Atlantic World of the late sixteenth century.

Unraveling Latin American Modernism: A Critical Analysis of Rubén Darío's "Canción de otoño en primavera"

Samantha Wineland
Dr. Ismênia Sales de Souza, Faculty Mentor
United States Air Force Academy

This paper offers a comprehensive analysis of Rubén Darío's seminal work "Canción de otoño en primavera" within the context of Latin American Modernism. Darío, often hailed as the father of Modernism, revolutionized Spanish-language poetry with his innovative style, rich symbolism, and profound introspection. Through a close reading of "Canción de otoño en primavera," this study seeks to elucidate the thematic, stylistic, and philosophical elements that characterize Darío's contribution to the Modernist movement. The analysis begins by contextualizing Darío's work within the broader literary and cultural landscape of late 19th and early 20th century Latin America, marked by political upheavals, cultural transformations, and a search for identity. Drawing on literary criticism and historical sources, the paper explores how Darío's poem embodies key tenets of Modernism, including a rejection of academicism, a celebration of individuality, and an embrace of artistic experimentation. Central to the analysis is an examination of the poem's themes of love, mortality, and the passage of time, which are imbued with symbolic imagery and metaphorical depth. By deconstructing Darío's use of language, rhythm, and literary devices, this study uncovers the layers of meaning embedded within each stanza, revealing the poet's profound exploration of human existence and the human condition. Furthermore, the paper investigates the interplay between form and content in "Canción de otoño en primavera," highlighting Darío's mastery of poetic techniques such as symbolism, allegory, and musicality. Through this analysis, the paper aims to shed light on the enduring relevance of Darío's work and its influence on subsequent generations of Latin American writers. In conclusion, this study offers valuable insights into the complexities of Latin American Modernism as exemplified in Rubén Darío's "Canción de otoño en primavera," reaffirming the poet's status as a visionary artist whose legacy continues to resonate in the literary landscape of the region.

Doubts of the Definite: The Case for College Core Literature and How it Can Guide Our Response to Modern Inquiry

Samual Schuhl
Dr. Ross Gresham, Faculty Mentor
United States Air Force Academy

In 21ST century America, strongly held values, beliefs, and identities are, due to media, increasingly available for challenge and inquiry by others. The 21ST century American is subject to vast arrays of amateur and expert opinions alike, especially through the presence of new media forums that give voice to non-experts. Despite the increased prevalence of these modernized—yet established—struggles for belief, the current undergraduate often overlooks the lessons of widespread English texts. How can core examples from literature prepare us for serious inquiry into our own deeply rooted beliefs and identities, especially when these things can't be "proved?" Taking examples from these core English texts—Shakespeare's history, *King Henry IV*, where Shakespeare depicts how one can address external doubt through personal dialogue, reflection, and discovery—we can see direct application for today's technological barrage on belief. Alternatively, Emily Dickinson's "I Saw a Fly

Buzz--When I Died" (465) offers a divergent solution wherein she prescribes acceptance of external doubt through blatant denial rather than contemplation. These disparate approaches offered by Dickinson and Shakespeare outline a relevant approach through core literature towards the affirmation of belief in the face of increased doubt cast by external forces. Furthermore, these texts demonstrate essential lessons and applications provided by required readings at the undergraduate level. This essay will examine methods and strategies proposed by these authors in *King Henry IV,* and "I Saw a Fly Buzz--When I Died" with regard to navigating external doubts of the definite in modern America through an individual lens; as well as how the college requirement of texts such as these work to develop and expose students towards modernized solutions grounded in experience.

Spanish and Portuguese Short Story Session

Dwire Hall 303

El Destino y Los Ojos en La Noche

Diego Castellanos
Dr. Ismenia De Souza, Faculty Mentor
United States Air Force Academy

El Destino is a short story designed to bring awareness about driving under the influence and its effects on other people. It also explores the idea of how the mind is extremely powerful and how it does things in order to cope with traumatic events. El Destino is a piece of creative fiction that displays my application of the Spanish language while bringing awareness of a serious topic in order to help bring more awareness of such. Los Ojos en La Noche is a two part short story that has a conflicting yet similar concept about how people tend to always want things but never really take the time to appreciate what they already have. Los Ojos en La Noche is another piece of creative fiction that exemplifies my use of the Spanish Language to deliver a message about the importance of appreciating the things you already have.

Demasiado Tarde

Josiah Christian
Dr. Ismenia De Souza, Faculty Mentor
United States Air Force Academy

Demasiado Tarde is a creative piece inspired by my experience with extreme heat growing up near the Mojave Desert, as well as the psychological effects of going unprepared into such. Taking inspiration from multiple Latin American creative works, Demasiado Tarde is a short work of fiction that demonstrates my understanding and use of the Spanish language in a creative setting while simultaneously bringing light to how danger may not seem dangerous until too late.

Mi Castigo

Alec Garcia
Maj. Jason Fischbach, Dr. Ismenia De Souza, Faculty Mentors
United States Air Force Academy

Major Jason Fischbach and Dr. Ismenia Sales de Souza, DFFL “Mi Castigo” is a short creative piece inspired by the poem “La Intrusa” by Claribel Alegría that explores guilt and karma and how they can affect one’s self-perception. It is a first person work of fiction that follows an individual struggling with their own guilty conscience and their attempts to absolve themselves from their past actions before finally accepting what they have done.

El Muro

Thomas Goglia
Major Jason Fischbach and Dr. Ismenia Sales de Souza, Faculty Mentors
United States Air Force Academy

El muro is based in my last two years of school—the things I have read, written, and experienced. It is fictional, yet somewhat autobiographical. In this way, I strove to combine the tones of fantastical authors and works I have experienced with a story relevant to my life as a cadet, and while the story may be specific, hopefully every reader can take away a message about living life when it isn’t as spectacular as you may see in the movies.

A Infância no Porto Rico (Childhood Memories of Puerto Rico)

Carla Ortiz Cerezo
Major Jason Fischbach and Dr. Ismênia Sales de Souza, Faculty Mentors
United States Air Force Academy

This is a short story and poetry reading in Foreign Languages. The cadets will analyze and read original short story and poetry written in Portuguese and Spanish. In addition, they will talk about different literary movements; how some of the movements and writers influenced and inspired their writing in the target language.

Mi sargento, el proselitista

Silas Strich
Dr. Ismenia S. De Souza, Faculty Mentor
United States Air Force Academy

The title of my work is *Mi sargento, el proselitista,* and the short story is about personal change over time, and how others can influence, or even corrupt you. The story is based in my own life and experiences of growth, as well as my Colombian ancestry and love for history.

Poster Session 2

Gallogly Event Center

The Life History of *Usnea hirta* and the Reproductive Plasticity Thereof

Miles Ackerman
Shane Heschel, Faculty Mentor
Colorado College

Lichens are algal symbionts and our understanding of both the natural history and ecology of lichens is an ever-growing process. Not only do they exist as valuable winter browsing for herbivores and crucial ingredients in various traditional medicines, but they are also bioindicators in CO habitats. Beard lichens such as those in the *Usnea* genus have a newfound reverence for their use as air quality bioindicators. At the Catamount Center in the Colorado Front Range, *U. hirta* is often seen clinging to *Pseudotsuga menziesii*, *Picea engelmannii*, and *Pinus flexilis*, with observational data indicating a preference for *P. menziesii*. This study aims to reveal whether this preference is statistically significant and ecologically relevant. The sampling of 9 total transects across 3 north facing slopes and consequent ANOVA revealed significant differences in *U. hirta* coverage at breast height for three variables: host tree species, tree tissue life status, and forest plot age. These differences may be explained by the highly rugose bark of *P. menziesii* and the advantages that offers in physical establishment and water retention. Moreover, SEM imaging revealed interesting reproductive strucutres and plasticity in reproductive strategies, potentially depending on habitat and/or substrate. Thus, while this study offers compelling evidence of preference by *U. hirta* for one species of gymnosperm and potential reproductive plasticity, the ideas presented here require further studies to certify. This study provides a jumping-off point for future studies of beard lichens in the Colorado Front Range, the direction of which should incorporate a closer look at lichen reproduction and bark characteristics (water-holding capacity, pH, etc.) of the host trees observed in this study.

Using a Probabilistic Model of Infrastructure System Reliability as a Decision Support Tool

Alexander Ankney, Garret Henigin, Jacob Miller, Kayla Kim and, Bevan Watson
Timothy Frank, Faculty Mentor
United States Air Force Academy

Critical infrastructure reliability is vital to a number of industries including the U.S. Department of Defense. Modeling critical infrastructure and estimating system failures are key steps to identify the components in greatest need for upgrade, recapitalization, or increased redundancy. This poster details a case study of one mission at an undisclosed U.S. Space Force Base, wherein the authors developed a numerical model representing the supporting water, power, electrical, and heating, ventilation, and air conditioning systems. The model was developed using best practices for fault analysis and validated by qualitative and quantitative measures. Through Monte Carlo simulations, the model estimated overall system availability using various probability distributions and parameter values. Sensitivity

analyses were performed, and one model was selected and then employed as a decision-support tool for various recapitalization projects. The methodology shows promise to better understand and increase critical infrastructure reliability for other military missions as well as non-DoD use-cases.

BIPOC considerations in the development and implementation of psilocybin assisted therapy

Denise Benitez
John Horner, Faculty Mentor
Colorado College

As research on psilocybin-assisted psychotherapy for depression increasingly shows promise for rapid improvement in symptoms compared to current standard treatments, we must intentionally consider Black, Indigenous, and People of Color (BIPOC) populations in the process. If the medical field does not intentionally and explicitly consider historically and currently marginalized populations, there is a risk of perpetuating structural racism in the development of the treatment. Consideration of these populations would mean that they are included as participants and researchers in clinical trials for treatment to ensure that results from the trials are generalizable and optimal treatments for these populations are developed. Once effectiveness has been clearly shown, BIPOC individuals should have the ability to access the treatment and should receive it in a culturally sensitive manner.

Improving transparency in qualitative coding for replication: the importance of inter-rater reliability measures

Trinity Benware, Selena Little
Richard E. Niemeyer, PhD, Faculty Mentor
United States Air Force Academy

Like other social sciences, criminology is experiencing the negative consequences of a credibility crisis, including the widespread use of questionable research practices (QRPs), high rates of false positive findings, and extensive researcher degrees of freedom (Chin et al., 2023; Niemeyer et al., 2022; Pridemore et al., 2018). In examinations of false positive findings, qualitative software packages (QSPs) can be useful for coding transparency and replication (Bostrom et al., in progress). However, using QSPs for coding introduces additional researcher degrees of freedom if subjective coding schemes are used. This project examines the importance of inter-rater reliability measures in coding text-based data for false positives analysis. Coders participated in coding training and coded using a predetermined codebook. Iner-rater reliability was examined within two sub-teams of coders and across all coders using different samples. The findings suggest INSERT FINDINGS WHEN WE HAVE THEM. We discuss implications for transparency and reproducibility of text-based data for false-positive research using QSPs.

Disordered Eating and Body Image in Emergency Medical Services Staff

Charlotte Bisaccia
Dr. Tricia Waters, Faculty Mentor
Colorado College

A great deal of research has been conducted on different sectors of first responders, especially emergency medical services (EMS), and how they each respond to traumas differently. Past research has shown that EMS professionals deal with many mental health issues such as PTSD, depression, anxiety, substance abuse, sleep disturbances, burnout, and even suicidal ideation. The current research assesses the levels of disordered eating and body image in EMTs/paramedics as compared to emergency department nurses using a disordered eating scale, an eating disorder scale, and a body image scale. Results showed that EMS had significantly lower body image satisfaction scores compared to nurses and that those participants in 911 showed lower body image scores than those in Interfacility Transport/Emergency Departments. Results trended towards showing that those with fewer lunches out of the past ten shifts had higher disordered eating. Additionally, a low percentage of participants felt that they could take regularly scheduled breaks for eating, the average number of lunch breaks taken out of 10 shifts was less than half, and a large percent of participants answered “yes” or “sometimes” to the common phenomenon of “eating when and where you can” while on a shift. These results exhibit concerning issues of decreased body image across EMS professionals and deep-rooted problems with nourishment while on shift. These issues must be addressed as it is a matter of public safety to attend to the mental health of first responders so that they can attend to the critical requirements of their job.

More and Less Structured Toys: Can Different Toys Change the Prosocial Behaviors of Children?

Luke Bleckman
John Horner, Faculty Mentor
Colorado College

Research has shown that unstructured play has a positive relationship with prosocial behaviors. The present study tests whether there are more prosocial behaviors observed when young children play with unstructured toys than when they play with structured toys. Unstructured toys included a set of wooden blocks and a cardboard box. Structured toys included a Bop-It and a Simon. Prosocial behaviors were measured using counts of 1) instances in which a child joined play (“joined”) and 2) instances of a toy being shared (“shared”). There were significantly higher counts of joined under the unstructured toy condition than under the structured toy condition, but due to the lack of interrater reliability and the low number of subjects, we suggest that the study warrants replication.

The index of qualitative variation and replication: assessing flexibility of constructs in social disorganization theory

Billie Botes
Richard E. Niemeyer, PhD, Faculty Mentor
United States Air Force Academy

Like other social sciences, criminology is experiencing a theory crisis as part of a larger replication crisis (Niemeyer et al., 2022; OTHERS). The theory crisis directly feeds into a methods-based crisis of flexible operationalization and poor reproducibility of findings. Niemeyer and colleagues (2022) estimate the impact of weak criminological theory on false positive findings using the Ioannidis equation and find that at least 90% of findings are false positives. We contribute to this literature by calculating the index of qualitative variation (IQV) for theoretical constructs in a sample of social disorganization empirical tests. The IQV empirically demonstrates the extent of researcher degrees of freedom through the flexibility of theoretical constructs. It accounts for the number of categories of operationalizations used for each construct and the use distribution across those operationalizations. We found that the IQV for poverty, racial and ethnic heterogeneity, and residential stability were extremely high in our sample, with values ranging from 0.84 to 0.99. This empirically identifies a theoretical contributor to the reproducibility crisis in criminology. We discuss the troubling implications of high theoretical flexibility for social disorganization theory and broader replication efforts.

Beyond the Mississippi: The Francophone World and French Colonial Legacy in the American West

Eric Boyle
Roy Jo Sartin, Faculty Mentor
University of Colorado Colorado Springs

When regarding the impact and lasting legacy of French colonialization and settlement in North America, both scholars and laymen alike often limit their scope to the lands east of the Mississippi River. This is understandable, as the vast majority of France's colonial investment on the continent was made along their waterway empire that stretched from the mouth of the St. Lawrence to that of the Mississippi. What must still be recognized, however, are the experiences and contributions made by the thousands of Frenchmen and French Canadians that explored, worked, and settled beyond the Mississippi in the lands of the American western frontier. This research aims to explore both the history as well as the enduring legacy that these men and their work had on the identity of the American West. Based on an understanding of the colonial polity that shaped the East, this research sheds light on the French and Canadian presence in the lands west of the Mississippi River through a case study that functions on the framework of the geographically modern American states, including Missouri, Kansas, Oklahoma, Nebraska, Iowa, New Mexico and Colorado.

Unveiling Zoonotic Risks: Exploring Pathogen Dynamics in Wildlife Populations through the One Health Lens

Mason Carlan, India Jones
Dr. Kellie M. Kuhn, Faculty Mentor
United States Air Force Academy

In recent years, recognition of the interconnection between environmental, animal, and human health has grown significantly, underpinning the "One Health" paradigm aimed at comprehending disease transmission dynamics across animal and human populations. Our investigation aims to assess the potential risk of zoonotic spillover and spillback events in the wildland-urban interface. Using the One Health framework, we examined pathogen loads in wildlife populations using shotgun metagenomics analysis of wildlife fecal samples. Fecal sampling is particularly useful because it is cost-effective and suitable for long-term monitoring and surveillance at large scales. Shotgun metagenomics analysis allowed us to quantify and characterize the microbial community in each sample. Here, we present preliminary findings regarding the presence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in white-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), and elk (*Cervus canadensis*). In 2021, humans spread SAR-CoV-2 to white-tail deer. Multiple spillback events and transmission of SAR-CoV-2 among deer resulted in the rapid spread of the virus in deer populations. We explicitly tested whether SARS-CoV-2 was more prevalent in deer near areas of high human densities. In the future, we will use our data to build predictive models of pathogen loads in animal populations along human density gradients. This research contributes to our understanding of ecological epidemiology by elucidating the relationships between environmental changes, animal health, and the emergence of zoonotic diseases, thereby informing targeted interventions and conservation strategies to safeguard both human and animal well-being.

Bridging the Gap: A Mixed Method Literature Review of Sex Education for Young Adults

Savannah L. Champagne
Kimberly S. Dickman, Katherine L. Bates, Faculty Mentors
United States Air Force Academy

Sexually Transmitted Infections (STIs) and sexual assault rates remain consistently higher among people ages 17 to 28 compared to any other population in the United States. Comprehensive sex education aims to reduce these risks and provide age-appropriate education, however much of the focus has been on the education of children under the age of 17 and little education is available for both young college students and military members. This research uses the Joanna Briggs Institute's (JBI) Mixed Method Systematic Review (MMSR) approach to examine literature published after 2013 regarding sex and sexual assault education for young adults. We find that people ages 17-28 are seeking comprehensive sex education that transcends the traditional focus on sexual assault prevention seen on college campuses and military installations. Adults want to be educated on topics regarding sex, sexuality, and reproduction, which is vital to leadership in any industry, especially the military. Recommendations include targeted comprehensive sex education for college students and young military members.

Progress Toward the Synthesis of Fluorinated Antimalarial Analogs of Amodiaquine

Kinsey Clark
Dr. Habiba Vaghoo, Faculty Mentor
Colorado College

The malaria parasite *P. falciparum* is a threat to millions worldwide, but resistance to the drugs used to treat is increasing. Amodiaquine and its analogs have been pursued as alternative antimalarial drugs due to its antimalarial activity against resistant strains, but it metabolizes into a toxic quinoneimine. It was hypothesized that this in vivo biproduct could be prevented with a substitution of the hydroxyl moiety with a difluoromethyl moiety. Fluorine's unique properties in pharmaceuticals has led to its addition to an increasing number of new pharmaceutical compounds, and its use in this research has the potential to be an effective and safer new antimalarial. This research successfully prepared two fluorinated analogs of Amodiaquine with purity above 95% using a two-step synthesis involving reducing a (difluoromethyl)nitrobenzene to an aniline which is then reacted with a quinoline compound. Further biological study of the compounds will be necessary to test the antimalaria activity, as well as the synthesis of similar compounds with the addition of side chains to the ring of the aniline component.

CRISPR-induced floral gene mutation as a means for genetic containment in poplar

Hazel Coon, Eleanor Hardwick, Zachary Leach
Steven Strauss, Amy Klocko, Cathleen Ma, Lisa Hargest, Amanda Goddard, Estafania Elorriaga, Faculty Mentors
University of Colordao Colorado Springs

Genetic engineering can be used to create new and improved varieties of trees with useful novel traits such as insect and disease resistance. However, adding traits via new genes is genetic modification and the use of such organisms is regulated and controversial. A main concern is the risk of genes moving. In the case of poplar trees, our species of interest, pollen can move long distances and release genetically modified material into the environment via breeding with wild trees. However, it is possible to prevent gene flow by containment approaches. Developing efficient and reliable genetic containment strategies is crucial for the safe use of transgenic trees.. Our goal is to utilize CRISPR-Cas9 technology as a possible approach to mitigate this gene flow. CRISPR-Cas9 editing can be used to make changes to genes of interest. Our research focuses on changing two key floral genes *AGAMOUS (AG)* and *LEAFY (LFY)*. Changes to these genes typically results in sterility. The research aims to assess the stability and efficacy of these mutations over time. The experimental plan is comprehensive analysis of 360 CRISPR-modified poplar trees planted in the field. We are focusing on characterizing genetic changes to targeted genes, analyzing floral form and fertility, and assessing overall tree performance. Trees were planted in 2017 and 2019, providing us with several years of growth data, trees are just now reaching maturity. By addressing important ecological and regulatory concerns, this research aims to provide a comprehensive understanding of CRISPR-Cas application in tree genetics.

Keywords: CRISPR; *AGAMOUS*; *LEAFY*; Poplar trees; floral development; genetic containment

Balancing Act:
A scoping review of Mental Wellness Interventions for College Student Athletes Balancing the Challenges of Sport and Academics

Sarah Cooper
Dr. Jess Kirby, Faculty Mentor
University of Colorado Colorado Springs

College student-athletes face the distinct challenge of balancing the demands of their sport with a full-time academic course load. In addition, they face the developmental tasks of emerging adulthood, including establishing personal identity, core values, relationships, and health behaviors. With the weight of these responsibilities, it should come as no surprise that these student-athletes are at risk of experiencing stress, overwhelm, exhaustion, burnout, depression, anxiety, and loneliness. It is essential that college student-athletes are equipped with the mental wellness skills to manage these challenges and build resilience. The purpose of this scoping review was to identify and synthesize the current literature on interventions for improving mental wellness in college student-athletes in the United States. A systematic search of 6 databases yielded 7,333 results from the past 20 years. A total of 65 intervention studies were retained for full review. These interventions focused on topics such as mental skills training, mindfulness, emotional regulation, resilience, body image, and mental health. The results of this review, along with identified gaps in the research and recommendations for future interventions to support college student-athletes will be presented.

Exploring Decision Reversibility Through College Grade Track Changes

Basimah B. Curry
Dr. Tomi-Ann Roberts, Mentor
Colorado College

The pass/fail grading system has been praised for its ability to reduce stress and anxiety among students. However, research on affective forecasting and decision-making processes suggests that the timing of students' decisions about grade tracks may complicate this benefit for some student groups. The current study examined this question among college undergraduates, who were presented with two different hypothetical scenarios about their grade track decision: one irreversible (an early deadline to decide) and one reversible (a later deadline to decide). Students were also asked about their real experiences with taking a course on the pass/fail track. Results were mixed, and revealed that the experimental manipulation did not impact students' reasoning as predicted. Students' felt-regret increased and felt-relief decreased over choosing the pass/fail grade track in an actual course from before to after final grades were released. Gender and race differences were found in Perfectionism and Academic Motivation. Female students and students higher in Perfectionism had significantly more regret and were less satisfied overall with having chosen the pass/fail track in an actual course than others. The timing of switching one's grade track (early versus later in the course) had no significant impact on regret, relief or satisfaction with taking a class pass/fail. All students indicated preferring a later to an earlier deadline for choosing their grade track. Educating students about affective forecasting and decision-stress in the context of their own identities and traits may enable them to make better grade track decisions for their wellbeing in college.

Keywords: Regret, Pass/Fail, Perfectionism, Decision-Making, Reversibility

Impacts of Alaskan Commercial Fishing on Natives

Emma Dahl
James Baginski, Faculty Mentor
University of Colorado Colorado Springs

My name is Emma Dahl and I am a current student at UCCS. I am choosing to present at CSURF for a class final project in Dr. James Baginski's class on Recreation, Tourism, and the Environment. With the aid of Dr. Baginski, I will be presenting on the impacts of commercial fishing on native communities. I will also be working on this project with my classmate, Maddie Ruszkiewicz, but she will just be helping in the research process, and I will be presenting alone. The format that I chose for this project was to use a poster and give a short 5-10 minute talk. About the actual content itself, I will be talking about the impacts of commercial fishing industries off the Alaskan coast. I will be deep diving into the impact on native communities that still rely on traditional practices of fishing as a food source and how they are impacted by these large fishing corporations. The Alaskan economy is extremely dependent on the seafood industry, being the most prolific in the United States. The fishing industry, including the entire extraction, processing, transportation and sale, provides millions of dollars and jobs to the state. But the problem is that these big corporations take away from the supply for native communities off the coast. Choosing to have a more subsistent life and living off the land that aligns with their traditions and ancestral values, they also rely on catching fish to feed themselves and their families. Overall, the project will cover the economic and social impacts of this large scale fishing and what we can do to preserve resources for the native communities.

Measurement of Isotope/Isomer Shifts of Radioactive Xenon

Finn Dallas, Jason Booker, Dakota Biggerstaff, Zachary Aster
James Scoville, Jerry Sell, Monte Anderson, Michael Shaffer, Randy Knize, Faculty Mentors
United States Air Force Academy

We report on the experimental progress to measure the isotope energy level shifts for the 882 nm 6s 3/2 $[3/2]_2 \rightarrow$ 6p 3/2 $[5/2]_3$ transition for both stable xenon isotopes as well as four radioisotopes commonly used in nuclear nonproliferation monitoring: ^{131m}Xe, ^{133}Xe, ^{133m}Xe, and ^{135}Xe. **The isotope/isomer shifts of stable Xenon are well reported, but the relative shifts of xenon radioisotopes are undocumented.** We perform these measurements by exciting xenon to a metastable state using a magneto optical trap (MOT) and use the MOT fluorescence imagery to determine the relative amount of trapped atoms as a function of laser frequency. The relative abundance of trapped atoms at specific frequencies give insight to their isotope/isomer shift and hyperfine splitting, thus allowing them to be traced at sensitivities of one part in 10^{25} atoms for purposes of nuclear nonproliferation monitoring.

40 Years of Changing Lipid Accumulation by *Euxoa* Moths at High Elevation

Audrey Fahland, Alli Deist, Aria Kelly
Emily Mooney, Faculty Mentor
University of Colorado Colorado Springs

Our objective was to track changes in lipid storage over a 40-year period through two species of Lepidoptera. Army cutworm moths (*Euxoa auxiliaris)* are migratory and move from the plains in the spring, to high elevations in the summer to feed on floral nectar of white flowers in the Rocky Mountains. Oregon Darts (*Euxoa lewisi)* are non-migratory moths who are also found feeding on nectar from white flowers at high elevations. We repeated sampling of moths in 2021, 2022, and 2023 at Pennsylvania Mountain, Colorado following protocols performed from 1978 through 1980. The non-migratory Oregon dart moth (*E. lewisi*) showed no significant change in lipid accumulation. However, we observed that the migratory army cutworm moth (*E. auxiliaris*) no longer accumulates lipids while feeding at high elevation (Ordinal Date*Study Year: $F = 8.550$, $P < 0.001$). These findings suggest a potential impact on the migration of *E. auxiliaris,* as fewer moths complete their migration journeys back to the plains to reproduce. This has the potential to affect both crops in the plains, where the army cutworm is considered a pest, and high elevation ecosystems, where the moths serve as important pollinators and a food source to bird and mammal populations.

Impact of Coming Out Experiences on Attachment, Moderated by Perceived Peer Support

Isabella Hageman
Dr. Margaret Kneuer, Faculty Mentor
Colorado College

Attachment styles, while typically unchanging throughout life, may be influenced throughout adolescence and into adulthood if a lesbian, gay, or bisexual (LGB) individual experiences a positive or negative interpersonal event that modifies their internal working models. The coming out experience is an example of an interpersonal event that can effect a person's attachment. Negative interpersonal events can change a secure attachment into an insecure one, and those with insecure attachments report less positive relationship evaluations and poorer mental health (Mohr et al., 2013; Zhang et al., 2022). However, research suggests that a more supportive culture in which there are higher levels of familial and peer support may be able to increase relationship satisfaction and improve mental health (Terrell & Dugger, 2018). The purpose of this study was to examine the correlation between parental reactions to coming out and attachment as well as the moderating effect of friend support on the relationship between familial support and attachment. Participants completed a survey assessing their coming out experience, their attachment style, and their perceived level of social support (familial and peer support). Negative reactions from a mother and positive reactions from a father are correlated with attachment. Peer support had a moderating effect on the relationship between familial support and attachment avoidance. It is clear that familial and peer support impact attachment; future research should examine what aspects of peer support have the most moderating effect on attachment in LGB individuals.

The Role of ebsA in Nostoc punctiforme Hormogonia and Motility

Aya Hassan, **Khoa Nguyen, Ethank Heflen**
Douglas Risser, Faculty Mentor
University of Colorado Colorado Springs

Nostoc punctiforme is a species of cyanobacteria known for its ability to fix nitrogen. This capability enables *N. punctiforme* to establish nitrogen-fixing symbioses with eukaryotes. *N. punctiforme* consists of vegetative filaments that give rise to three distinct cell types: akinetes, heterocyst, and hormogonia. Hormogonia are specialized motile filaments produced by certain cyanobacteria that enable movement across surfaces. This movement is advantageous because it allows the organism to navigate towards optimal light condition for photosynthesis or towards a plant partner with which it may have a symbiotic relationship. The production of a hormogonium-specific polysaccharide is associated with motility. Cyanobacteria utilize a common motor, the type IV pilus, to power motility. EbsA has been shown to be an essential component of the type IV pilus system in unicellular cyanobacteria. To determine its role in *N. punciforme*, the ortholog of *ebsA* was deleted. The D*ebsA* strain was non-motile but still produced filaments with hormogonium morphology. The mutant strain also failed to produce hormogonium polysaccharide or type IV pili on the cell surface. These results are similar to those seen for another T4P mutant strain of *N. punctiforme*, and thus indicates that *ebsA* is critical for T4P function in *N. punctiforme* like in unicellular cyanobacteria.

Maybe We Can Laugh It Out: Investigating the Impact of Laughter Through Memory on Constructive Conflict Resolution in Romantic Relationships

Riley Hester
Dr. Margaret Kneuer, Faculty Members
Colorado College

The present study investigated the impact of various memories related to laughter on the adoption of relationship maintenance strategies in romantic relationships after completing a conflict writing task. Participants were asked to first reflect on a recent conflict with their partner and were then immediately asked to reminisce on either a memory of independent laughter, shared laughter, or a shared positive experience with their partner. Participants then responded to three different questionnaires assessing measures of accommodation, compromise, and willingness to sacrifice in response to the conflict with their partner from the beginning of the survey. Results displayed no significant mean differences in dependent variable measures between each of the three memory conditions. Further directions including a dyadic research design as well as the assessment of potential mediating effects are discussed.

Mitigating Sevoflurane-Induced Postoperative Cognitive Dysfunction (POCD): Pharmacological and Clinical Interventions

Jack Higgins
Dr. Lori Driscoll, Faculty Mentor
Colorado College

Commonly utilized in major surgeries, inhalational general anesthetics have unclear pharmacological mechanisms of action, and recently their safety has come into question. Use of sevoflurane, the most frequently administered inhalational anesthetic, is positively correlated with symptoms presented in postoperative cognitive dysfunction (POCD), particularly in patients over 65 years of age. Similarly, sevoflurane impairs cognitive function and decreases brain derived neurotrophic factor (BDNF) only in aging mice. Older individuals naturally produce lower levels of androgens compared to younger people. Under normal conditions, androgens upregulate proteins responsible for synaptogenesis such as BDNF. Highlighting downstream effects of sevoflurane administration gives insight into the development of therapeutic pharmacological and clinical protocols. For example, synthetic androgen R1881 has been shown to promote increased synaptogenesis in P12 neuronal cells via activation of androgen and protein kinase receptors. Providing androgen supplementation to patients before scheduled surgeries may prevent drastic fluctuations in BDNF levels and neurological functioning post-operation. In addition, ketamine increases levels of BDNF by activating molecular pathways which are inhibited in the presence of sevoflurane. Administration of ketamine pre-operation has been thought to prevent neuroinflammation, but it may also interfere with sevoflurane during the procedure.

Keywords: sevoflurane, BDNF, synaptogenesis, R1881, ketamine

Journey to Belong: Exploring Bangladeshi Immigrant Experiences in New York City for Socioeconomic and Cultural Integration

Rafiul Alam Khan, Mustafa Sameen
Dr. Guanyi Yang, Faculty Mentor
Colorado College

This research project delves into the experiences of Bangladeshi immigrants in New York City, aiming to unravel the factors that contribute to their success or failure in socioeconomic and cultural integration. With focus on the largest Bangladeshi population in the US, the study employs qualitative research methods, including interviews and document analysis. By utilizing purposive and snowball sampling, the research seeks to understand the challenges faced by first and second-generation immigrants and identify the elements influencing their adaptation. The project outlines specific objectives, including the exploration of socioeconomic and cultural backgrounds, identification of challenges during adjustment, and examination of factors like employment opportunities, linguistic barriers, and cultural disparities affecting success or failure. Additionally, the study investigates the role of community groups and support networks, emphasizing the significance of local Bangladeshi businesses and restaurants in the immigrants' experiences. The methodology involves fieldwork in New York City, targeting neighborhoods like Jackson Heights and Jamaica, known for their significant Bangladeshi populations. A set of open-ended questions guides in-depth interviews, capturing personal narratives and perspectives. Analysis will uncover common patterns, while a photo gallery aims to visually represent participants' stories. Anticipated outcomes include valuable insights into the Bangladeshi immigrant

experience, contributing to broader discussions on immigrant success and failure. The research is poised to inform policies, assist community organizations, and enhance cultural understanding. The significance of the project lies in its potential to shape initiatives that improve the lives of immigrants and contribute to a deeper understanding of the dynamics of New York City's diverse communities. The project timeline spans four days, combining fieldwork in New York City with the creation of a documentary and data analysis. The goal is to provide an understanding of Bangladeshi immigrants' experiences in New York and generate information that can guide policies and support systems for immigrant communities.

Characterizing the histone post-translational modification enrichment and genome organization in species of the Ogataea clade

Nickolas Lande
Andrew D. Klocko, Faculty Mentor
University of Colorado Colorado Springs

The DNA of eukaryotic genomes is packaged in the nucleus as chromatin – an association of DNA and proteins that is necessary for the regulation of the genome, including for the control of gene transcription. Chromatin can either be active and open (euchromatin) or silenced and compact (heterochromatin), the latter typically characterized by a lack of histone acetylation in budding yeasts. Recent advances have shown that chromatin composition is a determining factor controlling genomic DNA organization, including how the aggregation of the heterochromatic regions at the nuclear periphery that segregates euchromatin to the center of the nucleus, is critical for the compaction of fungal genomes into the nucleus. Specifically, the centromeres aggregate independently of the telomere clusters to form a Rabl conformation. However, it is unknown if chromatin composition and genome organization diGer or is conserved in closely related species, including in fungi. To this end, we examined diGerences in histone post-translational modification (PTM) deposition by Chromatin Immunoprecipitationsequencing (ChIP-seq) and genome organization, assessed by chromosome conformation capture coupled with high-throughput sequencing (Hi-C) in two species of yeast in the Ogataea clade. We focused on Ogataea polymorpha, which is typically used for industrial protein production, and the closely related Ogataea haglerorum; the O. haglerorum isolate used in this study was reported to harbor a translocation between chromosomes 1 and 6, relative to O. polymorpha. Here, we will present our preliminary analysis of the speciesspecific diGerences between O. polymorpha and O. haglerorum. Using three activating marks, trimethylation of lysine 4 histone H3 (H3K4me3), the acetylation of lysine 9 on histone H3 (H3K9ac) and the acetylation of lysine 16 on histone H4 (H4K16ac), we show how euchromatic histone PTM deposition diverges between these two closely related species. Further, Hi-C shows that O. polymorpha and O. haglerorum have the clustering of centromeres that is independent from telomere bundles typical of a Rabl chromosome conformation. However, the O. haglerorum translocation impacts genome organization and histone PTM enrichment, with altered H3K4me3, H3K9ac, and H4K16ac deposition at newly formed telomeres in O. haglerorum, highlighting how genome structure and organization impacts chromatin composition.

Investigation of Efficient Shear Support in Short-Span R/UHPC Beams

Cole Landis, Alexis Tri, Elizabeth Decko, Darcy Farrell
Lt. Col Timothy Frank, Captain Peter Amaddio, Faculty Mentors
Unites States Air Force Academy

Ultra high performance concrete (UHPC) is a cementitious material containing a large percentage of cement, and roughly 1-3% by volume of randomly distributed steel fibers. When UHPC is reinforced with longitudinal steel, R/UHPC structural members can develop significantly higher strength for a given cross-sectional area than traditional concrete members. Due to the superior compressive properties of UHPC, larger longitudinal steel reinforcement ratios than commonly used in reinforced concrete lead to more efficient use of both the UHPC and steel materials. The objective of this research is to further explore efficient material usage in R/UHPC beams subjected to high shear demand. Specifically, this study explored various means and methods of providing shear capacity in R/UHPC beams where steel fiber content and longitudinal steel reinforcement ratio were held constant at 0.5% and 3.9%, respectively. Transverse steel spacing, transverse steel grade, and UHPC placement method were varied in seven short-span, small scale R/UHPC beams, which were experimentally tested to failure. Results indicated that traverse steel spacing had the greatest impact on specimen response; closer transverse steel spacing provided sufficient shear capacity to increase ultimate ductility by approximately 51%. Increasing the grade of the transverse steel did not significantly impact response, indicating that the shear force capacity within each transverse reinforcement bar was not a limiting factor on specimen peak strength or ultimate ductility. While some differences in fiber orientation within the R/UHPC beams were observed through destructive testing, the impact of placement method on beam response was negligible. Expanding the results at a larger scale and to longer, more flexurally-dominant beams would be a beneficial follow-on to this study.

Identifying airstrips from aerial imagery using boosted forest-based classification and regression in Python

Camden Larsen
Dr. Justin White, Faculty Mentor
United States Air Force Academy

Our goal was to build a deep learning model that can ingest spatial and landscape data and output locations of potential airstrips. The data used to train the model was terrain elevation and slope, land cover type, aerial imagery in the visible and thermal wavelengths, and road and railway networks. The model uses ESRI operations and is written in Python. We trained the model in North Dakota, USA, but our aim was to write the script such that any location data could be ingested. Model effectiveness was assessed via confusion matrix. Errors of omission were low but commission high. In subsequent work, we will parse apart geographic features that lead to commission and identify which of them could be potential landing site with specific criteria, which should lessen our error of commission and improve the usability of our model.

Non-thermal plasma jet treatment induces and decreases *Escherichia coli* cell growth

Melony Lomeli Ortiz
Dr. Adam Light, Faculty Mentor
Colorado College

In recent years, research interest in non-thermal plasma jet treatment's efficacy against bacterial growth has increased due to its potential applications in wound sterilization and medical equipment sanitation. Non-thermal plasma jet treatment offers an alternative as an environmentally friendly and minimally invasive sterilization method. This study investigated the impact of non-thermal plasma treatment on bacterial growth rates. Two trials were conducted: the first treating agar plates prior to bacterial inoculation, while the second applied plasma after inoculation, aiming to assess the influence of treatment sequence. Three variables, each with two parameters - flow rate (995 and 1995 standard liters per minute (slm)), voltage (5 and 9 kilovolts (kV)), and treatment duration (1 and 3 minutes) - were examined. These variables were randomly combined to create 16 treatment conditions, including control groups without bacteria and those with bacteria only. Additionally, four treatment conditions consisted of varying gas flow and treatment duration without voltage. Results revealed that the highest voltage, treatment duration, and flow rate combination yielded the greatest reduction in bacterial growth, particularly when plasma treatment occurred before bacterial inoculation. Bacterial growth was higher where bacteria were inoculated post-treatment with non-thermal plasma compared to the control.

Universality of the Need for Novelty Across Age Groups: Potential for Inclusion in Basic Psychological Needs Theory

Gina Lynch
John Horner, Faculty Mentor
Colorado College

This paper investigates the strength of novelty as a candidate need within Basic Psychological Needs Theory by testing the universality criterion proposed by Ryan & Deci (2017). In order for a need to be considered a basic psychological need, it should predict the well-being of all individuals, regardless of gender, age, cultural background, or personality differences. While the research currently available has supported novelty's universality claim, there is a gap in the literature when it comes to the potential age differences. The present study sampled adults aged 18-30 and 50-70, and measured their novelty-seeking tendencies alongside their overall well-being. It was found that higher novelty-seeking was significantly correlated with overall well-being, with little difference in the correlation strength between age groups. These findings provide support that the need for novelty is universal across age groups, and therefore support its inclusion as a basic psychological need.

Stable and efficient air processed OPV modules

Natalia Maahs
Bryon Larson, Faculty Mentor
Colorado College

Incorporating more solar technology into existing infrastructure is key to a renewable energy-based future. Organic Photovoltaics (OPVs) are a safe and cheap solar technology which can be applied to currently underutilized areas of energy production such as agriculture, windows, and buildings. OPVs can be printed on a variety of flexible substrates of different sizes and have the appearance of tinted glass. My project showed that semi-transparent OPV modules can be made entirely in ambient laboratory conditions and demonstrate both stability and effectiveness. I scaled up device area without compromising these variables, pointing to the industrial viability of OPVs. I built entirely solution processed modules with 14 cells and total active area of 10.92 cm2. These modules had 3.35% Power Conversion Efficiency (PCE) and 45% Fill Factor (FF). I investigated how devices could be encapsulated without reducing their long-term performance and determined that encapsulation was harming devices by trapping residual solvent in the device stack. I found that a 120C annealing temperature eliminated this reduction in performance. These results were consistent with extended light exposure stress testing. A device annealed at 120C and encapsulated showed stability when stressed under light for 64 hours. This project addressed the practical requirements of OPV devices in agricultural applications by developing large-area modules which were effective and stable under extended light and heat exposure.

Are learning assistants the hidden x factor in teaching General Chemistry?

Kailene Black, Jake Marcotte, Joey Wagoner
David J. Weiss and Patrick McGuire, Faculty Mentors
University of Colorado Colorado Springs

We are focused on approaches to improve the DFW rates in our General Chemistry courses, and the factors that affect students in our courses postpandemic. We've noticed that the DFW rates in our department fluctuate by faculty member and semester. For example, one professor may have 60% DFWs, while another has 10% with the same material in the same semester. In addition, the persistence rate of students in our courses can fluctuate between 71% and 91% of students continuing to the next semester of courses. Our campus values the persistence and retention of students to move them towards graduation. Considering our DFW and persistence rates, we've recently instituted learning assistants (LAs) in one section of General Chemistry. In this presentation, we compare multiple semesters of General Chemistry courses, including control and LA sections, using surveys and performance analysis- focusing on five questions: 1) Does a section with LAs perform better than one without, with the same instructor in the same semester, 2) What are the largest factors that affect active learning and student performance (i.e. campus help center vs. LA use), 3) What is the sense of belonging for students in the control vs. LA section, 4) Is there a difference in self-efficacy in the control vs. LA section, and 5) Do students' sense of belonging and performance change as a function of military affiliation or minority status of our students. We use in-class student surveys, and data of students using the campus tutoring center, also student performance data in the course to determine if LAs make a difference in student belonging, performance, DFWs and persistence rates. Our initial data indicates that one-on-one help makes the most impact in our lectures, in terms of student performance, whether they receive it from learning assistants, or from the campus tutoring center.

Thomas Moran: America's First National Park Influencer (working title)

Kim Carlson, Nick Marsh
Dr. James Baginski, Faculty Mentor
University of Colorado Colorado Springs

The purpose of this project is to portray the importance of early artists in the expansion of popularity of the National Parks. This increase in popularity was largely in part due to Thomas Moran's breathtaking paintings of never-before-seen wonderlands of the west which railroad, and tourism industries were quick to capitalize on. Our poster will be comprised of some of Moran's most famous compositions and the effects of this early form of advertisement today. It will also include descriptions of Moran's journeys to the west and will show the vantage points of some of his more famous paintings. Kim and I hope that this poster will be informative as to how the medium of painting was significant to the early expansion and creation of the National Park Service before the advent of photography.

Mass spectrometric analysis of amyloid beta fragmentation after induced oxidative stress

Evelyn M. McBride
Andrea R. Kelley, Faculty Mentor
United States Air Force Academy

Alzheimer's disease is characterized by declining brain function due to the theorized build-up of proteins in the brain. One protein thought to be involved is the amyloid precursor protein and the peptide products of its mis-cleavage. Deposits of amyloid peptides are thought to cause a buildup of sticky substances known as senile plaques within the brain effectively causing neuronal loss and decay leading to deteriorating cognitive ability and memory. A reported mechanism of this involves metal-mediated redox-chemistry. In an effort to elucidate further information about amyloid binding and aggregation within the brain, this project focuses on determining fragmentation patterns of the amyloid beta (1-28) peptide using analytical chemistry techniques. To further understand potential oxidative stress effects, a digested form of the peptide was treated with Zn^{2+}. Each of these peptides were analyzed using MALDI mass spectrometry to determine the fragmented peptide chains and the primary sites of binding.

Sleep's Impact on Marksmanship: A Study of USAFA Rifle Team Performance Across Seasons

Kyle McCarthy, Paige Sullivan, Matthew Flores
Lt Col Chad Tossell, Dr. Christopher McClernon, Maj Matthew Deming, Faculty Mentors
United States Air Force Academy

Sleep and fatigue profoundly influence athlete performance, yet their impact on marksmanship, a military-relevant task, remains understudied. This study aimed to characterize the sleep of a collegiate rifle team and its effects on marksmanship performance. Nine participants from the United States Air Force Academy (USAFA) rifle team completed a series of surveys and wore Oura rings to track their sleep across the fall and spring semester over the 2023/2024 academic year. Performance data were

also captured across their 11-rifle team competition meets in a variety of time zones. Initial results showed participants slept an average of 7.59 ± 1.76 hours daily, with decreased sleep before away meets. Using multiple polynomial regression models, individual shooting performance was predicted by pre-meet sleep, and team performance was linked to overall sleep quality. From the data, we are beginning to see a relationship between decreased sleep and decreased shooting performance. Findings suggest adjusting travel schedules to optimize sleep and performance. However, limitations include sample size and data gaps due to ring wear adherence. This research informs athlete performance strategies and highlights the relevance of sleep in military contexts.

Structure of membrane-bound human 15-lipoxygenase-2

Jamil Nemri
Crystal Vander Zanden, Faculty Mentor
University of Colorado Colorado Springs

15-lipoxygenase-2 (15-LOX-2) protein activity is linked to atherosclerosis because the enzyme plays a role in transforming white blood cells into foam cells, which form plaques in arteries. When 15-LOX-2 binds a membrane, it peroxidizes arachidonic acid, which signals the formation of foam cells. Therefore, understanding the structure of membrane-bound 15-LOX-2 would aid efforts to design effective drugs to inhibit 15-LOX-2 activity and treat heart disease. To determine the structure of membrane-bound 15-LOX-2, liquid surface X-ray reflectivity (XR) measurements were collected from LOX protein bound to a lipid monolayer in a Langmuir trough. XR data were fit to determine a profile of electron density normal to the membrane surface, illustrating the membrane structure and position of the bound protein. Data was collected on a membrane containing 80% 1,2-distearoyl-sn-glycero-3-phosphocholine lipids (DSPC) and 20% 1-stearoyl-2-arachidonoyl-sn-glycero-3-phosphocholine (SAPC), with and without addition of catalytically inactive Mn-bound 15-LOX-2. XR fitting results showed that the protein bound beneath the membrane with an overall length of ~40 Å. These results agree with XR data collected from membrane-bound coral 8R-lipoxygenase, supporting the conserved structure of membrane-bound lipoxygenase proteins. For further confirmation of 15-LOX-2 binding and activity, data was collected from a 100% SAPC membrane with and without catalytically active 15-LOX-2 to detect in situ oxidation of the SAPC membrane. The structure of the oxidized SAPC membrane was compared with a membrane composed of 100% 1-palmitoyl-2-azelaoyl-sn-glycero-3-phosphocholine (PAzePC), which is an oxidized lipid used as a control to emulate the product of 15-LOX-2 peroxidation. The SAPC electron density profile showed distinct changes in membrane structure after 15-LOX-2 interactions and had a similar electron density profile as the PAzePC membrane. Determining the structure of membrane-bound human 15-LOX-2 will allow further research towards developing drugs which can inhibit the activity of the protein, possibly providing treatment options for reduction of arterial plaque formation.

Fighting *Pseudomonas aeruginosa* Wound Infections with an Engineered Skin Microbe

Thomas Newell
J. Jordan Steel, Victoria Morrison, Camilla Mauzy,Kristi McElmurry, Faculty Mentors
United States Air Force Academy

Despite remarkable advances in prevention, wound infections continue to threaten U.S. military members in healthcare and combat settings. Pseudomonas aeruginosa (P. aeruginosa) is a particularly resistant strain of bacteria commonly found in the environment. It can cause infections and even death, which makes finding alternatives to P. aeruginosa antibiotics an urgent matter. Prescribed preventive measures against P. aeruginosa infections are not always feasible in military settings, and they are becoming less effective as the bacteria builds drug resistance. Therefore, this project aims to engineer a skin microbe to prevent infections caused by P. aeruginosa during wound healing. We aim to produce a microbial countermeasure to P. aeruginosa to help prevent and treat wound infections in combat and hospital settings. Our group developed a potential nanobody against FliD, a protein involved in P. aeruginosa motility, and is investigating it to determine whether it attenuates biofilm formation. This project has the potential to deliver a microbial method for fighting P. aeruginosa to improve wound healing in combat and health care environments. It could also set the foundation for producing antibiotic alternatives for other pathogens."

A Second Bacterial Actin System Regulates Cell Morphology in Nostoc punctiforme

Garrett Jenkins, Alicia Nguyen
Douglas Risser, Faculty Mentor
University of Colorado Colorado Springs

Nostoc punctiforme is a filamentous, nitrogen-fixing cyanobacterium that differentiates into three different cell types: hormogonia, akinetes, and heterocysts. When vegetative filaments differentiate into hormogonia, the cells morphologically change from more round to more cylindrical. The Mre system, including the bacterial actin-like protein (BALP) MreB, controls the rod morphology in other species of bacteria, and the Mre system is upregulated in hormogonia. Here, we identify and characterize a pair of genes, designated fcmB and fcmC, that comprise a second system essential for rod morphology in N. punctiforme. The fcmB gene is predicted to encode a BALP that is evolutionarily distinct from MreB, and most closely related to a group of BALPs typically involved in plasmid partitioning. Deletion of fcmB or fcmC resulted in the loss of rod-morphology, similar to the phenotypes reported for other rod complex mutants. Vancomycin-FL labeling indicated a reduction of cell wall synthesis along the length of the filament, also similar to that reported for rod complex mutants. Bacterial two-hybrid analysis demonstrated that FcmB and FcmC interact with each other, but not other rod-complex proteins tested. FcmB-GFP was also found to form filaments that were associated with the membrane. Collectively, these results imply that fcmB and fcmC comprise a discrete system, separate from the rod-complex, that is essential for rod-shaped morphology in N. punctiforme.

Examination of Potential Bias in National Park Designation

Ryan Osborne, Logan Cole
James Baginski, Faculty Mentor
University of Colorado Colorado Springs

The National Park Service (NPS) is a government entity that provides protected status to lands for historical and cultural preservation, recreation, and land conservation. The service is also held responsible for managing a great variety of national and international programs designed to help extend the benefits of natural and cultural resources through out the United States, and the world. There are three criteria listed by the NPS that play into designation. These are as follows: 1. Possesses significant natural, cultural, or recreational resources, 2. Be a suitable and feasible addition to the national park system, 3. Require direct NPS management instead of protection by some other government agency or by the private sector. Given the importance of the NPS in preserving these resources, this paper will explore the motives and biases behind designation National Parks. This is to be done by examining biases towards profitability, such as in Yosemite National Park where damage is being ignored in the name of said profit, as well as geographical, political, and cultural biases that may play into designation by using GIS, statistical, and informational analysis.

Temperature Effects on Vanessa cardui Butterfly Development

Joyclyn Reed-Starr
Lisa Hollis-Brown, Faculty Mentor
University of Colorado Colorado Springs

Carry-over effects, where environmental conditions in one life stage affect traits in subsequent stages, may play an important role in shaping the life history and reproductive success of organisms inhabiting changing environments. These carry-over effects can profoundly influence various aspects of an organism's development, including growth, survival, and reproductive fitness, ultimately shaping the dynamics of populations in response to environmental change. Prior research has emphasized temperature's role in shaping carry-over effects in various insects, such as the effects of temperature on developmental rates, body size, and reproductive output. Painted lady butterflies (Vanessa cardui) are insects found globally, and they inhabit diverse environments ranging from temperate to subtropical regions during their extensive migrations.However, little is known about the the carry-over effects of temperature on the life history of V. cardui. We hypothesized that V. cardui larval rearing temperature would induce carry-over effects in later life stages. We predicted that larvae reared at 24°C would exhibit specific differences compared to those reared at 29°C, in length of larval and pupal stages, and in adult lifespan. To assess these predictions,V. cardui larvae were reared in incubators set to either 24°C or 29°C. All individuals were then maintained at 24°C from the pupal to the adult stages. Throughout their development, individuals were subjected to consistent environmental conditions, including standardized diet compositions, habitat structures, and lighting regimes. The analysis of larvae reared under different temperatures revealed significant differences in several key life history traits, including the duration of the larval stage, pupal development period, and adult lifespan. Significantly, female V. cardui demonstrated notable responses in contrast to their male counterparts, highlighting the potential of temperature-induced sex-specific carry-over effects in V. cardui. Our study focused primarily on female responses, recognizing their pivotal role in reproduction and population dynamics. Our results support the hypothesis that rearing temperatures elicit pronounced carry-over effects in female V. cardui butterflies. These results emphasize the critical importance of acknowledging

temperature-mediated carry-over effects in insect populations, especially given concerns about global warming and the declining insect populations.

Poetry in the Desert Southwest: Explorations of Creativity, Discomfort, and Heat

Kristen Richards
Brandon Shimoda, Faculty Mentor
Colorado College

During the summer of 2023, I received a writing grant through Colorado College for a project I proposed focused on the impact of desert landscapes on the creation of poetry. Throughout this six-week project, I traveled through Colorado, Utah, and Arizona, spending nearly all of my waking hours writing poetry about my growing connection with the natural world. The research and understanding that emerged from experiences writing poetry in these places culminated in a heightened interest in the desert, and more specifically, the impact that unbearable desert heat had on the production of writing. My initial project proposed questions surrounding what my poetry was avoiding, what I was scared of regarding my writing, and how experiences in the desert southwest could help me begin to find answers. Spending time alone in the desert heat completely changed my view of how writers, especially poets, can utilize the more uncomfortable aspects of the natural world as inspiration for their work. The physical discomfort of being entirely outdoors in the 100 degree weather allowed and challenged me to lean into discomfort within my poetry. My writing evolved to challenge the meaning to “desert,” both physically and metaphorically, and the majority of my poetry during this time relied heavily on desert imagery and the feelings evoked from the fascinating and humbling landscape. The major outcome of this project was a full-length poetry collection, a book titled “The Desert is a Woman Too” published by Indie Earth Publishing. This book outlines much of my experience during this initial project. Not only a product of this research, “The Desert is a Woman Too” is a poetry collection that documents the journey and evolution of my understanding and respect for the desert landscapes I traveled through.

Analyzing Heavy Metal Contaminants in Monument Creek

Ethan Rothschild, Rebecca Willner
Dr. Murphy Brasuel, Faculty Mentor
Colorado College

In the realm of environmental chemistry, the measurement of heavy metal content holds paramount importance due to its potential impact on ecosystems and human health. This research project focuses on investigating the heavy metal content in Monument Creek, situated adjacent to the Colorado College campus, employing Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Monument Creek serves as a vital water source for the local community and sustains a diverse ecosystem. However, concerns regarding the accumulation of heavy metals, originating from industrial processes, urban runoff, and other anthropogenic activities, necessitate thorough examination. ICP-OES stands as a powerful analytical technique capable of detecting and quantifying trace levels of various elements, including heavy metals, with high sensitivity and precision. Through this project, we aim to assess the current state of heavy metal contamination in Monument Creek, providing valuable insights for environmental conservation efforts and raising awareness about the importance of water quality monitoring in our community. We sought to test the concentrations of cadmium, lead, arsenic,

and selenium in the water, four common heavy metal pollutants that all pose significant environmental and health risks.

Commercial Fishing Effects on Local Alaskan Communities

Emma Dahl, Maddie Ruszkiewicz
Dr. James Baginski, Faculty Mentor
University of Colorado Colorado Springs

In this project, we will be researching the impacts of commercial fishing industries off the Alaskan coast. We will be deep diving into the impact on native communities that still rely on traditional practices of fishing as a food source and how they are impacted by these large fishing corporations. The Alaskan economy is extremely dependent on the seafood industry, being the most prolific in the United States. The fishing industry, including the entire extraction, processing, transportation and sale, provides millions of dollars to the state, and additionally provides jobs for Alaskan citizens. So economically, this practice of overfishing is beneficial to the Alaskan population. However, the problem is that these big corporations take away from the supply for native communities off the coast. Choosing to have a more subsistent life and living off the land that aligns with their traditions and ancestral values, they also rely on catching fish to feed themselves and their families. In a recent episode of National Geographic's "Life Below Zero: First Alaskans", native Alaskan Ricko Dewilde described the phenomena by saying it is an "untenable living situation". The overfishing of Alaskan salmon and other fish by large companies has almost completely wiped out the native food source. Overall, the project will cover the economic and social impacts of this large scale fishing and what we can do to preserve resources for the native communities.

Integrating more real data into Calculus I courses

Tiia Shea
David Brown, Faculty Mentor
Colorado College

How can students be motivated to invest in their own learning? This research addresses the lack of real-world data in pure math curricula by adapting the maximum likelihood estimation method for usage in a Calculus I class. This is achieved through the creation of a small MLE-based calculus module. Maximum likelihood estimation (MLE) is a statistical procedure used to estimate the parameter(s) of a probability distribution that best describes a data set. By using optimization of single-variable equations, MLE can be used to bring more real data into math classrooms. Results of module implementation at Colorado College primarily show that students' perceptions about math applicability (where and how math can be useful in the real-world) and self-efficacy improved. Work in mathematics education is crucial to improving math curricula and making mathematics more applicable and accessible to all students.

Excited State Dynamics in Gold(I) N-Heterocyclic Carbene Complexes

Mikhail Stiffler, Nathaniel Srode
Ethan Holt and Kimberly de La Harpe, Faculty Mentors
United States Air Force Academy

Due to their tailorable emission properties, gold(I) complexes are exciting options for OLEDs and non-linear optical materials. This is in part due to their long triplet lifetimes, high intersystem crossing yields, low fluorescence quantum yields, and broad transient absorption spectrums. In collaboration with the Air Force Research Laboratory and Case Western Reserve University, the photophysical properties of two gold(I) complexes bearing electron-releasing diphenylamino and electron accepting 2,6-diisopropoylphenyl, and triphosphine ligands were studied. Both molecules exhibited room-temperature phosphorescence, and intersystem crossing quantum yields above 50%, as well as triplet lifetimes ranging from 400-500us. Observation of these qualities warrant further molecule characterization. Results show evidence of triplet-triplet annihilation. The triplet-triplet annihilation competes with thermally activated delayed fluorescence as the dominant decay pathway from the triplet state. Competition is caused by close proximity in energy of fluorescence and phosphorescence peaks. To better understand the competing decay pathways of triplet states in these molecules, the excited state dynamics were studied through energy-dependent delayed fluorescence and time-dependent triplet decay measurements. Initial results indicate that decay from the triplet state occurs as a primarily two photon process. When collecting the emission data for delayed fluorescence the data also includes emissions due to phosphorescence. Most of the emission data between the two types are separated, but there is still significant overlap between the two such that, without taking into account the overlap, the measured quantum yield is affected. To combat this, we will present a method of deconvoluting the data to separate the emissions due to delayed fluorescence and phosphorescence.

Streamlined Air Force Flight Scheduling: Implementing an Automated Method for an Instructor Pilot Assignment Problem

Elizabeth Deards, Grace Sublette, Noah Wentworth,
Brian Lemay, John Miller, Faculty Mentors
United States Air Force Academy Operations Research Program

Each day of pilot training at Laughlin Air Force Base (AFB), Texas involves approximately 140 training flights. Creating a one-day schedule of flights for both instructors and students takes 12 hours of manual work by a team of two instructor pilots who also fly regularly. To reduce this scheduling workload while efficiently satisfying training syllabus requirements, we developed an automated scheduling algorithm capable of generating a daily flying schedule to assign the instructor pilots to the 140 flights in approximately 5 minutes while continuing to meet training syllabus requirements. This saves a total of 40 work-hours per week. Furthermore, we designed a user-friendly interface, aiming to ensure the program's continued use despite the regular turnover of personnel observed in military organizations like the 47th Flying Training Wing. Our work can be leveraged at other Air Force pilot training bases saving similar time and resources and refocusing pilots' efforts towards flying.

The Potential Moderating Role of Sleep Disturbances on the Association between Childhood Trauma and Substance Use

Alyssa Trujillo
Colin T. Mahoney, Ph.D., Faculty Mentor
University of Colorado Colorado Springs

A history of childhood trauma, including physical and sexual abuse, and current substance use are highly prevalent among college students. Sleep disturbances, including both insomnia and hypersomnia, are also relevant in this population as they are both a consequence of traumatic experiences in childhood as well as an antecedent of use for some psychoactive substances (e.g., stimulants, opioids, cannabis) to alleviate sleep-related problems. The self-medication hypothesis may provide somewhat of an explanation for these connections, suggesting that individuals engage in substance use to suppress or reduce unwanted emotions or cognitions. The current study aims to examine the conditional effect of childhood trauma and on substance use contingent upon the moderator of sleep disturbances among college students. A sample of undergraduate students completed a battery of measures to determine childhood trauma history, posttraumatic stress disorder (PTSD) symptoms, sleep disturbances, and substance use. It was hypothesized that childhood trauma survivors with more sleep disturbances will engage in significantly more problematic substance use. Further, it was hypothesized that college students who have experienced childhood trauma will be significantly more likely to have sleep disturbances and engage in problematic substance use than those without a history of childhood trauma. Preliminary data was analyzed using correlation analysis; Childhood trauma exposure was significantly positively related to PTSD symptoms (r = .52, p = .01) and sleep disturbances (r = .43, p = .01). PTSD was also significantly positively related to sleep disturbances (r = .60 , p < .001). Both alcohol and cannabis use severity were not significantly related to childhood trauma, PTSD symptoms, or sleep problems. Our results indicate that exposure to childhood trauma increases the risk of PTSD symptoms and sleep problems.

Nanomagnet shape dependence on the ferromagnetic resonance of artificial spin ices

Varun Vanga
Ezio Iacocca, Faculty Mentor
University of Colorado Colorado Springs

An artificial spin ice (ASI) is a magnetic system that involves a lattice of many magnetic elements of nanoscopic dimensions. ASIs have applications as microwave devices and fundamental elements for unconventional computing. These elements typically have the shape of stadia: a rectangle capped with two semicircles. Although this geometry is frequently used in both experiments and simulations of ASIs, it is not known how variations of this shape affect their use in applications. The goal of this project is to numerically study how the change of shape impacts the ferromagnetic resonance frequency and modes in ASIs. The change in shape is characterized by considering elliptical caps with a varying major axis. We introduce a parameter P that quantifies the smooth transition from a perfect rectangle (P = 0) to a perfect ellipse (P=1). Numerical simulations for a single element show two modes: a bulk mode situated in the middle of the element and an edge mode. The frequency of the bulk mode decreased at a constant rate as a function of P. In contrast. the frequency of the edge mode decreased until it approached P = 0.45 where it became non-existent, and then increased in frequency until a maximum at P = 1. Similar behavior was observed for ASIs, where the main difference was that the edge mode

was always present due to the coupling between islands. Regardless, the edge mode frequency variation was found to be over 1 GHz. These results demonstrate that ASIs predominantly exhibit a distribution of frequencies for the edge mode that are correlated with the quality of fabrication.

Investigating Supersonic Flow Using Linear Array Focused Laser Differential Interferometry and Computational Fluid Dynamics

Shelby Wood and Avery Simer
Lt Col James Bowers, Faculty Mentor
United States Air Force Academy

Current experimental techniques for measuring local three-dimensional fluid flow fields rely on sensors that disrupt or alter the flow, which is disadvantageous for research and evaluation. Schlieren imaging can provide a two-dimensional visualization of fluid flow using density variations, but it is limited by its lack of ability to extrapolate three-dimensional velocities. This research is utilizing Linear Array Focused Laser Differential Interferometry (LA-FLDI) and Computational Fluid Dynamics (CFD) to locate and assess different point properties in supersonic flow coming from an axisymmetric converging/diverging nozzle and a complex geometry nozzle. LA-FLDI is a non-intrusive measurement technique that utilizes laser interference patterns to extract flow velocities. CFD is used to numerically model flow conditions to provide a comparison for experimental data for method verification and validation. These results will allow for non-intrusive 3D measurements using novel methods.

A Feminist Perspective on Parasocial Romance Relationships in Gaming

Cerella Zhao
Tomi-Ann Roberts, Faculty Mentor
Colorado College

This study explores the phenomenon of *Otome* video games and their role in facilitating alternative forms of romantic and sexual fulfillment for women within a digital space, distinct from the challenges of real-world heterosexual dating marked by sexual objectification and disempowerment. Through an online survey of 202 self-identified female participants, we examined their experiences of sexual self-esteem, self-objectification, enjoyment of sexualization, and empowerment within both real and virtual contexts. Our findings reveal that female players of *Otome* games perceive their virtual characters as having higher sexual self-esteem, greater enjoyment of sexualization, and more endorsement of sexually objectifying behaviors and beliefs compared to their real-life selves. Additionally, motivations for engaging in *Otome* games and the level of immersion in game characters were significant predictors of these virtual self-attitudes. Contrary to our predictions, empowerment did not significantly differ between real and virtual lives, nor did it vary based on game engagement motivation or character immersion levels. This study contributes to the understanding of digital romantic engagement as a potential space for self-exploration, identity affirmation, and empowerment, challenging the narrative that women engage in digital romance because they are lonely or bereft of real life romance options.
Keywords: Parasocial relationship, *Otome* games, digital romance, sexual self-esteem, self-objectification, empowerment, immersion, virtual relationships, female gamers

Oral Session 3

Human Impact and the Natural World

Dwire Hall 106

Selection of Day-Roost Habitat by Flammulated Owls

Eve Karowe
Brian Linkhart, Faculty Mentor
Colorado College

Flammulated owls (Psiloscops flammeolus) are small insectivorous raptors that breed in ponderosa pine ecosystems in Western North America. These owls depend on old-growth ponderosa pine and Douglas-fir forests for nesting, foraging, and day-roosting habitat. Old-growth pine forests are at risk due to shifting fire regimes and increased anthropogenic disturbance. Understanding how flammulated owls use old-growth forests can help us predict how changes in forest composition may impact flammulated owl communities. Flammulated owl habitat selection has been well documented regarding their foraging and nesting behaviors, but less is known about how they select day-roosting habitat. I sought to address this gap in knowledge by compiling data on the traits of day-roost sites selected by radio-tagged male flammulated owls in the 1980s and 2020s. I examined patterns in roost habitat use across three spatial scales: (1) the stand of trees in which roosts were located, (2) the roost tree proper, and (3) the perch the owl selected. I then assessed habitat selections by comparing roost sites to available but unused sites. Understanding characteristics of day-roosting habitat can help us predict how the loss of old-growth forests in the American West may impact flammulated owl habitat selection, influencing conservation and management strategies for the species. My results suggest that at each spatial scale, flammulated owls primarily selected traits that maximized the amount of foliage cover surrounding the roost. Additionally, results suggest that while flammulated owls do rely on ponderosa pines and Douglas-firs for day-roosting, they may rely more heavily on mature rather than old-growth trees.

History of Cave Exploration in Colorado Springs

Braxton Fuller
Professor Davillo-Martinez, Senior Instructor Roy Jo Sartin, Faculty Mentors
University of Colorado Colorado Springs

The Williams Canyon Project is a multidisciplinary scientific endeavor devoted to the exploration of karst in Williams Canyon. It is a National Speleological Society associated project that operates in coordination with Cave of the Winds and local cave exploration clubs. It has met with wonderful success over the last four decades and continues to discover, conserve, and educate the public about caves

local to Colorado Springs. This presentation will cover the history of an extremely important discovery in the 1990s and the subsequent impact it had on the structure of the Williams Canyon Project. The Mammoth Extension of the Huccacove Cave system was at once a celebrated discovery as well as a colossal issue for the local caving community. A significant fight emerged over who would map, conserve, and protect the new discovery. This fight led to the restructuring of the entire project into what it is today as well as brought the WCP to the brink of collapse.

Impacts of Human Disturbance and Interspecific Relationships on Carnivore Habitat Use in the Manitou Experimental Forest, Colorado

Isabel DeVito
Brian Linkhart, Faculty Mentor
Colorado College

Diverse carnivore communities are important in maintaining top-down controls on ecosystem function, so understanding factors influencing carnivore movement behavior is crucial for effective conservation. Both human activities and interspecific competition or predation by other carnivore species can impact habitat use and activity patterns of carnivores, and sometimes result in spatial or temporal avoidance of dominant carnivores or human disturbances. Research at the carnivore guild level in Colorado is limited, and no previous carnivore studies exist for the Manitou Experimental Forest (MEF). I used camera trapping to understand carnivore community composition and investigate the following research questions: does human disturbance impact carnivore habitat use, and do subordinate carnivore species spatially or temporally avoid dominant carnivores? Overall, human road disturbance did not negatively impact carnivore habitat use, although there was a trend of lower puma habitat use at higher road disturbance. Gray fox habitat use was negatively related to residential disturbance while red fox habitat use was significantly positively related to residential disturbance. There was generally little evidence of interspecific avoidance among carnivore species except among canines, which exhibit some level of temporal segregation between foxes and coyotes. I also provide preliminary evidence of mesocarnivores avoiding pumas at the seasonal scale, but more research is necessary to investigate this potential behavior. I found positive spatial association between coyote and bobcat and between striped skunk and several larger mesocarnivores. I also found evidence that red fox may be following pumas in order to scavenge carrion. My research suggests that MEF carnivore temporal and spatial coexistence is high, which may be facilitated by dietary partitioning. The relatively low levels of human disturbance in the forest do not appear to disrupt habitat use patterns for most species, indicating that low-density exurban development can represent suitable habitat for many carnivores in the Pikes Peak region.

Determining the Impact of Perfluorinated Compounds on Microbial Species Diversity

Halie A. Martin
Clayton Hull-Crew, Wendy Haggren, and Andrew D. Klocko, Faculty Mentors
University of Colorado Colorado Springs

Perfluorinated Compounds (PFCs) are chemicals characterized by multiple extremely strong carbon-fluorine bonds that convey lipophobic and hydrophobic properties to industrial products. PFCs are used in a wide range of products from fire extinguishers and waterproof clothing to food wrappers and non-

stick pans. Due to its prevalence within many industries, PFCs have extensively accumulated within the environment. Currently, there is no efficient way to clean PFCs from soil and water sources after sites are contaminated. This poses a health risk to the human population surrounding contaminated areas, as PFCs can bioaccumulate in the body and can cause adverse health effects. In fact, increased cancer rates have been well documented in PFC contaminated regions. In Colorado Springs, Colorado, the release of fire retardants into the Fountain Creek Watershed has caused documented PFC contamination requiring the urgent development of remediation strategies. Thus, there is a critical need for remediating acute PFC contamination from our local environment. Unfortunately, current methods for PFC removal are expensive and energetically costly. However, microbes (fungi or bacteria) found in PFC contaminated environments hypothetically would have developed biochemical pathways that metabolize PFCs into nontoxic byproducts. To identify microbes that potentially could bioremediate PFCs, we are comparing the fungal and bacterial communities of collected soil samples from areas with presumed clean and known PFCs contamination. By examining the microbiome diversity, we may identify a particular microbial genus that thrives in PFC contaminated areas that could be used for bioremediation. We present our characterization of fungal and bacterial community diversity in PFC contaminated soil.

Social Application of Modeling & Networks

Dwire Hall 112

Analyzing Stability of Competition Dynamics Between Melanoma Cells and an Immunotherapy-induced Response

Jane Santamore, Taylor McManus
Dr. Maila Hallare, Faculty Mentor
United States Air Force Academy

Melanoma is a highly aggressive cancer with a potential to spread rapidly. Immunotherapy is an applicable form of treatment designed to enhance the immune system in destroying these cells and preventing their spread. In this study, a mathematical model of seven nonlinear differential equations that simulate the body's immune response against melanomas was analyzed. Specifically, the response is induced by the combined treatment administration of activated OT1 CTLs and immunostimulatory monoclonal antibodies. The mathematical structure of the model is built on two compartments: the injection point compartment, where treatment is administered, and the skin compartment, where melanoma cells proliferate and competition between these cells and the immune system occurs. With this model, simulations considering different levels of immunotherapy were developed. Additional stability analyses of some cancer-free equilibria were performed to find parameter values that guarantee its stability. Finally, we perform sensitivity analysis, via a differential technique, to understand how the system varies under different parameter values.

Toward an Anthropology of the Not-Quite-Obsolete: COBOL and the Middle-Aged Infrastructure of Mainframe Maintenance

Seth Boniface
Dr. George Bayuga, Faculty Mentor
University of Colorado Colorado Springs

Popular media approaches to technology often fetishize the cutting-edge. The new, the fancy, and the exciting breakthroughs can contribute to how people imagine their futures. But myopic attention to progress and the perception that “the best” is the only way to understand technology often obscures how “old” technology continues to shape cultural and social life. Implicit in the idea of technological development is the idea of obsolescence, and that new development determinately replaces old technology. In this paper, I argue that this vulgar view of technological development hegemonically erases the continued influence of “old technology” on contemporary life and stifles our understanding of human-technological interaction. My case for analyzing this issue is COBOL, or Common Business Oriented Language, a 60-year-old programming language deemed archaic and dead for decades by mainstream computer programmers and software developers. Despite these declarations, this programming language is alive, and it can still be found abundantly in mainframes for critical public infrastructures. It also possesses a dedicated community of programmers working to maintain and improve the language. Through exploring how the forgotten continues to simultaneously exist with the cutting-edge, I argue that technology can exist outside of the binary of obsolete and modern, persisting in human-built infrastructures where it exists as the “Not-Quite-Obsolete.”

What are the neurosociological foundations of identities and identity-related processes, and how do they relate to cognitive security?

Emily Beale
Richard E. Niemeyer, Faculty Mentor
United States Air Force Academy

This paper aims to bridge the gap between neuroscience and micro-sociology by exploring the relevance of research on the default mode network (DMN) to identity theory. Our argument suggests that the neurological activity patterns of the DMN characterize the biological mechanisms underlying the core concepts and processes of identity theory. By incorporating these biological insights, identity theory's core concepts and arguments are empirically supported, and micro-sociologists gain a deeper understanding of the relationship between the mind, brain, and social structures. Furthermore, this approach opens new avenues for research, including how cognitive attacks that target personal and social identities increase an individual's vulnerability to misinformation, disinformation, and other forms of manipulation.

Cultural Landscapes

Dwire Hall 204

Our "…sacred, immutable duty" to Burn: The Eruptions of Violence, Panic, and Confusion in the Pogroms of 1903-1906

Matthew Reese
Barbara Headle, Faculty Mentor
University of Colorado, Colorado Springs

This presentation analyzes the intense emotions surrounding the anti-Jewish pogroms in the Russian Empire during the Revolution of 1905. Since the eighteenth century, pogroms and other forms of group violence constituted a foundational pillar of Imperial Russian life. These pogroms directed against Jews, revolutionaries, and other minorities often took non-lethal forms and served as tools to reestablish social or political authority. However, in the wave of pogroms that followed Tsar Nicholas II's October Manifesto, the violence had shifted to such a degree that murder was now the order of the day in the eyes of pogromists and in some cases, government authorities. This presentation seeks to examine the changes in pogrom violence as expressions of internalized panic and confusion that originally started with reactionary, ultra-conservative groups but quickly spread to every stratum of Russian society. Further, by using these pogroms and the emotions surrounding them as a heuristic device, one can better understand the political, social, and cultural landscapes of late Tsarist Russia.

A Study of the SS *Suevia*: Language Learning and Intercultural Knowledge Through Historical Translation

Chalfant Conley, Ace Venverloh
Lt Col Rouven Steeves, Faculty Mentor
United States Air Force Academy

Presentations in English and German

As students of German at the U.S. Air Force Academy, we stumbled across an opportunity to contribute to the knowledge of German-American culture in the 1870s. We found the ship's log of the First Engineer of the SS *Suevia*, a steamship traversing the Hamburg-America Line, and we transcribed it from *Kurrentschrift* to contemporary German before translating it into English. At first, we could only decipher a few words on each page, but as we familiarized ourselves with *Kurrentschrift*, our reading and translation skills became more fluid. This process necessitated multiple iterations of transcription and translation, during which we learned an unprecedented amount about the mechanics of early steamships and the history of the Hamburg-America Line. The ability to read *Kurrentschrift*, much like cursive in The United States of America, is a dying skill. As fewer and fewer people are able to read this script, more and more history recorded in this hand will be lost to time. Furthermore, we learned to apply our knowledge of German rhetoric and grammar to the sometimes hasty writing of our engineer friend, Heinrich Meyer, to achieve a complete and accurate translation. Our labors improved our understanding of the German language's grammar and syntax, maritime culture in the mid to late nineteenth century, and vocabulary, especially as it relates to seafaring. The following presentation is then intended to share with you 1) how this project got started in the first place, 2) how we went about tackling it, 3) our discoveries and what we learned in the process, not least as it applies to language

learning, and 4) what we are doing with this project as well as the possibilities of how this particular project could readily be expanded and how similar projects could unfold in light of the lessons we have learned.

Magnets and the Microcosm

Dwire Hall 303

Argon-fueled plasma jet treatment induced growth and decreased cell viability of Pseudomonas aeruginosa

Vanessa Perez, Mauricio Erazo Jr.
Dr. Olivia Hatton, Dr. Adam Light, Faculty Mentors
Colorado College

Biofilms – bacterial aggregates with significant implications in diverse biological processes – serve as focal points in applications from crop preservation to health issue etiology. Biofilm growth assays, crucial for studying biofilm formation, encounter challenges related to errors in the lab that affect biofilm retention. Improving biofilm retention is essential for a comprehensive understanding of its broader applications. This study aims to augment the wettability of polypropylene surfaces to allow for P. aeruginosa biofilms to adhere better onto polypropylene surfaces, the material well plates are commonly made from, through atmospheric-pressure plasma jet treatment. We investigated changes in contact angle measurements on polypropylene surfaces before and after plasma jet treatment. Although surface wettability increased with increased plasma jet treatment, biofilm formation remained largely unaffected. Concurrently, variations in P. aeruginosa cell viability were observed at different plasma jet treatment durations. Lower plasma jet treatment time (15 seconds) decreased cell growth, while increased treatment time (60 and 300 second) induced P. aeruginosa cell growth.

Experimental Observation of Magnetic Rogue Waves

Kaitlin McAllister,
Matthew Copus[1], Mark Elo[2], Robert Camley[1], Dmytro Bozhko[1]
Professor Dmytro Bozhko, Faculty Mentor
[1]University of Colorado Colorado Springs, Colorado
[2]Tabor Electronics, Inc., Hatasia 9, Nesher 3660301, Israel

For hundreds of years, seafarers have told stories about enormous waves that appear out of nowhere and sink ships, but the physics of these *rogue waves* has only recently begun to be understood. Rogue waves are localized in time and space with amplitudes much larger than surrounding waves. Since the first measurement of an ocean rogue wave in 1995, the physics of rogue waves has been investigated in water and other systems including light and sound. Water rogue waves were synthesized with a *time-reversal* process, involving recording a localized pulse and re-emitting the time-reversed recorded waveforms, which interfere and refocus into a rogue wave [1]. A similar abstract form of time reversal was used to theoretically simulate *magnetic rogue waves* (MRWs), produced from the interference of *spin waves*, wave-like motions deviating from a uniformly aligned magnetic state [2]. Here we present

the first experimental observation of MRWs. A near-field microwave scanning microscope measures MRWs in an out-of-plane-magnetized macroscopic thin film of yttrium iron garnet (YIG). A microwave antenna probe locally excites a spin wave. Four antennas near the corners of the sample record it and re-emit the time-reversed recorded waveforms using an arbitrary waveform generator. The probe makes space-and-time-resolved measurements of the resulting MRW. Magnetic rogue waves are an interesting object for fundamental studies since damping breaks time reversal and spins do not precess backward.

[1] A. Przadka et al., PRL **109**, 064501 (2012).
[2] M. G. Copus, R. E. Camley, PRB **102**, 220410 (2020).
The support from the National Science Foundation of the USA within grant ECCS-2138236 is gratefully acknowledged. K. McAllister acknowledges support from UCCS Undergraduate Research Academy, Goldwater Scholarship, Kane Scholarship.

Spatiotemporal single-cell profiling between Alzheimer Disease and traumatic brain injury reveals dysregulated pathways as potential therapeutic targets

Mauricio Erazo Jr.
Dr. Oscar Harari, Faculty mentor
Colorado College

Traumatic brain injury (TBI) is a known risk factor for Alzheimer Disease (AD). Both TBI and AD have been found to display similar neurological symptoms and have increasing incidences of disability, morbidity, mortality, and economic burden. Despite these connections, the precise molecular relationship between the two remains relatively underexplored. Single-cell RNA-sequencing (scRNA-seq) has allowed for a progressive understanding of the cellular and genetic landscapes of TBI and AD. This study repurposes single-cell data from the frontal cortex and hippocampus collected at the acute (24-hr) and subacute (7-day) phases from mice that underwent fluid percussion injury (FPI) (Arneson et al., 2022). We compared this data to single-cell human data from the parietal cortex of postmortem AD brains (Brase et al., 2021). This includes carriers of mutations (APP, PSEN1 and PSEN2), also referred to autosomal dominant AD (ADAD), and individuals with sporadic AD (sAD). We examined the molecular overlap of differentially expressed genes (DEGs) in FPI TBI brains with those differentially expressed in AD brains to identify cell-type-specific biological pathway comparisons across different timescales. Astrocytes and activated microglia, being the most transcriptionally sensitive cells in the TBI data, were the primary targets of investigation. Statistical analyses revealed substantial molecular resemblance of DEGs co-expressed in both TBI and AD brains in astrocytes and activated microglia. Our results show specific pathways dysregulated in astrocytic and glial cells in the acute and subacute phases of TBI mouse models that resemble those dysregulated in human postmortem AD brains. By understanding the molecular similarities and differences at single-cell resolution between TBI and AD in a spatiotemporal manner, we aim to uncover specific pathways dysregulated in TBI that contribute to AD etiology.

Theoretical model for the dynamics of a macroscopic artificial spin ice

Lawrence A. Scafuri, Renju R. Peroor, D. A. Bozhko
E. Iacocca, Faculty Mentor

Center for Magnetism and Magnetic Nanostructures
University of Colorado Colorado Springs

Artificial spin ices (ASIs) are arrays of nanometer-sized magnets structured in geometrical arrangements. Studying these structures lends insights into the physics of geometrical frustration, with potential applications to data storage and emerging technologies like neuromorphic computing. Here, we present theoretical modeling of a macroscopic-scale ASI consisting of 60 one-inch magnets composed into a square pattern. An electromagnet placed under the lattice generates an oscillatory magnetic field capable of driving the system at a range of frequencies and amplitudes. Like many physical systems, our ASI tends to vibrate most strongly at certain field frequencies, called *resonant frequencies*. We find many resonant modes in the ASI. At low field amplitudes, the intensity of oscillation is directly proportional to the strength of the external field, which is known as a linear behavior. At sufficiently high fields, however, this linear behavior is no longer observed. Instead, resonant modes mix, and the dynamics of the lattice become nonlinear. Nonlinearity is a key feature of the dynamics of our ASI and could be critical for potential functional applications such as frequency combs. Our numerical predictions were used to conduct experiments on a physical model of the ASI, revealing excellent agreement.

Thank You!

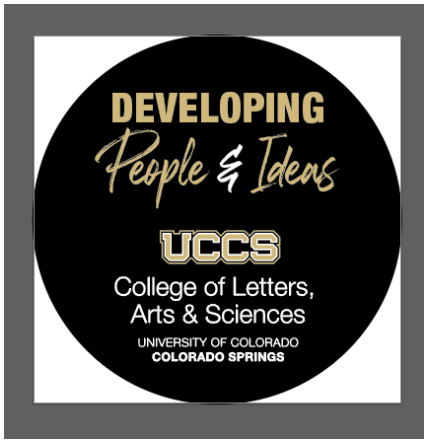
We extend our deep felt thanks to **Jennifer Poe**, Dir. of the Center for Student Research and **Susan Vandagriff**, Instruction Librarian of the Kraemer Family Library for their leadership in organizing CSURF. We also extend our thanks to members of the partner institutions – **Margie Oldham** (UCCS), **Lisa Schwartz** (CC), **Glen Rohlfing** (PPSC) and **Amy Berg** (USAFA).

Thanks go out to all the members of the **UCCS Event Services, Catering** and **Facilities** departments. GREAT JOB everyone!

We especially are grateful to the many **UCCS faculty** who have dedicated countless hours to the service of our students as mentors and advisors. Thank you to our **Office of Research** for providing guidance, funding and support to both students and faculty.

Lastly, we sincerely thank **Dr. L. Lynn Vidler,** Dean of the College of Letters, Arts & Sciences, for their continued support of this magnificent event celebrating undergraduate students in their research and creative work pursuits.

Thank you for attending!


DEVELOPING
People & Ideas
UCCS
College of Letters,
Arts & Sciences
UNIVERSITY OF COLORADO
COLORADO SPRINGS