2026 Research and Creative Activities Symposium (RaCAS)!

RaCAS is CU Denver's annual celebration of student-driven research, scholarship, and artistic endeavors. This year, we are thrilled to return to campus with a hybrid in-person event!
Here in our Virtual Project Showcase, you will find digital presentations showcasing the work of over 300 student presenters. We encourage you to take time to explore projects both within and outside your discipline - you never know where inspiration will strike! RaCAS is about community, conversation, and collaboration, and we encourage you to use the comment walls to start a conversation with student presenters. Presentations will remain posted after RaCAS so you can continue to discover and enjoy them!

View All Projects: https://symposium.foragerone.com/2026-racas/presentations

Thank you to all the Presenters, Mentors, Reviewers, and Volunteers for a fantastic 2026 RaCAS event!

JUDGE AWARDS BY CATEGORY

- Top Climate Change Research Poster: Makayla DeHerrera, Building Climate Change Studies: Integrating Science, Society, and Justice in Climate Education
- **Top Climate Change Oral Presenter:** Carolina Jaime-Anson, Assessing Adaptive Capacity of Housed and Unhoused Native Americans in Denver: Spatial and Community-Based Approaches
- **Colorado Community Impact Judged Award: Indira Saha,** Listening to Loss: Using Oral History to Understand Displacement and Reclaim Denver's Old Westside
- **Colorado Community Impact Judged Award: Laura Juliana Zabaleta Arias,** Elevating Community Voices in Gun Violence Prevention: A Case Study of Community Perceptions of Education Outreach in Colorado
- **Innovative Solutions-Based Research Judged Award: Omar Mendoza,** Building a Custom Augmented Reality Tablet for Accessible Cultural Heritage
- **Innovative Solutions-Based Research Judged Award: Princesa Rodriguez Herrera,** Microglial Targeting to Restore Sleep and Enhance Recovery After Traumatic Brain Injury
- **Excellence in Interdisciplinary Collaborations Judged Award: Abigail Gebremariam,** Electron Impact Excitation of Singly-Ionized Neon using B-Spline atomic R-Matrix Code

PEOPLE'S CHOICE AWARDS

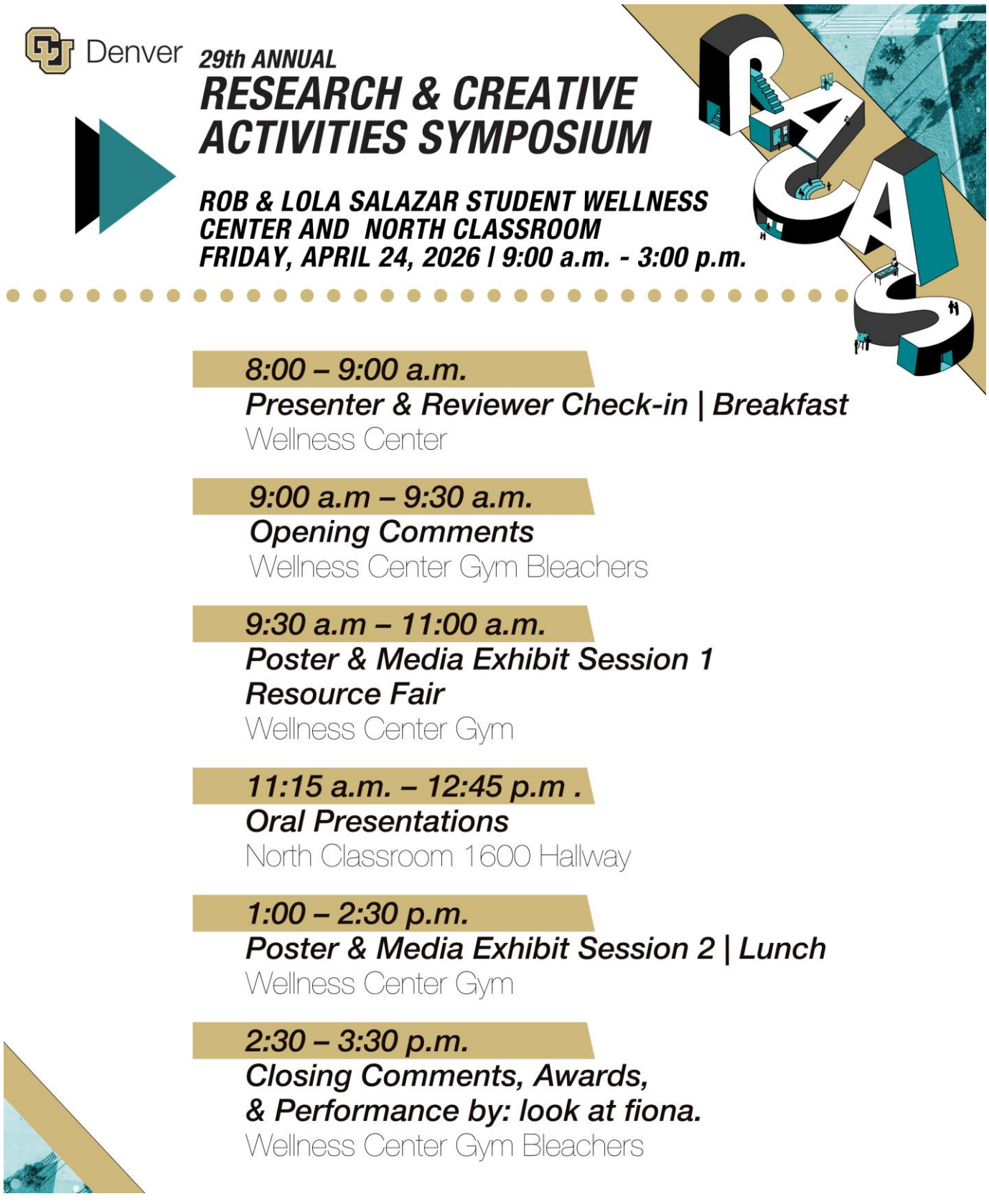
- **Engaging Visual Display People's Choice Award: Safa Hama,** Robotic Arm Controls Development
- **Outstanding First-Time Presenter People's Choice Award, Keinada Andereas:** Improvement of Adolescent Depression Screening in Primary Pediatrics
- **Overall People's Choice Award: Danna Carroll & Isabella Ridenhour:** Comparative Analysis of Neurodivergent Children in Ecuador and Colorado

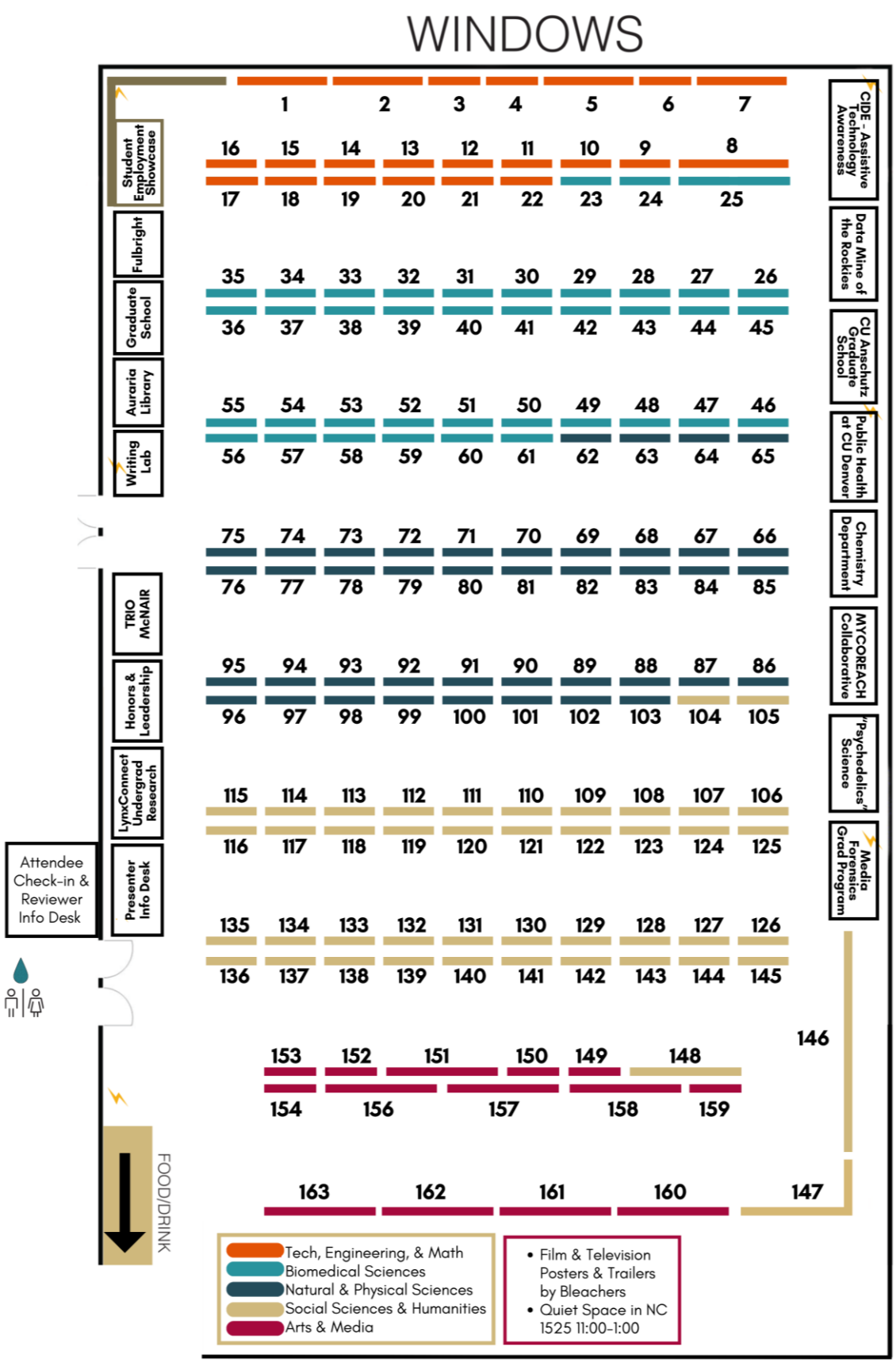
UNDERGRADUATE RESEARCH MENTOR OF THE YEAR WINNER

- Benjamin Greenwood, Psychology

UNDERGRADUATE MENTOR OF THE YEAR TOP NOMINATIONS

- Andrew Bateman, Film & Television
- Kris Christensen, Geography & Environmental Sciences
- Chris Miller, Integrative Biology




WINDOWS
Student Employment Showcase
Fullbright
Graduate School
Auraria Library
Writing Lab
TRIO McNAIR
Honors & Leadership
LynxConnect Undergrad Research
Presenter Info Desk
Attendee Check-in & Reviewer Info Desk
FOOD/DRINK
CIDE - Assistive Technology Awareness
Data Mine of the Rockies
CU Anschutz Graduate School
Public Health at CU Denver
Chemistry Department
MYCOREACH Collaborative
"Psychedelics" Science
Media Forensics Grad Program
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Tech, Engineering, & Math
Biomedical Sciences
Natural & Physical Sciences
Social Sciences & Humanities
Arts & Media
• Film & Television Posters & Trailers by Bleachers
• Quiet Space in NC 1525 11:00-1:00

Alphabetical By Title

3000 Hz
Maria Koop, *Arts & Media*
Mentor: Hans Rosenwinkel

Abstract:
If a picture is worth one thousand words, then what is a sound worth? In our latest short fiction narrative film, 3000 Hz, we wish to discuss and explore this possibility. As filmmakers we often explore how to use words to bring out emotion, but what if sound can do the same? By playing with sound dynamics and frequencies, what emotions can we illicit from our audiences? And by doing so and featuring science in our production, what inspiration can we bring to future STEM students? By collaborating with my peers to create an experimental original soundtrack, 90's educational media inspired sound design, and special effects technician, this project will contribute a study of sound design in film, and the psychological implications that the fusion of different tones create.
https://symposium.foragerone.com/2026-racas/presentations/80730

3D Volumetric Display
Kevin Diaz *Tech, Engineering, & Math*
Mentor: Dr. Nam Bui

Abstract:
PURPOSE: Communication has significantly changed post COVID as many organizations adjusted to teleconferencing. 2D image and video conferencing has proven to be useful but limited in technology and engineering. One challenge is the ability to display a product/project in greater detail. Developing a device that allows you to view a 3D spatial reconstruction will take video conferencing to the next level.
PROCEDURE: We developed a device that powered rotating screens to view a 3D spatial reconstruction utilizing a circuit that was designed to power a DC motor via Pulse Width Modulation (PWM). The PWM was used to spin two LED panels at more than 300 rotations per minute (RPM) through a slip ring that efficiently transfers power to rotating objects. An additional circuit was created for image synchronization and RPM calculations; this was done utilizing photo-interrupters to monitor precise timing when the display crossed specific points. Controlling these circuits, LED panels, and motor were done utilizing an Arduino UNO microcontroller and a Raspberry PI 3 microprocessor. These methods allowed us to characterize the system's power consumption, RPM needed for proper spatial reconstruction, noise levels, and overall system stability.
OBSERVATIONS**:** We determined that regular motor operation at 200 RPM consumed upwards of 45 watts and that in close proximity the motor would create approximately 60 dB of noise leading to a level that most would find distracting. Additionally, system stability became an issue due to the device vibrating, creating extra ambient noise, which would require additional weight to stabilize it, thus creating additional costs and a heavier device. These observations established a functional proof-of-concept for motor-driven POV volumetric displays, identifying power delivery and consumption, acoustic management, and rotational stability as the primary engineering targets for next-generation 3D spatial viewing devices.
https://symposium.foragerone.com/2026-racas/presentations/81061

A Hybrid Approach towards lung cancer treatment: Inhibiting FPR1 by isoflavones from *Danggui Buxue Tang*
Uyen Bui, *Natural & Physical Sciences*
Mentor: Woonghee Lee

Abstract:
Traditional herbal medicine has been used for centuries across many cultures as a primary form of prevention and treatment for diseases. It involves using natural herbs such as leaves, roots, and flowers, as well as their extracts. In many cases, herbal remedies have been used to help manage and relieve symptoms such as pain, or inflammation. Recently, an herbal formula called SH003 was developed from the traditional formula *Danggui Buxue Tang*. This formula, composed of *Astragalus membranaceus, Angelica gigas Nakai, and Trichosanthes kirilowii Maxim*, has been studied for its potential therapeutic effects, including the ability to regulate the body's immune system. Since its development in 2012, SH003 has been studied across various cancer types. Despite lung cancer being the leading cause of global mortality, its common chemotherapy treatments face significant limitations such as side effects. Specifically, cisplatin can promote NETosis through the release of mitochondrial damage signals that block formyl peptide receptor 1 (FPR1) activation on neutrophils which are DNA and proteins from NETs structures. While NET formation can help the body fight infections, excessive NET production can contribute to disease progression. Holistically, the side effect symptoms of cisplatin, such as fatigue, anorexia, anemia, and more,

are understood as a Qi and blood deficiency. The herbs in SH003 are known to help clear the heat and improve those deficiencies. Still, it is not well understood how SH003 can aid cisplatin-based treatment. From previous study of Choi, et. al. 2022, it has been found that certain isoflavones can be potential FPR1 antagonists. In SH003, the significant isoflavones are calycosin, formononetin, calycosin 7-O-glucoside, and formononetin-7-O-glucoside. Therefore, we are conducting a series of *in-vitro* and *in-silico* experiments on the binding of these isoflavones.
https://symposium.foragerone.com/2026-racas/presentations/80984

A Journey of Healing through University Writing: from educational trauma to becoming a teacher and how my students will benefit
Pamela Pousson, *Social Sciences & Humanities*
Mentor: Erica Holyoke, PhD

Abstract:
"My chest was so tight that I couldn't hear what anyone was saying when they read because I was worried that I would have to read and then everyone would call me a baby again at recess." A creative semester long multi-genre writing project that moves through a path of educational trauma, growth and knowledge of the education system and school to prison pipeline, to a new path of becoming a teacher and advocate. This multi-genre writing allows for communication with a broad audience in innovative and intentional ways to clearly depict the emotional depth of educational trauma and healing. The self-reflection and growth from a once functionally illiterate, first generation, drop out student to paving a path of advocacy and sharing. I am leaving the shadows of shame and embarrassment behind as I move through the personal storm of being "that" student, diagnosed with multiple learning disabilities and giftedness as an adult, advocating against the education system as a mother, and now finding my calling as a teacher and advocate for systemic change in the educational system. As an adult, I am now capable of applying words to my experiences and bringing you inside the thoughts, feelings, and physiological effects of a struggling student. Students deserve to feel safe and valued in their educational settings and in the presence of adults of authority. Reflecting on my traumatic educational journey through my continued education of becoming a teacher, I value the perspective I have gained. The significance of this journey can continue through sharing my work with students and educators of all levels looking to grow in their reflective practices and most importantly knowing the impact they have on their students. No matter the journey you are on, everyone is a student and a teacher in their own life.
https://symposium.foragerone.com/2026-racas/presentations/80936

A Sacred, Communal Pause: How Racially Marginalized Youth's Commitment to Healing Expands Understandings of Activism
Chanelle Jones Ahmed, Social *Sciences & Humanities*
Mentor: Helen Wang

Abstract:
The continued state-sanctioned violence towards marginalized communities and a reactionary political landscape have exacerbated the need for youth of color activists to prioritize holistic wellness. Healing is necessary because although engagement in activism may address root causes of harm, it also takes an immense toll on the mind/body/spirit (Ginwright, 2015; Conner et al., 2023). Understanding this toll and identifying strategies to address it calls for research into the intersection of youth activism and healing. To explore this topic, we convened a Participatory Action Research (PAR) project comprised of high school and college students, young adults working in youth organizations, community organizers, and multi-generational university researchers. This paper explores what members of the PAR team have learned about the relationship between healing and activism from youth of color.
https://symposium.foragerone.com/2026-racas/presentations/80944

A Two-Stage Deep Learning Pipeline for Sewer Pipe DefectDetection and Multi-Label Classification
Qijian Ma, *Tech, Engineering, & Math*
Mentor: Dr. Farnoush Banaei-Kashani

Abstract:
Sewer pipe inspection plays an essential role in maintaining underground infrastructure and preventing structural failures. Automated sewer pipe inspection is an important but challenging task due to subtle visual defects and strong class imbalance in real-world data, which limits the performance of deep learning models, especially on rare defect categories. To address this, this project proposes a two-stage deep learning pipeline for sewer defect detection and multi-label classification using the Sewer-ML dataset. The approach separates detection from classification: in the first stage, a lightweight convolutional neural network (CNN) performs binary classification to filter out non-defective images; in the second stage, a ResNet18 model classifies the remaining images into 18 defect categories in a multi-label setting. By removing non-defective samples before classification, the

pipeline reduces noise and helps balance the data seen by the classifier. The goal of this work is to evaluate whether this two-stage design can improve overall performance and make the model more reliable, particularly for less common defect types in sewer inspection systems.
https://symposium.foragerone.com/2026-racas/presentations/80992

Academic Libraries as Centers of Community for Equitable STEM Education Library as Laboratory (LibLab)
Mozhdeh Saffari-Parizi, *Natural & Physical Sciences*
Mentor: Dennis DeBay

Abstract:
Academic libraries have long served as central hubs within their communities, evolving to meet the changing needs of students, faculty, and researchers. In the context of STEM education, academic libraries play a critical role in promoting equitable access to resources, tools, and learning opportunities. By providing both traditional and innovative services, libraries continue to function as inclusive spaces that support academic success and foster community engagement.
Historically, libraries have provided essential research materials and study environments, ensuring that all users, regardless of background, have access to knowledge. In recent decades, this role has expanded to include digital resources, electronic journals, and databases, as well as initiatives that address the rising cost of education. Open Educational Resources (OER) and textbook affordability programs are key examples of how academic libraries contribute to equity by reducing financial barriers and increasing access to high-quality learning materials.
Beyond access to information, many academic libraries have developed hands-on learning environments that support STEM education. Our library was among the first to begin building this type of scientific resource collection, demonstrating an early commitment to expanding the role of the library in experiential learning. Several years ago, we established a scientific resources collection designed to enhance hands-on learning opportunities. This collection includes anatomical models, microscopic histological slides, microscopes, and electronic equipment such as multimeters, oscilloscopes, and function generators. By offering access to these tools within the library, we create opportunities for students to engage in practical, laboratory-like experiences outside of traditional classroom settings.
Additionally, the library serves multiple institutions with distinct but complementary missions, further reinforcing its role as a shared space for collaboration and resource sharing. This model highlights the library's capacity to support diverse academic communities while promoting interdisciplinary learning and innovation.
Ultimately, the academic library's role extends beyond STEM education. By providing equitable access to resources, fostering inclusive learning environments, and supporting both digital and hands-on experiences, libraries continue to act as vital centers of community. Their ongoing evolution ensures that they remain essential partners in advancing educational equity and student success across disciplines.
https://symposium.foragerone.com/2026-racas/presentations/80912

Activation Outliers in Transformer Quantization: Statistical Analysis & Deployment Tradeoffs
Pranav Kumar Kaliaperumal, *Tech, Engineering, & Math*
Mentor: Christopher Phiel

Abstract:
Post-training quantization (PTQ) is widely used to reduce the computational and memory cost of deep neural networks, but transformer architectures exhibit severe accuracy degradation under naive activation quantization. In this work, we present a fully reproducible empirical study of this failure mode in BERT-base fine-tuned on QNLI. We show that global W8A8 quantization causes validation accuracy to collapse from 89.66% to 54.33%, and demonstrate that this degradation is driven by structured activation outliers rather than random noise. Through depth-wise statistical analysis, we observe kurtosis growth (9 → 271) and energy concentration (15% → 55% in top 1% of channels), revealing strong heavy-tailed behavior and channel dominance. We evaluate mitigation strategies including mixed precision, per embedding-group (PEG) quantization, and percentile based calibration. Mixed precision nearly restores baseline accuracy, while PEG provides partial recovery depending on group granularity. However, deployment profiling on an RTX 3050 GPU shows minimal improvements in latency and memory usage across all methods, highlighting the importance of hardware aware optimization. Our results establish that transformer PTQ failure is fundamentally a channel structured phenomenon, requiring precision allocation strategies rather than scalar clipping.
https://symposium.foragerone.com/2026-racas/presentations/80842

AN ANALYSIS OF PHYSICAL AND MENTAL HEALTH THROUGH EGO NETWORKS IN UNDERREPRESENTED COMMUNITIES
Dyanna Reyes, *Social Sciences & Humanities*
Mentor: Paulina Erices

Abstract:
Social networks describe people's closest relationships and the relationships of their relationships, which makes opportunities available by virtue of connection (Bourdieu, 1998). In minoritized communities, "good connections" may make the difference between receiving timely medical care or facing a life of disability or between dropping out of high school and getting a college scholarship. Indeed, better-connected people can access helpful information, enjoy stronger social support, reach better opportunities for social mobility, and even have better health outcomes (Small, 2009; Berkman & Glass, 2000). However, minoritized groups have smaller social networks and experience reduced access to resources, information, and influence (Lubbers, 2023). We understand the relative meaning of physical and mental health but how do underrepresented communities such as the Indigenous, Spanish, and Vietnamese communities in Southwest Denver shape their definition of health and how does their social capital play apart into their health overall? I will analyze each of the communities on different socio-economic levels by using by exploring the networks centrality through closeness (Kim, 2019) and their subgroup-typology (Vacca, 2019). I argue that all these factors play into shaping an individual's health, mental and physical. In conclusion, this project, by closely examining factors that shape self-ratings of health, sheds light on the rarely acknowledged communities that help Denver flourish. Through my findings, I will paint a picture of community and explain why health should be not just a surface-level definition, but how it is threaded by social capital.
https://symposium.foragerone.com/2026-racas/presentations/80847

An Exploration of Mental Health Stigma in First-Generation Hispanic Immigrants
Sarah Issa, *Social Sciences & Humanities*
Mentor: Bryan Contreras Zamora

Abstract:
First-generation Hispanic immigrants (FGHIs) in the U.S. experience disproportionately higher rates of mental health challenges compared to the general U.S. population, yet are significantly less likely than this population to seek professional mental health care. This study examines how cultural values, stigma, and structural barriers influence mental health perceptions and help-seeking behaviors among FGHIs.
Guided by the minority Stress Model and a constructivist grounded theory approach, three Spanish language virtual focus groups were conducted with 13 participants from the Denver metro area. Data was analyzed using Constructivist Grounded Theory Grounded Theory.
Findings reveal that participants navigate mental health within a broader process of negotiating emotional legitimacy in the context of migrations. Mental Health Stigma processes including public stigma, self-stigma, and family silence combined with immigration-related stress such as language barriers and documentation concerns, contributed to emotional suppression and delayed help seeking. Participants commonly engaged in informal support seeking through family, faith, and community networks, often turning to formal mental health services only as a last resort due to barriers to access such as cost, limited insurance, and lack of culturally responsive care. Overtime, some participants demonstrated a shift toward increased emotional legitimacy characterized by greater acceptance of emotional experiences and cautious engagement with formal services. This transformation was associated with improved coping strategies, increased openness, and disruption of intergenerational patterns of stigma. These findings highlight the importance of culturally responsive, bilingual, and accessible mental health services that address structural barriers and reduce stigma to improve engagement among FGHIs.
https://symposium.foragerone.com/2026-racas/presentations/81032

An indirect test of timescape cosmology
Adrian Fisher, *Natural & Physical Sciences*
Mentor: Alberto Sadun

Abstract:
This presented research is of an experiment to test predictions made by the timescape cosmological model, a competitor to the leading model of cosmology known as ΛCDM. In constructing this experiment, an introduction is given for ΛCDM, including a discussion of Hubble's law and Doppler shifts. Discussion is also provided for the shortcomings of ΛCDM's Cosmological Principle which assumes homogeneity and isotropy as central axioms. Timescape is then introduced as a model of cosmology which has been found by other research teams to fit some inhomogeneity and anisotropy data better than ΛCDM. A test is provided on the timescape model's prediction that galaxies will have different clock rates depending on whether or not they are in a cosmic void or cluster using an initial sample of 304,607 galaxies from data provided by the Sloan Digital Sky Survey (SDSS) in the redshift range of $0.15
https://symposium.foragerone.com/2026-racas/presentations/80843

Analyzing the Effectiveness of Blown Wing Applications in Fighter Jet movement Dynamics
Kowshik Shanmugamani and Aryaveer Sheoran, *Tech, Engineering, & Math*
Mentor: Kayla Ahr

Abstract:
Optimizing maneuverability in fighter jets is crucial for maintaining air superiority with the new generation and future generations of fighter jets that are beginning to roll out. Prioritizing turn rate and maneuverability, especially in high alpha and low speed regimes, where whichever fighter can turn their nose faster wins. This study tests blown wings, an innovation used by small STOL aircraft, by integrating them on a model wing in a way that can be used in fighter jet wings. Due to flow separation leading to drag, we can measure how well the blown wing performs by measuring the impact on the drag produced. We found data by building our own wing tunnel to test a blown wing type at different air pressures and wing angles of attack(AOA), and calculated the lift and drag in the controlled environment. Our results showed that an increased psi on the wing was able to outperform the same wing with a lower or no psi with slightly greater lift and extreme decreases in drag at steeper angles.
https://symposium.foragerone.com/2026-racas/presentations/80988

ANSERing the Mysteries of Herbal Medicine
Abigail Chiu, *Natural & Physical Sciences*
Mentor: Dr. Woonghee Lee

Abstract:
For centuries, human medicine has relied on plant-based mixtures to treat a wide variety of symptoms. Modern Western medicine typically isolates or creates specific small molecules to activate or block targeted proteins in the body.[1] However, a large portion of the global population still relies on traditional herbal recipes, which are often highly effective but scientifically poorly understood.[2] To bridge this gap and help researchers demystify traditional medicine, we have developed a suite of user-friendly software tools to make the study of herbal compounds more accessible. ANSER (Archive of Natural Substances for hErBal Research) is a comprehensive, browsable database of small molecules sourced globally, featuring extensive herbal libraries from South Korea, Vietnam, and China. To test these molecules, we are developing ADOCK, a virtual screening program that allows researchers to simulate how compounds from the ANSER database bind to specific protein receptors. It is supported by ANCOR (Automated Navigation of binding site COoRdinates), which can provide the molecular connection points via prediction, extraction from a protein-ligand complex, or experimental NMR perturbation results. Finally, we are introducing APAX (AI Predictor for Assembling molecular compleXes), which streamlines complex artificial intelligence prediction programs into an easy-to-use interface for rapid testing of protein-molecule interactions. Together, these tools empower researchers to modernize and validate herbal medicines, potentially unlocking new, naturally derived treatments for the world.
https://symposium.foragerone.com/2026-racas/presentations/81050

Application of Nanoparticles in Cancer Imaging
Roberto Jacobo and Ryan Ha, *Biomedical Sciences*
Mentor: Dr. Jung-Jae Lee

Abstract:
This research explores a unique approach to traditional cancer imaging techniques. Currently, techniques are limited by minimal infrared penetration through body tissues and the troublesome chemical environments that tumors create. The issue with chemo- and bioluminescent techniques is the oxygen dependency of the illuminating compound, especially in an environment with little oxygen available, such as within tumors. To address this, we have been assigned the responsibility to evaluate the efficacy of a multitude of compounds and their ability to control the slow and gradual release of oxygen, allowing for accurate, reliable, and longer-lasting chemiluminescent imaging. We are specifically investigating pyridine compounds, which possess the ability to trap molecular oxygen within their bonds through a Diels-Alder reaction. The reverse, or retro-reaction of these compounds releases the oxygen and can be optimized to occur within the physiological temperature range of the human body. We will be conducting the Diels-Alder reaction, then measuring the rate at which the reverse reaction occurs through Nuclear Magnetic Resonance to determine the rate at which the oxygen is released. We will then compare the results of this compound to the other compounds that the lab has tested to evaluate its proficiency in the slow and gradual release of molecular oxygen. In combination with these compounds, we have also begun testing our initial carrier compound, microscopic gold nanorods. Initial testing will include the data collection of the compounds' photothermal properties, cytotoxicity to cells, and their ability to be conjugated and loaded with drugs. Overall, the end goal of this project is to create a biocompatible, long-lasting nanoparticle that can be loaded with chemiluminescent compounds powered by the release of oxygen and targeted directly to tumor sites for great visualization in aid of cancer treatment and real-time tumor resection.
https://symposium.foragerone.com/2026-racas/presentations/80966

Assessing Adaptive Capacity of Housed and Unhoused Native Americans in Denver: Spatial and Community-Based Approaches
Carolina Jaime-Anson, *Social Sciences & Humanities*
Mentor: Ivan J. Ramirez

Abstract:
Housed and unhoused Native Americans face disproportionate climate and health risks due to compounding vulnerabilities, yet little research has explored adaptive capacity in this population. Government agencies and policymakers use indices as "place-based tools" that enable the public and local decision-makers to develop initiatives that reduce climate and environmental vulnerability among disproportionately impacted populations. However, these tools often rely on secondary data sources that inherently exclude people experiencing homelessness (PEH), undercount Native Americans, and often do not incorporate community engagement methods. Additionally, indices tend to focus on the vulnerability of populations, contributing to deficit narratives and neglecting to highlight collective strengths and capacities. The research presented in this dissertation is intended to address these gaps by constructing an adaptive capacity index that considers the experiences of housed and unhoused Native American populations and engaging with the Native-led and Native-serving community-based organizations that support them. Through this mixed-methods approach, statistical and spatial analysis were used to test index validity and highlight geographic areas of higher and lower adaptive capacity in Denver County. Additionally, thematic analysis of interviews was conducted to contextualize quantitative findings and ground them in community perspectives. Quantitative analysis revealed significant correlations between adaptive capacity components and health indicators, though some unexpected negative associations underscored the complexity of compounding vulnerabilities. Quantitative analysis also indicated that the Native American population in Denver is disproportionately burdened by environmental, social, health, and infrastructural stressors that collectively limit adaptive capacity.
Qualitative findings both reinforced and reframed these patterns by highlighting systemic barriers, the importance of cultural connectedness, and the role of service providers in bridging resource gaps. These findings are consistent with prior research that distinguishes Indigenous populations as systemically and structurally susceptible to climate impacts. However, they also illuminate the unique community characteristics that enable Indigenous communities to adapt in ways not fully captured by conventional vulnerability frameworks. Altogether, these findings expand our understanding of resilience beyond deficit-based models and underscore the importance of culturally grounded, community-driven approaches and initiatives. Results contribute a novel index framework with potential application in policy and planning and reinforce ethical considerations in conducting research with vulnerable Indigenous populations.
https://symposium.foragerone.com/2026-racas/presentations/81074

Assessing Social Vulnerability to El Niño in Peru: A Geospatial Approach
Aleksandra Cejovic, *Natural & Physical Sciences*
Mentor: Ivan Ramirez, PhD

Abstract:

This study investigates the spatial patterns of social vulnerability in Peru during and following an extreme climate event. Peru like other equatorial countries is particularly susceptible to the recurring effects of climate variability and extremes associated with El Niño. El Niño affects global to local weather every few years, disrupting rainfall and temperature patterns, which in turn impacts local infrastructure and health vulnerability. While many studies advanced our understanding of El Niño-health effects, less is known about the social vulnerability which communities face during and following El Niños. Social vulnerability such as lack of access to clean water or adequate sanitation can increase a population's exposure, sensitivity, and decrease capacity to respond to climate-health threats. Specifically examine a spatial dataset collected during fieldwork in Peru, composed of indicators of demography, socioeconomics, and health in 2016, a year associated with an extreme El Niño event. The dataset made up of district-level indicators across Peru presents a rich opportunity to understand the geography of social vulnerability, how it spatially varies and clusters, and which indicators are key for policy interventions. Preliminary results will be discussed.
https://symposium.foragerone.com/2026-racas/presentations/80865

Assessing Traffic-Related Air Pollutants Along the I-70 Mountain Corridor in Idaho Springs, Colorado
Maddie Garbalagtys, Luke Pelletier, Griffin Teague, Erin Burke, and Angelique Tran, *Natural & Physical Sciences*
Mentor: Benjamin Crawford

Abstract:
Traffic-related air pollution is a growing concern in mountain corridor communities where high vehicle volumes, wildfire smoke events, and complex terrain influence pollutant dispersion. This study examines the spatial distribution of particulate matter (PM2.5 and PM10) near the Interstate 70 (I-70) corridor in Idaho Springs, Colorado. We hypothesize that pollutant concentrations decrease with distance from the roadway but remain detectable beyond typical near-roadway influence distances.
Air quality data from three monitoring locations representing urban (Denver), foothill (Golden), and mountain (Idaho Springs) environments were analyzed using publicly available datasets. Idaho Springs was selected using Annual Average Daily Traffic

data and spatial analysis in ArcGIS Pro. It was additionally selected due to the absence of long-term regulatory monitoring, highlighting a gap in localized air quality understanding. Field measurements of PM2.5 and PM10 were collected using Atmotube Pro portable sensors at distances up to 250 meters from I-70.
Preliminary findings show distinct spatial patterns in PM2.5 and PM10 across urban, foothill, and mountain environments. Pollutant concentrations remain detectable beyond typical near-roadway influence distances. Additional analysis is needed to further evaluate the role of terrain and roadway proximity in pollutant dispersion, suggesting potential persistence of traffic-related air pollution in mountain corridor environments.
https://symposium.foragerone.com/2026-racas/presentations/80908

Associations of MCAI Score and First-Generation Status with Academic Performance in Chemistry Courses
Zizhe Zhou, *Social Sciences & Humanities*
Mentor: Dr. Priscilla Burrow

Abstract:
This study investigates the relationship between metacognitive ability, first-generation status, and academic performance in undergraduate chemistry courses. Using data from approximately 1,475 student observations across CHEM 2038 and CHEM 2068, we combine survey-based Metacognitive Activities Inventory (MCAI) scores with course outcomes, including lab practical scores and final grades. Correlation and multiple linear regression analyses reveal that MCAI scores are positively and statistically significantly associated with both lab performance and final GPA, although the effect sizes are small. In contrast, first-generation status shows a consistent negative association with lab practical performance and a mixed effect on final grades, despite similar MCAI distributions across groups. Overall, the results suggest that while metacognitive skillfulness contributes to academic success, it explains only a limited portion of performance variation, and additional structural or educational factors may underlie observed disparities.
https://symposium.foragerone.com/2026-racas/presentations/80877

Bar and Club Culture's Influence on Violence
Galilea Villalobos Acosta, *Social Sciences & Humanities*
Mentor: Dr. Sasha Breger

Abstract:
Alcohol usage has long remained an issue in society. Roughly about 80% of individuals who are incarcerated have had a history with alcohol (Mukku et al., 2012). At least 40% of violent crimes were committed because of an intoxicated individual (Boles et al., 2003). The culture around alcohol has normalized drinking before attending a bar or club and excessive drinking while there. Violence resulting from the consumption of alcohol may be more than its effects on the
brain. The culture surrounding alcohol consumption is important to look into. For this research I will examine how the culture surrounding alcohol and nightlife influence violence. Whether the person drank before going out and what the culture surrounding alcohol looks like will be examined an analyzed here. To understand the link between nightlife, alcohol, and violence I will look at past literature, their methodology, and recent attitudes surrounding drinking culture.
Knowing what nightlife and drinking culture look like will allow for a better understanding as to why violence may occur.
https://symposium.foragerone.com/2026-racas/presentations/80896

Benchmarking Sequencing Technologies and Metagenomic Assembly Techniques in a Colorado Landfill Bioremediation System
Mike Beitner, *Natural & Physical Sciences*
Mentor: Chris Miller

Abstract:
The reconstruction of high-quality metagenome-assembled genomes (MAGs) from complex, non-model ecosystems remains a primary bottleneck in microbial ecology. This study systematically evaluates seven de-novo whole genome assemblers: metaSPAdes, IDBA-UD, and MEGAHIT (short-read); Flye and metaMDBG (long-read); and metaSPAdes-hybrid and METACONNET (hybrid). Performance was evaluated across both long-read (Oxford Nanopore) and short-read (Illumina) sequencing runs to determine the optimal bioinformatic pipeline for resolving taxonomic and functional diversity of the biological treatment system attenuating 1,4-Dioxane at the Lowry Landfill Superfund Site.
To quantify the contribution of long-read volume on MAG count and completeness, we supplemented existing Illumina sequencing runs with three Oxford Nanopore sequencing runs of various depths. The largest of these runs was also subsampled to generate a read ladder to identify the threshold of long-read coverage required to maximize MAG yield and structural resolution. Following assembly, MAGs underwent binning and refinement via MetaWRAP, taxonomic assignment by GTDB-Tk, and completeness and contamination validation using GUNC, BUSCO, and CheckM2.

We are testing the hypothesis that short-read assemblers offer high throughput but offer limited contiguity and are prone to assembly fragmentation, especially in repeat-rich regions. Long-read assemblers yield highly contiguous scaffolds at the expense of base-level consensus accuracy. Conversely, hybrid assemblers significantly enhance structural resolution without nucleotide-level accuracy loss. To validate these structural gains in a biological context, we evaluated the reconstruction of ubiquitous and well-characterized taxa within the bioreactor. A functional annotation case study of key nitrifiers demonstrates hybrid methods can recover complete metabolic pathways that are otherwise omitted by single-technology pipelines. This study aims to provide a roadmap for environmental metagenomics, clarifying how to optimize sequencing and assembly to characterize real-world complex ecosystems.
https://symposium.foragerone.com/2026-racas/presentations/80959

***Beyond receptor binding: Envelope protein interactions help viral tissue tropism*.**
Adiam Bereket, *Social Sciences & Humanities*
Mentor: Siddharth Krishnamurthy

Abstract:
Viruses cause disease based on the tissues they infect. Traditionally, viral tropism is predicted by the presence of a viral receptor on host cells. However, many tissues that express the appropriate receptor are uninfected. This highlights a major gap in the field, as there is currently no reliable way to predict which tissues a virus can and cannot infect.
Here, we use the enteric coronavirus Murine Hepatitis Virus Y (MHV-Y) to investigate how viral factors beyond receptor binding influence tissue tropism in the intestine. MHV-Y infects specific regions of the intestinal tract, including Peyer's patches, mesenteric lymph nodes, and the proximal colon. We found that colon infection depends on the viral envelope protein hemagglutinin esterase (HE). Although HE does not directly mediate receptor binding, it interacts with a host ligand called 4-O-acetylated sialic acid (4AcSA), whose cellular source in the intestine is not well understood.
To address this, I analyzed the distribution of 4AcSA across susceptible intestinal tissues using immunofluorescence.
This work provides a step toward better predicting which tissues a virus can infect based on the viral envelope proteins it expresses, rather than host viral receptors.
https://symposium.foragerone.com/2026-racas/presentations/80942

Breaking Dominion: Microbial Bioremediation, Indian Treaty Law, and the Legal Consequences of Living Environmental Data on Indigenous Lands
Nakita Locklear, *Natural & Physical Sciences*
Mentor: Timberley Roane

Abstract:
A legal framework within the United States regulating the use of microbial-based remediation techniques on Indigenous lands using genetically modified microorganisms (GEMs) is lacking. GEMs are often proposed for use in degrading and/or detoxifying environmental xenobiotics. This lends itself to a biological, Indigenous-oriented approach to future remedies. This lack of oversight and cooperation creates a legal loophole at the confluence of environmental law, microbial bioremediation techniques, and Indigenous environmental self-determination. While the primary goal for creating these bioremediation techniques is maintaining human health, all manner of non-human life can benefit from this expansion of knowledge. Traditional Ecological Knowledge (TEM) within Indigenous communities holds the potential to partner with new Western sciences in a way that will benefit all communities. This paper will examine the Dominionistic juris prudence of Federal environmental law so it may highlight the harm a lack of proper research around GEMs remedying the dangers of environmental pollutants and other xenobiotics. This examination must include a focus on the lack of input and participation Indigenous communities are given within the decision-making and oversight process of environmental policies. This will require a meticulous review of both the environmental regulatory bodies (Environmental Protection Agency, Bureau of Land Management, Forestry Service, etc.) and the bodies that govern life for Indigenous reservations (Bureau of Indian Affairs, Indian Health Services, etc.). This is in addition to examining the regulations involving the use of GEMs. This paper proposes a reconceptualization of environmental governance that centers Indigenous self-determination and reexamines the legal precedence underpinning scientific intervention in contaminated ecosystems. Furthering discussion of these issues will benefit all communities within the affected areas and can serve as a bridge of understanding between Western ecology and TEK. Within Indigenous communities it is understood that a river knows nothing about the borders of humans, nor should it care. Caring for that river is the responsibility of us all.
https://symposium.foragerone.com/2026-racas/presentations/81006

Bugged Out: Trevor Paglen's Limit Telephotography
Jonas Sanchez, *Arts & Media*
Mentor: Maria Buszek

Abstract:
Bugged Out: Trevor Paglen's Limit Telephotography explores the meanings behind American activist artist and geographer Trevor Paglen's *Limit Telephotography* project. In this series, Paglen photographs government black sites, secret military bases often outside legal and public view. Because of the subject matter of his photography, he often takes these photos from distances exceeding sixty miles, resulting in deconstructed and abstracted photographs.
While there is an apparent investigative quality, I propose an alternative reading of *Limit Telephotography*: conspiracy and paranoia. Paglen often operates close to the world of hackers, UFO specialists, and conspiracy theorists. There is, as one scholar put it, "a delirious aesthetic of systematicity" central to the project.
Paglen challenges the nature of activist and investigative photography which usually demands clarity and "high resolution." *Limit Telephotography* demands that we reimagine the value and function of the photograph in an era where the photograph will never truly capture "truth" in a world where the growing "realness" of artificially generated images forces the question of whether there is value left in investigative photography.
This presentation will examine and challenge the existing academic writings on *Limit Telephotography* and Trevor Paglen, by using the lenses of conspiracy and paranoia, and Paglen's personal writing. I hope to make further sense of the series' meanings.
https://symposium.foragerone.com/2026-racas/presentations/80826

Building a Custom Augmented Reality Tablet for Accessible Cultural Heritage
Omar Mendoza, *Tech, Engineering, & Math*
Mentor: Michael Rogers

Abstract:
Exploring historical sites isn't always physically possible for everyone, creating a need for high-quality, accessible virtual tours. This ongoing project focuses on building a custom handheld augmented reality (AR) tablet to enable users to explore detailed 3D models of historical locations offline. To handle the massive data requirements of these 3D environments, a custom memory system is under development to enable the easy deployment of new historical sites, much like swapping game cartridges. Additionally, integrating a movement sensor ensures that tilting or turning the physical tablet naturally changes the user's view in the virtual world. Ultimately, this device aims to make experiencing cultural heritage more inclusive and accessible for everyone.
https://symposium.foragerone.com/2026-racas/presentations/81004

Building Climate Change Studies: Integrating Science, Society, and Justice in Climate Education
Makayla DeHerrera, *Natural & Physical Sciences*
Mentor: Christy Briles

Abstract:
The accelerating pace of climate change demands new models of higher education that unify science, society, and policy to prepare future leaders for interdisciplinary problem solving. The University of Colorado Denver's *Climate Change Studies* program was developed to meet this need through a framework that integrates scientific understanding with social, ethical, and policy perspectives. Designed as both a Bachelor of Arts and Bachelor of Science degree, the program emphasizes inclusivity, critical thinking, and equitable climate solutions within local and global contexts.
This poster presents the development and launch of the program as a case study in building interdisciplinary climate education within an urban research university. It outlines the curriculum design process, coordination across departments and colleges, and incorporation of experiential and community-based learning. A central focus is the role of **climate justice** as a guiding principle for curriculum development, student engagement, and institutional partnerships.
Early outcomes demonstrate strong student interest, broad faculty participation, and emerging collaborations that link research, policy, and education. Together, these efforts illustrate how geography can anchor climate education that integrates data-driven science with the lived experiences of communities most affected by climate change. The model offers insights for institutions seeking to create climate-focused programs that are inclusive, solutions-oriented, and rooted in place-based learning.
https://symposium.foragerone.com/2026-racas/presentations/80833

Built to Biodegrade: Design Fabrication Analysis of the Potential of Mycelium-Based Materials
Andrew Keady, *Natural & Physical Sciences*
Mentor: Dr. Assia Crawford

Abstract:
This project will explore the development of mycelium-based textiles and biofabricated materials for a sustainable design installation at the Wild Futures Lab. Several creation-based industries, such as textiles and construction, are consistently among the largest contributors to carbon emissions and landfill waste. Through hands-on biological experimentation, digital fabrication,

and material analysis, I developed an installation that demonstrated the potential of living materials in design and architecture. This shows people across important industries the practical solutions that can be found in sustainable material alternatives, further proves to current professionals how realistic mycelium-based solutions can be, helps familiarize viewers with these possibilities, and contributes more research into the ever-growing field of sustainable materials. My focus was on integrating mycelium-based bio-textiles with digitally fabricated structures, creating an exhibit that highlights the intersection of sustainability, material innovation, and aesthetics.
https://symposium.foragerone.com/2026-racas/presentations/81075

Characterization and Mitigation of Signal Noise In the DAQFor Nano-SQUID Project
Lucas Schaab, *Tech, Engineering, & Math*
Mentor: Martin Huber

Abstract:
The Quantum Sensors Laboratory in the physics department is focused on the fabrication of superconducting quantum interference devices (SQUIDs), and more specifically the nanoscale SQUID-on-tip (SOT) for use by our collaborators at CU Boulder for scanning SQUID microscopy. Following the fabrication process these devices require characterization, a challenging endeavor as the devices produced will vary in diameter between 75-200nm. The SOTs therefore have very small output signals, and it is imperative for the project to minimize any external signal noise which could influence the readings from the SOT. My project is to recognize and account for sources of noise which may be intrinsic or externally generated to eVectively characterize our devices. The process of this research involves modifying the existing configuration of the data acquisition (DAQ) system in order to isolate and identify the sources of noise which may be present. My research will employ
spectrum analyzers and oscilloscopes to collect and analyze data. The core instrument of the DAQ, which is most susceptible to external signal noise, is “Calculon”, a device which has been designed and assembled specifically for the work in the Quantum Sensors Laboratory. This device is comprised of three components, an analogue to digital converter (ADC), a digital to analogue converter (DAC), and a microcontroller all of which are housed
inside a Faraday insulated box. This device’s purpose is to convert any digital commands from a computer interface to analog signals for remote control of analog instruments and to convert any analogue signals back to digital signals to be stored and processed by computers. The ultimate goal of all of this work is to establish a robust and automated system for characterizing these SOTs efficiently and increase the throughput of the lab.
https://symposium.foragerone.com/2026-racas/presentations/80904

Characterizing Disease Progression in Glutaric Aciduria Type 1
Courtney Helton, *Biomedical Sciences*
Mentor: Dr. Curtis R Coughlin 2nd

Abstract:
Glutaric aciduria type I (GA-I) is a rare metabolic disorder caused by inherited mutations in the *GCDH* gene, leading to deficiency of glutaryl-CoA dehydrogenase, an enzyme involved in lysine metabolism, and accumulation of glutaric acid and 3-hydroxyglutaric acid. This accumulation can result in metabolic stress, increasing the risk of neurological damage, including striatal injury, that may lead to movement disorders. Clinical outcomes in GA-I vary widely, with differences in neurological progression and emerging evidence suggesting complications such as kidney dysfunction.
To analyze these differences, a Research Electronic Data Capture (REDCap) database is used to collect longitudinal clinical data from individuals with GA-I. The database includes demographic information, genotype, biochemical markers, kidney function measures, neuroimaging findings, and treatment history.
The combined data supports the evaluation of patient outcomes with GA-I, including motor and cognitive development, as well as periods of metabolic stress. The study focuses on how these outcomes change over time and how they relate to factors such as metabolic regulation, treatment history, and timing of intervention.
Although data collection is ongoing, this project establishes a foundation for future analysis and improved characterization of disease progression. Identifying these patterns may guide the development of more precise therapeutics, treatments, and assist families in further understanding this disorder.
https://symposium.foragerone.com/2026-racas/presentations/81010

Climate Change, Internal Displacement and Sustainable Housing within Colorado
Marianna White, *Social Sciences & Humanities*
Mentor: Dr. Ivan Ramírez

Abstract:
Climate change increases migration through direct pathways, via property destruction, intensified storms, floods and wildfires, and indirect pathways, like poverty, famine, and resource-based violence. Climate-fueled internal displacement generates significant and unique stresses on cities, which often absorb displaced people, while also facing pre-existing social and environmental health issues. It is vital for urban centers to plan for climate IDPs and increase their economic and societal resilience. In this presentation, I will focus on Denver, CO and sustainable and ethical housing for IDPs as an adaptive capacity strategy. Denver is vulnerable to systemic issues from a population influx, due to its current housing crisis, heated summers, and high rates of homelessness. I have three main goals to address: mapping and outlining the resources and key players in climate adaptation, climate justice, and climate policy, outlining the current stage of sustainable and affordable housing; and housing and policy recommendations to prepare for the increase in IDPs, that prioritize Denver's carbon reduction goals, and climate justice.
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Climbing the Color Spectrum; Larval Pigmentation Across Elevations
Michelle Majumdar, *Natural & Physical Sciences*
Mentor: Dr. Michael P. Moore

Abstract:
Dragonflies predate dinosaurs by approximately a hundred million years, and is subsequently one of the most stable and durable organisms for studying evolution. They're most commonly studied to point out evolutionary differences and trends in characteristics like sexual selection and flight capacity. With that being said, they're often only examined as adults, which leaves a great deal left to be explored or understood regarding how dragonflies tackle the task of evolutionary adaptation in multiple stages of life. After all, the vast majority of organisms go through a variety of developmental stages in life, and evolutionary adaptations aren't just limited to one stage of the life cycle.
My research is unconventional in the sense that it focuses specifically on dragonfly *larvae* instead of grown dragonflies. One might make the assumption that there's not much information to extract from larvae as opposed to fully grown and developed dragonflies—on the contrary, evolutionary differences do start to manifest as early as the larval stage. In my data specifically, depending on the altitude where the dragonflies were reared, the specific coloration of their bodies was observed to lend insight regarding how these organisms mitigate different levels of ultraviolet (UV) radiation at different altitudes. I'll be comparing larval body coloration against standard paper to see the extent of ultraviolet exposure and how dragonflies show evolutionary differences in their responses to environmental stressors, focusing on whether differences present themselves depending on where the larvae were *born* (collected) as opposed to where they were initially *raised* (reared).
I argue that dragonfly larvae born at higher altitudes tend to have darker bodies to better mitigate the environmental stressors, which lends insight to how many organisms can be designed to withstand challenges around them from the earliest stages of life. This research opens the door to understanding evolution and its benefits from a much wider perspective, and also to the extent of phenotypic plasticity, or the ability to change traits to mitigate environmental challenges, in the earliest stages of development.
https://symposium.foragerone.com/2026-racas/presentations/80990

Colfax Microforrest
Emme Booth, *Social Sciences & Humanities*
Mentor: Sarah Hearne

Abstract:
The broader problem extends beyond a lack of vegetation. The real issue is that this section of Colfax currently lacks an activated, people-centered public space that encourages residents, commuters, students, and visitors to engage with the neighborhood. At present, the area functions largely as a pass-through space rather than a destination, and some even feel that it is unsafe to stay there for too long.
This contributes to weaker community interaction, lower perceived comfort and safety, underutilized transit-adjacent public space, and limited neighborhood identity. Additionally, the predominance of impermeable surfaces contributes to urban heat island effects, poor stormwater absorption, limited biodiversity, and poor pollinator presence.
Not only does this project contribute to climate resilience in a dense urban space, but it will also help the community to feel more welcoming.
We propose the installation of a dense native microforest within the selected pocket park space along Colfax. The microforest will use native Colorado flora, shrubs, grasses, and pollinator-friendly plants specifically

selected for low long-term maintenance, low water demand, local ecological compatibility, biodiversity support, and long-term resilience. Using native species ensures the space can thrive while perpetuating local ecosystems and reducing ongoing resource inputs. The site will include, layered native plantings, shaded seating / waiting areas, walking pathways, educational signage, and interactive community features.
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Collegiate Indoor Green Space and Student Wellness:An Exploration of the Planned Interior Redevelopment of theTivoli Student Union and Opportunities for ImprovedSustainability and Green Amenities
Sean Rumley and Jared Byrum, *Social Sciences & Humanities*
Mentor: Kirsten Christensen

Abstract:
Owned and operated by the Auraria Higher Education Center (AHEC) and serving three separate colleges, the Tivoli Student Union serves Colorado's largest student body of over 38,000 individuals. As AHEC endeavors to reimagine and redevelop the interior of the 1882 building, numerous opportunities exist to enhance sustainable development (ZGF, 2026). Versatile greenery and improved natural light provide multidimensional services through urban agriculture, education opportunities, and food equity initiatives to support the Auraria community. The reality of climate change presents Denver with the responsibility to design thoughtful spaces with the capacity for circular practices rooted in general welfare and ecological innovation. An urban node that provides for both its environment and its people is magnetic. This case study outlines a series of student-first approaches AHEC can take during this redevelopment to enhance student experiences, improve indoor green amenities, reduce campus food insecurity, and better integrate aesthetic and functional improvements to the building interior. The Tivoli Student Union serves a diverse population, eager to redefine the relationship between urban space and public wellness. Therefore, this project embodies an investment in the city's economic and civil prosperity. The success of the Tivoli is contingent on AHEC's ability to prioritize elements of community engagement and environmental revitalization. With the incorporation of the strategies examined in this case study, we are confident the Auraria Campus will emerge as a pillar for metropolitan resiliency.
https://symposium.foragerone.com/2026-racas/presentations/80934

Comparative Analysis of Neurodivergent Children in Ecuador and Colorado
Danna Carroll and Isabella Ridenhour, *Social Sciences & Humanities*
Mentor: Jonathan Safer-Lichtenstein

Abstract:
Neurodivergent children with autism and ADHD and their families in Latin America face significant barriers to accessing evidence-based interventions, including limited provider availability, high costs, and a lack of specialized services. Across Latin America, approximately 76% of families with autistic children report difficulties accessing services during the elementary years, and in Ecuador, many caregivers express concern about their child's developmental trajectory due to insufficient resources. Hispanic families, particularly those outside the United States, remain underrepresented in intervention research, limiting the generalizability of existing findings.
Unstuck and On Target (Unstuck) is an executive functioning (EF) intervention originally developed in the United States as a school-based program for children ages 8–11 with autism and/or ADHD. The intervention targets deficits in flexibility, planning, and emotional regulation by teaching skills that support EF development. While Unstuck has demonstrated effectiveness in U.S. populations, its applicability in Latin American contexts remains largely unexplored.
The larger overarching project addresses these gaps by piloting a Spanish-translated, clinic-based version of Unstuck in both Aurora, Colorado, and Quito, Ecuador, and conducting a comparative analysis with a sample of Spanish-speaking Hispanic families in Colorado. The study utilizes a pilot randomized controlled trial (RCT) design in Ecuador, in which 20 caregiver–child dyads are randomly assigned to either an immediate intervention group or a waitlist control group. For the current study, we will be doing comparative analyses of these samples at baseline. The intervention is delivered over eight 90-minute sessions with parallel caregiver training. Baseline, post-intervention, and follow-up assessments include standardized measures of executive functioning, autism and ADHD characteristics, verbal IQ, caregiver strain, EF knowledge, and access to services. Quantitative data are analyzed using SPSS to examine within- and between-group changes, as well as cross-site comparisons, while qualitative data from caregiver focus groups and implementer interviews are analyzed using rapid thematic methods to identify barriers, facilitators, and culturally relevant adaptations. It is expected that the intervention will demonstrate high feasibility and acceptability in Ecuador, along with improvements in child EF and caregiver outcomes.
Comparative quantitative analyses between the Colorado and Ecuador samples are anticipated to reveal similarities in demographic and diagnostic characteristics across sites, alongside differences in baseline EF challenges, caregiver strain, and

service access. Qualitative findings are expected to highlight culturally specific factors influencing engagement and implementation, with suggested adaptations focusing on improving the contextual fit and delivery of the intervention while maintaining its core mechanisms. Findings from this study aim to inform the scalability and cultural adaptation of EF interventions for underserved Hispanic populations in both the United States and Latin America.
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Comparative Analysis of 3D Scanning Modalitiesfor 3D Anatomical Reconstruction of The Wrist
Yara Al Halabi, *Biomedical Sciences*
Mentor: Professor Michael " Bodhi" Rogers

Abstract:
This study conducts a comparison of few 3D laser scanners in order to determine which provides the most accuracy and precision in reconstructing a human wrist model. Such evaluation is crucial for directing future studies aimed at determining the best imaging technique for capturing the intricate anatomy of an open cadaveric wrist. A Daryou dental camera, a Canon DSLR camera, a Panasonic CSI camera and a Revopoint 3D laser scanner are among the scanners evaluated. Agisoft Metashape was used to create 3D models from the gathered scan data using photogrammetry. The results identifies the most dependable scanning as well as points out areas for methodological improvement , especially in fixation procedures to increase model quality and overall accuracy in subsequent research.
https://symposium.foragerone.com/2026-racas/presentations/80838

Comparing Microclimate Conditions on Green Roofs, Cool Roofs and Ground-Level Turf at the Auraria Campus
Moriah Fremd, Hannah Bloom, Jared Bynum, Rose Pejman, and Ella Sartwell, *Natural & Physical Sciences*
Mentor: Dr. Ben Crawford

Abstract:
Green roofs have been an increasingly common strategy utilized in cities to help mitigate the urban heat effect, reduce surface runoff and support biodiversity. 'Cool roofs' are a complimentary strategy in which high-albedo coatings reflect sunlight and efficiently release any heat they absorb. While many studies compare green roofs to conventional and cool roofs, fewer studies look at the comparison between green roof performance relative to ground level turf.
By comparing the ground turf to the green roof we can understand the necessity and benefit for green roofs in urban settings. Our paper will compare environmental conditions within three surface types; cool roof as our control, green roof and ground turf, all located on the Auraria Campus. Surface temperature, NDVI, soil moisture, PM2.5, and PM10 concentrations will be compared between green-roof level and ground-turf level.
NDVI will be collected using a hyperspectral drone, while surface temperature will be measured with a thermal camera. Particulate Matter will be obtained using the *Atmotube PRO* monitor and program.
We expect that the cool roof will exhibit higher surface temperature and potentially higher particulate matter (PM) levels than the green roof. We anticipate higher soil moisture retention and lower surface temperature in the green roof compared to ground turf. Overall, this research will provide data to better understand the contribution of green roofs in mitigating urban climate conditions.
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Computational Screening of FDA-Approved Cancer Drugs for Targeting Altered Proteins in Cholangiocarcinoma
Aariv Arora, *Biomedical Sciences*
Mentor: Daniel Plymire

Abstract:
Cholangiocarcinoma is a rare and aggressive cancer of the bile ducts with limited treatment options and poor survival outcomes. Genomic studies have shown that this cancer frequently involves alterations in metabolic enzymes and regulatory proteins that disrupt normal cellular processes and promote tumor growth. These altered proteins represent potential therapeutic targets, but the rarity of cholangiocarcinoma has limited the development of new targeted drugs. In this project, I investigated whether existing FDA-approved cancer drugs could be computationally repurposed to target proteins commonly altered in cholangiocarcinoma.
Four targets were selected based on reported mutation frequency, biological relevance, and therapeutic significance: IDH1, FGFR2, ARID1A, and BAP1. I hypothesized that some FDA-approved cancer drugs would demonstrate high predicted binding affinity to these targets, suggesting potential relevance for drug repurposing.
Protein sequences were obtained from UniProt, and drug structures were represented in SMILES format from a curated dataset of FDA-approved oncology drugs. Protein–ligand complexes were modeled using the Chai Discovery platform and visualized and converted to PDB format using PyMOL. Binding affinity was estimated using the CSM-Lig server and reported as $-\log_{10}$(KD | Ki),

where higher values indicate stronger predicted binding. Binding scores were compared across all four targets, and the highest-affinity compounds were examined for recurring structural features.
Several FDA-approved drugs demonstrated strong predicted binding to one or more targets, including compounds that showed high affinity across multiple proteins. Analysis of the strongest binders revealed shared structural characteristics such as aromatic scaffolds and heterocyclic groups, suggesting common features that may enhance ligand–protein compatibility. To further evaluate candidate feasibility, a known inhibitor was used for each protein as a control, residue-level interactions were examined using PyMOL, and predicted pharmacokinetic properties of top candidates were assessed using SwissADME.
These results demonstrate that computational screening can be an effective approach for prioritizing existing drugs for further experimental evaluation in rare cancers such as cholangiocarcinoma. While experimental validation is required to confirm biological effectiveness, this study provides a rational framework for identifying candidate drugs and guiding future laboratory research.
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Consequences of The Coca-Cola Company's Transfer Pricing Case for the IRS, Multinational Corporations and the U.S. Economy
Jeni Hale, *Social Sciences & Humanities*
Mentor: Yosef Bonaparte

Abstract:
In an ongoing landmark case, The Coca-Cola Company continues to legally battle the IRS over an audit of the company's transfer pricing practices during the 2007-2009 fiscal years. The company's transfer pricing method was consistent with IRS direction they received in 1996. However, the IRS condemned that same method when they conducted the audit. Recent tax court decisions have mostly favored the IRS but The Coca-Cola Company continues to appeal and defend its positions. This transfer pricing tax case will have lasting and complex implications for the IRS, multinational corporations and the economy as a whole. If the current ruling stands, The Coca-Cola Company will have a tax liability in the billions of dollars to cover the back taxes and accrued interest for their past transfer pricing decisions. There is no question that corporations have the responsibility to pay their share of taxes to support the local infrastructure that benefits their business model. The question this research aims to answer is if an IRS win would lead to positive or negative economic outcomes. This research explores the potential consequences of an IRS win on net corporate tax revenue, corporate transfer pricing strategies, corporate audit defense practices, product price inflation, tax inversion, and job loss.
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Critical Mass Theory
Gracie Northcutt, *Social Sciences & Humanities*
Mentor: Traci Sitzmann

Abstract:
As a research assistant on this project, I contributed to a large-scale review examining when workplace diversity becomes a measurable competitive advantage. Our research focuses on critical mass theory, which suggests that diversity has stronger effects once members of an underrepresented group reach enough representation to meaningfully influence group dynamics and outcomes.
To investigate this, we conducted an integrative conceptual review of 267 studies. A key part of this work involved examining whether prior research used methods capable of actually testing critical mass theory. We found that many studies did not meet those standards, often because they failed to test nonlinear relationships or did not include enough representation to identify a threshold. Among the studies that did meet methodological requirements, most supported critical mass theory, with the average threshold appearing at about 29% representation.
These findings suggest that reaching a diversity critical mass can improve interpersonal dynamics and contribute to outcomes such as employee satisfaction, innovation, organizational reputation, and performance. At the same time, the review shows that these effects depend on context, including leadership, organizational equity, and broader social conditions.
Through this project, I have helped explore how diversity can move beyond symbolic representation and become a meaningful driver of organizational effectiveness.
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CU Denver: Spanish Program Needs Analysis
Reagan Brandenberg and Yoltzin Tadeo-Romero, *Social Sciences & Humanities*
Mentor: Dr. Alyssa Martoccio

Abstract:
This presentation summarizes Phases 1, 2, and 3 of an ongoing Program Evaluation (Needs Analysis) of the Spanish Section within the Department of Modern Languages at CU Denver. Initiated in Fall 2023, the project seeks to better understand the needs, preferences, and experiences of students enrolled in Spanish programs, with the overarching goal of improving enrollment and retention across majors, minors, master's students, and certificate participants.
During the 2024–2025 academic year, Phase 1 focused on initial data collection and analysis, the results of which are currently being prepared for publication in an academic paper. Building on these findings, the 2025–2026 academic year will center on Phases 2 and 3. Phase 2 emphasizes the dissemination of Phase 1 results and the implementation of key action items derived from the data. This includes developing visual representations such as tables and figures, as well as sharing findings with relevant stakeholders to inform program improvements.
Phase 3 expands the scope of the project beyond the Spanish Section by collecting and analyzing data from additional departments within the College of Liberal Arts and Sciences (CLAS), other colleges at CU Denver, and Modern Languages departments across Colorado and the United States. This phase aims to provide comparative insights and identify broader trends in language education.
https://symposium.foragerone.com/2026-racas/presentations/80870

Cultivating Institutional Flourishing: A mixed methods study of faculty well-being and structural support
Nihashini Ranjit, Emmeline Gale, and Chrysantha Davis, *Social Sciences & Humanities*
Mentor: Dr. Annika Mosier

Abstract:
Approximately 64% of university faculty report experiencing burnout (American Psychological Association), underscoring an urgent need for institutions to better support faculty well-being. In response, universities can implement targeted, evidence-based services that reduce stress and foster faculty flourishing. Because faculty well-being is closely linked to teaching quality, productivity, and student success, strengthening institutional supports is a strategic investment in the broader campus community. This project aims to develop a campus-specific, evidence-informed approach to faculty flourishing at CU Denver. Guided by the PERMA-V model (Positive Emotion, Engagement, Relationships, Meaning, Accomplishment, and Vitality; from Dr. Martin Seligman's well-being theory in Positive Psychology), this mixed-methods study examines faculty well-being and identifies campus-specific structural and programmatic supports. We will integrate findings from (a) a targeted literature review on faculty flourishing, (b) a review of faculty well-being initiatives at local and national universities, and (c) data from a survey and focus groups on local faculty input. Our literature review suggests faculty flourishing is positively influenced by interventions in three main areas: (1) culture, connection, and recognition; (2) supporting individual growth and development; and (3) workload redesign and purpose. Preliminary analyses indicate that although University of Colorado campuses offer many programs and resources that promote student well-being, fewer comparable resources are designed to support faculty and staff. Across available campus resources, offerings most commonly align with the Engagement and Accomplishment PERMA-V domains, with fewer supports addressing Positive Emotion and Meaning. Current efforts are evaluating CU Denver faculty perspectives on flourishing via survey results and focus-group findings using qualitative and quantitative analyses. Ultimately, this project will translate evidence from the literature, peer-institution practices, and CU Denver faculty perspectives into actionable recommendations to improve faculty flourishing. Strengthening supports for our campus community is essential to institutional growth, student success, and sustainable productivity.
https://symposium.foragerone.com/2026-racas/presentations/80927

Data Analysis and Calibration of Scintillation Detector
George Spilver, *Natural & Physical Sciences*
Mentor: Dr. Anthony Villano

Abstract:
Scintillation detectors are devices that output a voltage that varies when certain kinds of particles interact with the detector. These detectors can be used to observe cosmic ray interactions and radiation from nearby sources, including environmental gamma rays and muons reaching Earth's surface from the atmosphere. For the voltage measured from the detectors to be useful, the device and the software that it connects to must first be set up and calibrated. This project introduces the proper setup of the detector and software and establishes a system for extracting and manipulating the resulting data to gain valuable information about the detected interactions. To accomplish this task, the detector was connected to an oscilloscope to initially observe the detector's voltage output, as well as to a computer to store the data over time. Python code was used within JupyterLab to manipulate this captured information to generate graphs visualizing data from different sessions and detector

parameters together. A Monte Carlo simulation of the detector was generated and used to estimate the probability distribution of muon path lengths as they travel through the detector, and therefore the energy deposited in the detector by these muon interactions. Using known values for incoming muon angular distribution and average muon energy deposited per unit length, this simulation allowed the data to be properly calibrated, revealing the energy levels the detector voltage represented rather than the arbitrary values of the raw output. This project facilitated the learning of various tools for particle physics which enabled the calibration and interpretation of scintillation detector data. This presents the opportunity to gain information about local cosmic rays such as incoming particle rate, energy, and lifetime.
https://symposium.foragerone.com/2026-racas/presentations/80978

Defining Well-Being: Associations with Cardiovascular Risk Among African Americans in the MIDUS Study
Mahnoor Awan, *Biomedical Sciences*
Mentor: Jennifer Morozink Boylan, Ph.D

Abstract:
Background: This project examines how definitions of well-being derived from the Midlife in the United States (MIDUS) study relate to cardiovascular risk factors among African American adults. Specifically, we are investigating whether qualitative descriptions of what individuals believe makes life go well are associated with objective cardiovascular indicators. Prior research suggests that psychosocial well-being and social relationships are important determinants of cardiovascular health, yet less is known about how culturally grounded definitions of well-being influence these outcomes within specific populations.
Methods: Data were drawn from Wave 2 of the Midlife in the United States (MIDUS) study. The present analyses focused on African American participants (n = 395). Respondents provided open-ended answers to the prompt "What do you do to make your life go well?" These responses were coded by a group of judges to identify recurring well-being themes. Analyses focused on subthemes endorsed by at least 5% of participants (approximately 25 themes), with the most common themes including specific subgroups within the overarching themes of faith, positive social relationships, and positive emotions. Cardiovascular health (CVH) was assessed using the American Heart Association's Life's Essential 8 framework, which includes four health behaviors (diet, physical activity, nicotine exposure, and sleep) and four health factors (body mass index, blood lipids, blood glucose, and blood pressure). These components were used to generate a composite CVH index. This index was then compared between participants who endorsed these common well-being themes and those who did not in order to determine whether responses played a role in overall CVH health.
Results: Overall, participants who endorsed certain well-being subthemes demonstrated higher mean CVH scores. The subthemes associated with the greatest differences in mean CVH included engaging in physical activity, spending time with friends, communicating effectively, eating well, relying on a higher power, minimizing stress, and being hardworking.
https://symposium.foragerone.com/2026-racas/presentations/81023

Design and Normative Analysis of the Alameda Avenue Project
James Hoslchen and Jessie Aldridge IV, *Social Sciences & Humanities*
Mentor: Kirsten (Kris) Christensen

Abstract:
In line with the goal to end traffic deaths stemming from Denver's Vision Zero initiative, Denver's Department of Transportation and Infrastructure (DOTI) has focused on addressing the high-collision corridor of Alameda Ave. Where standard procedure had at first been followed, a last-minute change from a lane reduction to a lane repurposing instead serves as a contentious litmus test for what principles the city abides by when deciding and implementing public infrastructure. While claiming that both proposals adequately address the needed safety improvements and are in line with best design practices, where there is a glaring difference is their adherence to the principles of citizen participation and public trust. In determining the relationship between DOTI's design choices and best urban design practices, and the democratic normative environment in which they were made; we weigh the design merits of the two proposals in question, utilizing collision, traffic, semiotics, and demographic data to spatially visualize the safety improvement to this corridor; we analysed whether DOTI's procedural steps and own internal policies invoked citizen participation; we synthesized local media reporting and the broader public commentary on the controversial project change from a lane reduction to a lane repurposing, as a source of journalistic analysis and aggregated citizen opinions respectively. Urban design cannot stem solely from physical metrics, and considerations for the social impacts of a design and the process by which it comes about are critical to the long-term viability of a relationship between a bureaucracy and its constituents. Where within citizen participation DOTI's procedures broke down will be identified, and the effects of lost public trust will be established. Recommendations will be provided for how Denver can amend its municipal management in a manner that ensures the adherence to democratic values, so that such breakdowns in public trust are unlikely to happen again.
https://symposium.foragerone.com/2026-racas/presentations/80996

Design, Fabrication, and Testing of Alternative Artificial Muscles
Matthew DeVries, *Biomedical Sciences*
Mentor: Dana Carpenter

Abstract:
According to a study on myoelectric prosthetics (prosthetics controlled via nerve interface), upper limb prosthetics can range between $25,000 - $50,000 for a below-the-elbow prosthetic and $50,000-$75,000 for an above-the-elbow device [1]. These costs, while sometimes partially covered by insurance or the Department of Veterans Affairs, still lands these devices squarely in the realm of cost-prohibitive for many people. A large amount of the production cost comes from the specialized actuators and drivers necessary to produce motion in a very limited space. In this project I have researched notable alternative actuators for use as artificial muscles in the design of prosthetic devices, aiming for designs that minimize cost and perform similarly to organic muscles in response time, force output, and energy requirements. Additionally, typical actuators utilized in existing devices increase device complexity by requiring additional mechanics to convert rotational motion into the linear forces utilized by organic limbs, but also increase weight by needing heavy metals in construction. A 2020 study on the rates of prosthetic usage in upper-limb amputees, 44% of upper limb amputees at all levels reject the usage of a prosthetic device. In the study, 92.86% used a device actuated via electrical impulses from muscles, and 7.14% used purely mechanical. The primary complaint among participants was the comfort (60.87%) and the weight (52.17%), with 43.48% also complaining about the function of the prosthetics. In users who rejected the usage of a prosthetic, 70% complained about comfort, 70% complained about weight, and 50% complained about function [2]. Alternatives researched in this project thus also aim to emulate the natural linear contractile motion to enable more intuitive function of the device while staying as light as possible. Research into affordable, effective actuators provides more options for prosthetic design, and in turn enables more innovation into accessible assistive devices.
[1] Resnik, Linda. “Advanced Upper Limb Prosthetic Devices: Implications for Upper Limb Prosthetic Rehabilitation.” *ScienceDirect*, vol. 93, no. 4, 2012, pp. 710-717. *ScienceDirect*, https://www.sciencedirect.com/science/article/pii/S0003999311009750.
[2] Salminger, Stefan. “Current rates of prosthetic usage in upper-limb amputees - have innovations had an impact on device acceptance?” *Disability and rehabilitation*, vol. 44, no. 14, 2022, pp. 3708-3713, https://pubmed.ncbi.nlm.nih.gov/33377803/.
https://symposium.foragerone.com/2026-racas/presentations/81024

Desky: The Embodied RAG Assistant
Elyas Larfi, Christian Mandujano Borjas, and Ridwan Mohamud, *Tech, Engineering, & Math*
Mentor: Dr. Salim Lakhani

Abstract:
Knowledge workers and students increasingly struggle with "context-switching" fatigue as they navigate disconnected digital tools like email, calendars, and personal notes. While existing voice assistants provide basic utility, they often lack the deep personalization, long-term memory, and emotional intelligence required to be truly effective productivity partners. Furthermore, current productivity automation software typically lacks a physical presence, limiting user interaction to desktop applications. Desky addresses this gap by introducing an affordable, desk-based robot that serves as a proactive, embodied AI assistant.
The system is powered by a Large Language Model (LLM) integrated with a Retrieval-Augmented Generation (RAG) pipeline, enabling it to access a local Qdrant vector database for long-term memory storage. This architecture allows the assistant to maintain contextual awareness of a user’s specific role, projects, and personal preferences. Built on a Jetson AGX platform, the hardware features a 3D-printed embodiment with a screen for facial expressions, a monochrome camera for perception, and a robotic arm with multiple degrees of freedom for physical interaction.
Functionally, Desky utilizes speech-emotion classification to adapt its responses and visual "eyes" to the user's mood. Through specialized tool-calling capabilities, it can manage calendars, draft emails, and interact with Notion databases autonomously. By bridging the gap between digital automation and robotic embodiment, this project demonstrates a future where AI assistants act not just as reactive tools, but as proactive, emotionally aware companions integrated into the physical workspace
https://symposium.foragerone.com/2026-racas/presentations/80956

Detecting Cyber-Suspicious Behavior in Space
Katie Lowerre and Simon Herz, *Tech, Engineering, & Math*
Mentor: Data Mine of the Rockies

Abstract:
Evidence has shown some Resident Space Objects (RSOs) have exhibited behaviors inconsistent with their cataloged status or declared function. These anomalies may indicate deliberate attempts to mask operational activity, avoid detection, or interfere

with other nearby RSOs. This project aims to bolster cyber cognizance for Space Domain Awareness (SDA) by developing standardized approaches to detect, track, monitor, and report on cyber-suspicious indicators.
The approaches fulfilled by this project will include prototype development of a User Interface (UI) with accompanying User Experience (UX) scenarios to autonomously detect and assess Cyber-suspicious behaviors. Prototype development will include an interfaceable cyber classification framework that characterizes the behavior of questionable RSOs. Using multiple data sources to identify behavioral trends, analysts will establish a baseline for labeling abnormal behaviors, and flag deviations that may warrant further analysis or escalation. Prototyping will include crafting a threat scoring engine and operator-facing module aligning detection and classification outputs producing actionable intelligence. The interface seeks to provide analysts with a clear understanding of object behavior, automated risk assessments, and evidence to guide escalation decisions.
Project Objectives:
1.Define a standardized observational method to identify abnormal behaviors of Resident Space Objects (RSOs) which appear inconsistent with their cataloged status or declared function.
2.Define a standardized data classification framework and a benchmark method of labeling behaviors that characterize RSOs exhibiting cyber-suspicious indicators across multiple orbital domains (i.e., LEO, MEO, GEO, etc.).
3.Define a standardized threat assessment and scoring method to quantitatively produce a Risk Score for RSOs bearing cyber-suspicious indicators.
4.Encapsulate the above objectives into a framework for a User Interface (UI) with accompanying User Experience (UX) scenarios capable of enabling operators and analysts with increased situational awareness of active Cyber activities.
https://symposium.foragerone.com/2026-racas/presentations/80868

Developing Models of Menin Inhibition for Pediatric B Cell Leukemia
Sarah Issa, *Biomedical Sciences*
Mentor: Patricia Ernst

Abstract:
Infant B-cell acute lymphoblastic leukemia (B-ALL) driven by rearrangements of the *KMT2A* gene remains a highly aggressive leukemia with poor clinical outcomes. These rearrangements create fusion oncoproteins that require interactions with the chromatin-associated scaffold protein menin to maintain leukemic gene expression programs. Small-molecule menin inhibitors such as revumenib have recently shown promising clinical activity; however, the extent to which pharmacologic inhibition fully replicates genetic loss of menin remains unclear. To investigate this question, we developed a conditional mouse model of *KMT2A*-rearranged B-ALL in which menin can be genetically deleted following leukemic transformation. Using this system, leukemic progenitor cells were generated through transformation with KMT2A fusion oncoproteins and subjected to either genetic menin deletion or pharmacologic inhibition using the menin inhibitor VTP-50469. RNA sequencing was performed to characterize transcriptional changes associated with each perturbation. Differential gene expression analysis revealed that menin loss resulted in significant downregulation of canonical *KMT2A* target genes, including *MEIS1*, *HOXA10*, and *EYA1*, consistent with disruption of the leukemic transcriptional program. While both genetic deletion and drug inhibition affected overlapping pathways, differences in gene expression patterns were observed, suggesting that pharmacologic inhibition may not fully recapitulate the effects of complete menin loss. These findings highlight potential mechanisms of incomplete drug response and provide insight into transcriptional pathways that may contribute to resistance to menin-targeted therapies. Understanding these differences may help improve therapeutic strategies for infants with *KMT2A*-rearranged B-ALL.
https://symposium.foragerone.com/2026-racas/presentations/81031

Development of a classroom activity exploring quantum phenomena using authentic, research-grade code on the AMOSGateway
Abbie Hollmann, *Natural & Physical Sciences*
Mentor: Dr. Kathryn Hamilton

Abstract:
Computation and simulation are now widely adopted in physics classrooms, typically with the goal of enhancing students' conceptual understanding or providing a familiar context within which students can learn the basics of computer programming. These experiences, while very valuable, do not typically reflect how professional physicists use computation to perform research. To provide students with a more authentic way of engaging with computation, and to explore contexts beyond the level of typical educational simulations, we have developed an activity exploring Above Threshold Ionization using research-grade software. The code we will use, the R-Matrix with Time-dependence (RMT) method, is deployed on the Atomic, Molecular, and Optical Science Gateway (AMOSGateway), a web-based platform which provides accessible user interfaces for a dozen state-of-the-art AMO physics software suites. Students can select different input parameters (such as laser wavelength and intensity), choose a supercomputing resource, and make plots of their results all directly on the AMOSGateway. This allows students to explore concepts and phenomena that are typically idealized in lecture classes in the same way that a professional

physicist might do so. Using research-grade code creates an opportunity to engage authentically as a physicist, with implications for both conceptual learning and physics identity formation.
https://symposium.foragerone.com/2026-racas/presentations/80935

Development of a Microfluidic Device for Measuring Fibrinolysis
Raseel Zmily and Julie Nguyen, *Tech, Engineering, & Math*
Mentor: Keith Neeves

Abstract:
Fibrinolysis is the process by which blood clots, and specifically the biopolymer fibrin that holds them together, are broken down in the body. It is dysregulated in many diseases, including inherited and acquired bleeding disorders, which often present as heavy menstrual bleeding in women. Laboratory measurements of fibrinolysis are typically macroscopic, gel-based turbidity assays absent of spatial information. Here, we have developed a microfluidic platform to measure fibrinolysis at the microscopic-scale which enables high resolution and spatial-temporal information. A fibrin gel was formed in channels perpendicular to and connected with a flow channel. Plasmin, an enzyme that lyses fibrin, was perfused through the flow channel, and fibrinolysis was monitored over time using confocal microscopy. Successful loading and polymerization of fibrin gel within the platform has been confirmed by confocal microscopy of fibrin fibers. We have observed the formation of a fluid-air interface during fibrin polymerization, likely due to Marangoni flows driven by evaporative effects. In vivo, fibrin at blood-air interfaces form a protective film around the blood clot to limit microbial invasion. This interface may also influence fibrin structure and plasmin transport within the microfluidic device and therefore warrants further investigation.
https://symposium.foragerone.com/2026-racas/presentations/80922

Development of a Reproducible Pipeline for Confocal Image Processing and Quantification
Jacqueline Ruiz Rivera, *Biomedical Sciences*
Mentor: Brisa Peña

Abstract:
This project developed a reproducible pipeline for confocal image processing and quantification. Cells were stained with MitoTracker, phalloidin, and DAPI, and images were collected under consistent conditions. Image analysis was standardized using uniform thresholding and region of interest (ROI) selection.
Overnight incubation in serum-free media improved image clarity and reduced background fluorescence compared to standard conditions. Overall, standardizing both sample preparation and image processing increased the consistency and reliability of results, providing a framework for reproducible confocal microscopy analysis.
https://symposium.foragerone.com/2026-racas/presentations/80887

Director and Production Designer
Sophia Sherman and Christine Galvez, *Arts & Media*
Mentor: Edward Tyndall

Abstract:
Post WW2 Berlin was an environment that imbued its population with paranoia, and left a lasting impact on numerous generations to come. The Red Scare demonstrates America's intrinsic fear of ideological threats, and our short film “The Scare,” explores what happens on the individual scale when we leave that belief unchecked. Even more so, deaf and disabled populations are a community that are often forgotten when thinking about the inflicted trauma of that time period. The goals of this project are to elucidate the lasting effects of Cold War paranoia through the lens of a young girl (Terry Galloway) who is losing her hearing in both ears. Terry is unaware of the dangers around her, and throughout the course of the short film is faced with a rude awakening when Cold War tensions start to impact her life. She oscillates between the two contrasting ideologies that encapsulate “The Scare”: Complacent denial, and cynical distrust. Using sound mixing and auditory editing techniques we emphasize the Berlin experience through the lens of our Deaf protagonist by balancing Terry’s POV with the real world events that she’s not processing. Utilizing detailed captions for hard of hearing viewers, and fleshing out the environment and visual aspects as accurately as possible, we can engross audiences into the stakes of the world in tandem with Terry’s internal experience, allowing the historical tensions to be told not only through narrative but also visual and auditory storytelling.
https://symposium.foragerone.com/2026-racas/presentations/80933

Discovery, Function, and Evolution of Recombinase-Associated Antiphage Defense Systems
Navtej Singh, *Biomedical Sciences*
Mentor: Breck A. Duerkop, Ph.D.

Abstract:
The rise of multidrug-resistant infections has renewed interest in bacteriophage therapy, but bacteria encode diverse antiphage defense systems that block phage replication. We identified a two-gene antiphage operon on the conjugative plasmid pTEF2 of vancomycin-resistant *Enterococcus faecalis* V583, consisting of a small serine recombinase (EFB0058) co-transcribed with a Type IV restriction enzyme (EFB0059). Selection of escape phages revealed TifA, a phage-encoded anti-defense factor, establishing an active coevolutionary arms race at this locus. Because serine recombinases are frequently associated with mobile genetic elements that shuttle defense cassettes across bacterial genomes, we developed RADS (Recombinase-Associated Defense Search), a phylogenetically agnostic bioinformatics pipeline that uses EFB0058 as bait. RADS recovers every major known defense family in both Bacillota and Bacteroidota, and uncovers novel antiphage families including KAP P-loop NTPases and bacterial Schlafens, validated by phage-challenge assays. These findings redefine how antiphage defenses are discovered and raise concerns that mobile antiphage systems may spread under clinical phage-therapy selection.
https://symposium.foragerone.com/2026-racas/presentations/81018

Distinct Roles of C2A and C2B Domains in Curvature-Dependent Membrane Interactions of Synaptotagmin-7
Stephanie White, *Biomedical Sciences*
Mentor: Dr. Knight

Abstract:
Pancreatic beta cells play a critical role in maintaining glucose homeostasis by releasing important molecules such as hormones and neurotransmitters through membrane fusion. This process is known as regulated exocytosis, and it allows cells to communicate and respond to changes in the body, including metabolic demands. A key protein involved in this process is Synaptotagmin-7 (Syt7). Syt7 contains two membrane-binding regions called C2 domains, known as C2A and C2B. In the presence of calcium ions, these domains insert into membranes that contain negatively charged lipids such as phosphatidylserine (PS). While both domains contribute to membrane binding, it is still unclear how they interact with membranes of different shapes and compositions. Membrane curvature changes dramatically during exocytosis and can influence how proteins such as Syt7 bind. To investigate this question, we have studied how the C2A and C2B domains interact with liposomes, which are small artificial membrane vesicles that mimic the structure of biological membranes. Using stopped-flow fluorescence spectroscopy, membrane binding strength can be approximated by measuring the rate at which each protein domain detaches from the membrane surface. Liposomes, containing varying levels of phosphatidylserine (10–50%) and different diameters (30 nm, 100 nm, and 200 nm) allow us to test how membrane composition and curvature influence protein binding. Our preliminary results suggest that the C2A domain binds membranes more strongly, and show sensitivity to membrane curvature only at low PS, while the C2B domain displays more curvature dependence at high PS concentrations. One possible explanation is that these domains may interact with membranes in a way that slightly deforms or organizes lipids—which would be easier with larger liposomes. Understanding how these domains function differently will improve our understanding of how Synaptotagmin proteins regulate membrane fusion. Clarifying this protein's role in insulin secretion will contribute to a broader understanding of how cells control secretion and communication.
https://symposium.foragerone.com/2026-racas/presentations/81076

Documentary Production - Research Phase
Angellina Fioretto, *Arts & Media*
Mentor: Hans Rosenwinkel

Abstract:
Worked with filmmaking professionals to develop and produce a variety of impactful documentary series that shed light on critical global issues—environmental protection and human trafficking—through compelling storytelling and real-life case studies. This included working heavily on the pre-production side by conducting research and outlines on the documentary topics at hand.
https://symposium.foragerone.com/2026-racas/presentations/80846

"Don't Push Me 'Cause I'm Close to the Edge": Narrative Strategies and Mental Health Discourse in Hip-Hop
Bella Natalizia, *Social Sciences & Humanities*
Mentor: Lacy Lowrey

Abstract:
In 1982, Grandmaster Flash described being "close to the edge" through jungle metaphors and environmental chaos. In 2015, Kendrick Lamar recorded himself sobbing and gasping as he confronted his depression. Both songs address mental health crises. Both serve therapeutic functions. But between these two moments lies a profound transformation in how hip-hop artists communicate emotional vulnerability. This project asks: how have hip-hop's narrative strategies for expressing mental health evolved from the genre's early eras to the present, and what cultural negotiations around masculinity and authenticity have enabled this evolution?
Hip-hop has functioned therapeutically for marginalized communities since its South Bronx origins, yet the genre's hypermasculine culture has historically constrained emotional expression. Using narrative theory—Fisher's concept of humans as storytellers, Richardson's distinction between content and form, and McDonald's situation models—I analyze four representative songs spanning 1982 to 2015. I argue that hip-hop's therapeutic function has remained consistent, but the narrative strategies enabling that function have fundamentally transformed. Pre-2000s artists like Grandmaster Flash ("The Message") and the Geto Boys ("Mind Playing Tricks on Me") used what I call "constrained narratives": collective voice, environmental metaphors, and survival framing that expressed vulnerability without appearing weak. Post-2000s artists like Kid Cudi ("Soundtrack 2 My Life") and Kendrick Lamar ("u") center mental health explicitly through direct confession and narrative complexity, redefining authentic Black masculinity to include emotional honesty.
This research reveals how storytelling innovation enables cultural transformation, explains documented increases in hip-hop's mental health discourse, and offers insights for destigmatizing men's mental health across male-dominated cultural spaces.
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e: Gamification as a Behavioral Intervention for Improving Assignment Submission Compliance in Higher Education: A Canvas LMS Study
Ahmed Saygili, *Social Sciences & Humanities*
Mentor: Shawn Enriques

Abstract:
Late and missing assignments represent a persistent challenge in higher education, with documented negative consequences for student academic performance and instructor workload management. This study examines the efficacy of gamification as a low-cost behavioral intervention within Canvas LMS to reduce late and missing assignment submissions among undergraduate students at the University of Colorado Denver.
Employing a quasi-experimental treatment-control design, two sections of the same undergraduate course were selected for participation. The treatment group (54 students) will be exposed to a gamified learning environment featuring streaks, badges, experience points (XP), and a leaderboard, while the control group (51 students) will remain in the standard Canvas interface absent any gamification elements. To isolate the effects of individual features, gamification elements are planned for incremental introduction throughout the spring semester, beginning with individual features and culminating in the full suite of gamification components.
To facilitate data collection and intervention delivery, a custom full-stack web application was developed and integrated with the Canvas API. The platform captures submission behavior in real time, generates daily gradebook snapshots, and provides an administrative analytics dashboard enabling direct comparison of behavioral trends between cohorts. Primary outcome measures include on-time submission rates, late submission rates, missing assignment rates, and longitudinal grade trajectories. The current phase of the study is focused on platform development, data infrastructure validation, and baseline data collection prior to the student-facing rollout. The gamification interface has been developed and internally tested, with introduction to student participants planned for the coming weeks. Quantitative analysis will be conducted at the conclusion of the semester to assess the statistical significance of gamification's effect on submission behavior and academic outcomes.
This research contributes to the expanding literature on educational technology, behavioral economics in academic settings, and student engagement, offering practical implications for instructors and institutions seeking evidence-based interventions to improve student accountability in online and hybrid learning environments.
https://symposium.foragerone.com/2026-racas/presentations/80993

Eddy Covariance Analysis of Urban Land Cover and Carbon Dioxide Emissions Measured in Fort Collins, CO
Juliette Sabre, Lauren Parkinson, Sarah Buckley, and Emma Barnett, *Natural & Physical Sciences*
Mentor: Benjamin Crawford

Abstract:
We are investigating the relationship between heterogeneous urban land cover and magnitudes of carbon fluxes. This research is important to the field of urban climatology because micrometeorological interactions between greenhouse gas emissions are

complex and understudied in locations like Fort Collins, CO, which contain urban and suburban surface elements. Micrometeorological studies of greenhouse gas become of increasing importance as increasingly more people reside in urban settlements continue to grow. With increased understanding of small scale effects of urban design choices on carbon and methane fluxes, policymakers and urban planners can make more informed decisions to improve local air quality for residents. We began our investigation by analyzing Ameriflux Eddy Covariance data from Fort Collins, CO. Measured via sonic anemometer and thermal gas analyzer, the Ameriflux Flux Tower records air temperature, urban energy balance factors, and fluxes at a 30-minute interval from March 2024 to April 2025. Thousands of measurements are aggregated and examined to see when carbon fluxes peak seasonally, throughout the day, and from which wind direction. This information is supported by ancillary data, through remote sensing analysis of NAIP 1m resolution imagery from 2023 and 1m resolution LiDAR data of a 2km by 2km area surrounding the flux tower. Using a Random Forest Model for image classification, the image was classified into 5 land cover types: soil, water, building, street, tree, and grass covers. The source area of the flux tower, calculated using the Kormann model, is overlaid on top of the classified image so each of these land cover types can be analyzed in association with carbon and methane fluxes through wind direction sectors. We expect to see a negative correlation between increased impervious surface and carbon emissions, and more intensive zoned land uses to be associated with increased carbon emissions.
https://symposium.foragerone.com/2026-racas/presentations/81051

Effect of Amniotic Fluid Cell Extracellular Vesicles on Macrophage Phenotype
Alejandro Salazar and Tarren Stepehns, *Biomedical Sciences*
Mentor: Dr. Jeffery Jacot

Abstract:
Studies demonstrated that mesenchymal stem cell-based (MSC) therapies improve motor outcomes in animal models of spina bifida myelomeningocele. Extracellular vesicles (EV), a type of cellular secretion containing signaling molecules, proteins, and genetic material, derived from several types of MSCs, were identified as drivers of spinal defect regeneration.
Amniotic fluid mesenchymal stem cells (AFSC) are ubiquitous in the prenatal environment and serve as an autologous treatment option to base regenerative therapies. However, extracellular vesicles derived from amniotic fluid mesenchymal stem cells (AFSC) have not been characterized. Further investigation is required to understand AFSC EVs immune modulation, which is a key driver of spinal defect pathology.
Here, we studied the impact of AFSC EV on macrophage phenotype to determine if AFSC EV exposure can polarize macrophages to predominantly regenerative or inflammatory phenotypes. AFSCs were grown and stimulated to produce EVs, which were isolated from AFSC growth media. Separately, THP-1 monocytes were grown and transformed into macrophages, which were split between control inflammatory, non-treatment control, control inflammatory with EVs, and only EV exposure groups. Post treatment, macrophages were fluorescent stained with DAPI (nucleus), CD-68 (cell membrane), and CD-206 (regenerative phenotype marker) then observed using immunofluorescent imaging. Fluorescent images were processed and analyzed with Fiji to determine the percentage of CD-206 positive cells in each group.
Macrophage groups exposed to EVs had significantly greater percentages of CD-206 expression compared to controls.
https://symposium.foragerone.com/2026-racas/presentations/80888

Effects of Exercise on Aggression are Sex Dependent
Ciana Beller and Filsan Mawlid, *Biomedical Sciences*
Mentor: Benjamin Greenwood

Abstract:
Exercise is a non-pharmaceutical option for improving symptoms of mood- and stress-related disorders, as well as preventing the development of these disorders. Aggression can be a symptom of stress-related disorders, but the effects of exercise on aggression are not well understood. Existing research has emphasized male aggression by focusing on male-typical rodent models of aggression, while sex differences in aggression remain understudied. Previous studies have shown that male and female rodents express aggression differently; males exhibit aggression in an offensive manner while females exhibit aggression in a defensive manner. However, most aggression models measure only offensive aggression. We aim to determine how exercise affects aggression in both sexes by measuring both offensive and defensive aggressive behaviors. Additionally, we will determine the role of ovarian hormones on the female pattern of aggression through removing ovaries. We hypothesize that exercise will reduce aggression in both sexes, but sex-specific patterns will emerge. We further hypothesize that sex hormones determine sex-specific patterns of aggression and could impact the effect of exercise. Preliminary results support a sex difference in aggression, with males presenting higher levels of offensive aggression, and females displaying higher levels of defensive aggression. Ovariectomized females display reduced aggressive behaviors compared to naturally cycling females, supporting the hypothesis that ovarian hormones are necessary for the female pattern of aggression. Preliminary data indicate that exercise reduce aggression in both males and intact females, but not is ovariectomized females. If confirmed, these data suggest that exercise can reduce sex-specific patterns of aggression, but the effect of exercise in females depends on the presence of ovarian hormones. These results have implications for the treatment of aggression with exercise.
https://symposium.foragerone.com/2026-racas/presentations/80981

Effects of UV Exposure on Aerosol Chemistry in High- Altitude Urban Environments
Edwin Vega-Roman, *Natural & Physical Sciences*
Mentor: Yong Liu, PhD

Abstract:
Anthropogenic emissions increase concentrations of greenhouse gases and atmospheric particulate matter, including aerosols capable of generating reactive oxygen species (ROS). These ROS contribute to oxidative stress in biological systems and have been linked to cardiovascular, neurodegenerative, and respiratory health effects. This project focuses on learning and aims to investigate whether aerosols in high-altitude urban environments, such as Denver, may reveal elevated oxidative potential due to increased ultraviolet (UV) radiation exposure.
Dithiothreitol (DTT) assays were conducted using iron (Fe^{3+}) and copper (Cu^{2+}), transition metals commonly found in atmospheric particulate matter. Metal solutions were prepared at micromolar concentrations and reacted with DTT in a ~pH 7 phosphate buffer following the method described by Cho et al (2005). Reaction mixtures were allowed to react in sealed tubes and sampled at multiple time intervals to quantify DTT consumption over time. Reactions were quenched using 5,5-dithio-bis-(2-nitrobenzoic acid) (DTNB/Ellman's reagent), producing the chromophore 2-nitro-5-thiobenzoate (TNB). Absorbance was measured at 412 nm using a Lambda 365 UV-Vis spectrophotometer to determine remaining DTT concentration and estimate oxidative potential.
Both metals showed DTT linear consumption (R^2 ~ 0.9), indicating the assay is working across multiple trials. The initial time point was excluded for each metal due to variability in reaction initiation and mixing. The results observed were consistent with literature reports of their redox activity. While atmospheric samples were not collected during this phase of the study, these calibration experiments confirm that the assay successfully detects oxidative activity under biologically relevant conditions. Future work will compare UV-aged and non-aged samples and apply the calibrated assay to aerosol particles collected from Denver using a Micro-Orifice Uniform Deposit Impactor (MOUDI).
https://symposium.foragerone.com/2026-racas/presentations/80884

Efficacy of a Novel Drug for Treating Alcohol Dependence in Rats
Genecis Andrade and Lilia Khellaf, *Biomedical Sciences*
Mentor: Dr. Benjamin Greenwood

Abstract:
Alcohol use disorder is considered a leading preventable cause of death. Current treatments for alcohol use disorder are a combination of FDA-approved medications, psychosocial therapies, and mutual support groups. Although these treatments can improve outcomes, many individuals still experience relapse, which is the return of alcohol abuse after a period of abstinence. Given that current treatments are only moderately effective, finding new drugs that reduce alcohol consumption and relapse in alcohol-dependent individuals would be beneficial to public health.
The goal of our study is to illuminate the effects of a novel drug on alcohol dependence and relapse in rats. The mechanism of the drug cannot be disclosed due to a signed non-disclosure agreement. To establish alcohol dependence, adult, female Wistar rats (n=27; 3 groups) were given 15% ethanol for the first 2 hours of the dark cycle for 5 weeks. To establish a relapse model, alcohol was removed for 4 weeks. Then, rats were divided into 3 groups: vehicle, 10 mg/kg of the drug, and 30mg/kg of the drug, administered by oral gavage 90 minutes prior to alcohol exposure. Vehicle or drug-paired alcohol sessions continued 3 times weekly for 2 weeks. Alcohol intake was measured, and blood, brain, and liver tissues were collected to measure drug concentrations. We found that the drug was present in blood and tissues, indicating that the drug was metabolized by the liver and successfully crossed the blood-brain barrier. Compared to the vehicle, neither dose of the drug reduced body weight gain over time. Interestingly, 10 mg/kg (p= 0.0194), but not 30 mg/kg (p= 0.0895), of the drug reduced alcohol intake. This data suggests an inverted-U relationship between drug concentration and effectiveness. In conclusion, this drug shows promise in preventing the relapse of alcohol use disorders.
https://symposium.foragerone.com/2026-racas/presentations/81016

Electron Impact Excitation of Singly-Ionized Neon using B-Spline atomic R-Matrix Code
Abigail Gebremariam, *Natural & Physical Sciences*
Mentor: Kathryn Hamilton

Abstract:
We commonly refer to atoms as the building blocks of life, but atoms themselves are in fact made up of smaller particles called electrons, protons, and neutrons. In one common model of the atom called the Bohr Model, the positively charged protons group together with the chargeless neutrons to form a nucleus at the center of the atom, and the negatively charged electrons are distributed in shells, or roughly circular orbits, around this point. While the electrons have one particular shell, they like to remain in, if we give them enough energy they can jump from one shell to another, a move which is commonly referred to as a

“transition”. In this project we seek to determine how likely it is that the electrons in singly-ionized neon atoms (neon atoms with one electron removed) will make these transitions after they have received different amounts of energy.
To do this, we will perform calculations using a world-leading atomic physics code called the B-Spline atomic R-Matrix (BSR) code. The calculations will be very computationally intense, and so we will use the Texas-based supercomputer Frontera in order to generate results more quickly. The results from these calculations will be shared on a public database. This research has vast applications in Plasma Physics and Astrophysics.
https://symposium.foragerone.com/2026-racas/presentations/81009

Elevated Transit: Denver-Boulder and Beyond
Tareq Alshinawi, Turki Alanazi, and Bassam Alanazi, *Social Sciences & Humanities*
Mentor: Kris Christensen

Abstract:
As Denver and the Front Range continue to grow, this project examines whether a grade-separated elevated transit network could improve reliability, reduce street conflicts, and strengthen regional connectivity without relying on hypothetical claims. We use Honolulu Skyline as a modern U.S. elevated rail case, the West Seattle Link Extension as an example of current American planning, permitting, and governance challenges, Bangkok’s BTS Skytrain as a fully elevated urban system designed to avoid street-level congestion, and Singapore’s MRT as a model of rail-centered network planning and first/last-mile integration (Honolulu Authority for Rapid Transportation [HART], n.d.; Land Transport Authority [LTA], n.d.; Sound Transit, n.d.; Bangkok Mass Transit System Public Company Limited [BTSC], n.d.). These examples help define the broader concept, show how elevated systems work in practice, and identify where this model may best fit Denver–Boulder and beyond.
Our method is a comparative case-study framework that evaluates three linked questions: what problem the system solves, how feasible it is to build and fund, and how sustainable it remains over time. We examine coverage gaps, last-mile access, reliability, network effects, affordability, capital-versus-operating costs, and the tradeoffs between building elevated transit and improving buses, BRT, station safety, and existing rail. We also assess operational emissions, construction impacts, land footprint, resilience, right-of-way, permitting, governance, and public buy-in. The result is a best-fit framework for Denver that identifies where elevated transit makes the most sense: high-demand corridors, major anchors, transfer nodes, and constrained alignments, and where lower-cost options remain the better choice.
https://symposium.foragerone.com/2026-racas/presentations/80930

Elevating Community Voices in Gun Violence Prevention: A Case Study of Community Perceptions of Education Outreach in Colorado
Laura Juliana Zabaleta Arias, *Social Sciences & Humanities*
Mentor: Courtney Leapley

Abstract:
Gun violence in the United States is both a public safety and public health crisis characterized by stark demographic disparities. National data consistently show that from 2010 to 2020, Black males experience firearm homicide rates approximately 10.38 times higher than white males, and gun violence has become one of the leading causes of death for individuals ages 1-17. This study examines how community members who have been directly or indirectly impacted by gun violence perceive prevention education initiatives implemented in Colorado. It seeks to understand whether existing education and outreach efforts resonate with the lived experiences, concerns, and realities of the communities they aim to reach, and how community perspectives might inform the design and implementation of future prevention education initiatives. Qualitative data were collected using a case study approach conducted in partnership with Colorado Ceasefire. Data collection included four facilitated community listening sessions and a survey distributed through community networks to gather perspectives from individuals who were unable to attend the listening sessions. Research examining community narratives of gun violence has shown that individuals living in heavily impacted neighborhoods often interpret firearm violence as an ongoing structural condition shaped by inequality and social marginalization. In contrast, prevention education campaigns frequently emphasize individual behavioral change, such as safe storage practices or awareness of legal prevention tools. This divergence in framing suggests that prevention education may unintentionally overlook the broader social realities through which communities interpret firearm violence. The findings from this study will contribute to broader discussions on community-informed violence prevention strategies and may help inform the development of future education and outreach programs in Colorado.
https://symposium.foragerone.com/2026-racas/presentations/80812

Engineering an In Vitro Exercise Model to Probe Mechanobiological Adaptations in Cardiac Fibroblasts
Grace Spillers, *Biomedical Sciences*
Mentor: Dr. Brisa Pena

Abstract:
Introduction: Exercise exerts well-documented benefits across multiple organs, including the heart, where mechanical loading promotes physiological cardiac hypertrophy and triggers a cascade of mechanobiological adaptations. These include reduced cardiovascular risk, mitigation of oxidative stress, and improved vascular and metabolic homeostasis. In the setting of heart failure (HF), exercise training can counteract pathological remodeling. However, the mechanotransduction pathways that mediate these protective effects remain poorly defined. This gap is partly due to the lack of controlled experimental systems that can reproduce the mechanical and temporal features of exercise. Here, using the heart as a model, we developed an in vitro exercise platform employing electrical stimulation to mimic cardiac training and test whether such stimulation recapitulates beneficial mechanobiological effects in cardiac fibroblasts.
Methods: Rat cardiac fibroblasts were isolated from 12-week-old males, expanded for one week, and used at passage 1. Cells were cultured on glass-bottom plates and subjected to electrical stimulation (2 V, 30 min/day, 4 days). After stimulation, cells were fixed and immunostained for cytoskeletal organization and key mechanobiological markers.
Results: Electrically stimulated fibroblasts exhibited increased cell area (hypertrophic morphology), reduced stress fiber density, and lower α-SMA and ROS intensity compared with controls, suggesting a shift toward a physiological, non-fibrotic phenotype. No changes were observed in mitochondrial morphology or PIEZO1 expression.
Conclusion: This in vitro exercise model reproduces hallmark beneficial effects of cardiac training at the cellular level, enhanced physiological hypertrophy and reduced fibrotic and oxidative signatures, without activation of the mechanosensor PIEZO1, whose upregulation is linked to pathological remodeling.
https://symposium.foragerone.com/2026-racas/presentations/80678

Enhancing Coastal Resilience: Evaluating Flood-Resistant Building Material in Fort Lauderdale
Melane Camarillo and Ramiz Alanazi, *Natural & Physical Sciences*
Mentor: Kirsten Christensen

Abstract:
Flooding is one of the most common natural hazards affecting coastal regions, as communities face increasing threats from rising sea levels and extreme rainfall. This study focuses on Fort Lauderdale, Florida, examining the severe flooding that occurred in April 2023 and the need to improve building resilience. During this event, water levels rose by more than 20 inches above ground (National Weather Service, 2023), causing more than $100 million in damage to nearly 1,100 homes, schools, and public properties (Man, 2023). The event exposed significant weaknesses in existing infrastructure, including inadequate drainage systems and the use of materials that are not resistant to water damage. In addition to physical destruction, the flooding disrupted daily life, displaced residents, and created long-term economic challenges for affected communities. This research evaluates how different building materials, such as reinforced concrete, treated wood, water-resistant insulation, permeable surface systems, and elevated foundation designs, perform under flood conditions and contribute to reducing structural damage. These materials are analyzed based on their ability to resist water intrusion, limit mold growth, and maintain structural integrity during and after flooding events. The study also examines how building codes and engineering practices can support the adoption of more flood-resistant materials and designs. While some of these solutions may involve higher initial costs, they can significantly reduce long-term repair expenses and improve recovery time after disasters. This project highlights the importance of combining an understanding of natural hazards with advanced material selection and engineering strategies to protect vulnerable areas and strengthen resilience against future flooding in coastal regions.
https://symposium.foragerone.com/2026-racas/presentations/80932

Establishing Structural Parameters of the 5'-GUAC sequence as an RNA Motif
Yasmine Barache, *Biomedical Sciences*
Mentor: Dr. Marino Resendiz

Abstract:
RNA is involved in various biological processes such as protein synthesis and gene regulation. RNA can fold into various secondary structures that are important for function, which include hairpins, internal loops, bulges, and pseudoknots; all of which contain double stranded regions. Duplexes can in turn adopt different conformations such as A-form, B-form, and Z-form. We set out to explore the structural features of the 5’-GUAC palindromic sequence which is ubiquitous in viral RNA, examples including Coronavirus (SARS-CoV-2), Human Papillomavirus (HPV) and Rhinovirus (RV); this motif has been found to be involved in viral gene packing. To this end we used circular dichroism (CD), NMR, gel electrophoresis, and computer modeling (*via* Density Functional Theory DFT). The chosen models were 12-mers and 16-mers designed to fold into tetraloop hairpins, or adopt double stranded structures which contained 5’-GUAC tetranucleotide regions in various positions. All oligonucleotides were obtained

via solid phase synthesis, purified using PAGE and characterized with MALDI-TOF spectrometry. Systematic single nucleotide variations were carried out to assess the differences arising as a function of nucleobase within the motif of interest. Unexpectedly, CD spectra corresponding to 5'-GUAC repeat displayed a band with positive ellipticity at 280nm, contrary to typical spectra of A-form duplex regions where this band is missing; furthermore, the intensity of the band was augmented when present in hairpin stems. CD data was combined with NMR (1D & 2D) to determine that changing the 3rd and 4th position induces an inherited disorder in the H-bonding patterns thus causing the band at 280nm to undergo changes. The same trend was observed with hairpins. Current progress about the nature of this sequence motif is expected to lead to a better understanding of the function of viral RNAs.
https://symposium.foragerone.com/2026-racas/presentations/80883

Evaluating Native and Low-Irrigation Vegetation for Urban Cooling in Semi-Arid Cities: MRT Measurements from Denver Botanic Gardens
Anna Blevins, *Natural & Physical Sciences*
Mentor: Benjamin Crawford

Abstract:
Semi-arid cities face escalating challenges from rising temperatures, prolonged drought, and increasing pressure on limited water supplies, making sustainable landscape design a critical component of urban climate adaptation. This study examines whether native plant landscaping, rather than traditional turfgrass, can effectively reduce urban heat and conserve water in semi-arid environments. While often associated with xeriscaping, native landscaping is defined here as the intentional use of regionally adapted vegetation, soil amendments, and efficient irrigation to enhance ecological function.
To evaluate the microclimatic performance of native landscapes, field measurements were collected at the Denver Botanic Gardens from August 21 to October 29. Using handheld microclimate measurement tools, light meters, and infrared thermometers, the study quantified air temperature, globe temperature, relative humidity, wind speed, light intensity, and surface temperature across sun and shade conditions. Mean Radiant Temperature (MRT) was calculated, and background temperature data from the NLR Solar Radiation Research Laboratory were used to normalize measurements.
Preliminary expectations suggest that native plant landscapes could reduce irrigation demand while enhancing thermal comfort through evapotranspiration, whereas turfgrass systems require substantial water and chemical inputs to remain viable in semi-arid climates. This research aims to determine how variations in vegetation type shape both thermal comfort and irrigation needs, providing evidence that can guide cities toward landscape practices that reduce heat exposure, conserve water, and strengthen long-term climate resilience.
https://symposium.foragerone.com/2026-racas/presentations/80840

Evaluating of Gun Policy Strength and Its Relationship to Firearm Mortality
Gabriella Ruyle, Kadence Hill, Kennedy Radcliff, and Timea Dobrosi, *Social Sciences & Humanities*
Mentor: Courtney Leapley

Abstract:
Firearm policy varies widely across U.S. states, creating an opportunity to examine how different legal approaches may relate to firearm death rates. This study explores the relationship between state firearm legislation and gun-related homicide and suicide rates between 2014 and 2023. The analysis focuses on three firearm policies: Right-to-Carry (RTC) laws, Stand Your Ground (SYG) laws, and Child Access Prevention (CAP) laws, which represent different regulatory approaches to public firearm carrying, legal standards for the use of force, and safe firearm storage. State-level data were compiled for all 50 states across the study period, including measures of policy strength and firearm injury-realted deaths, including homicide and suicide rates per 100,000 residents. Using descriptive statistics and correlation analysis, this study examines whether variation in the strength of these laws is associated with differences in firearm death rates across states and over time. The results provide an exploratory overview of how differences in firearm policy environments may correspond with patterns in gun-related deaths.
https://symposium.foragerone.com/2026-racas/presentations/80845

Examining Gun Violence Policies: A Case Study Analysis CAP, SYG, and RTC
Kadence Hill, Timea Dobrosi, Gabriella Ruyle, and Kennedy Radcliffe, *Social Sciences & Humanities*
Mentor: Courtney Leapley

Abstract:
Gun violence in the U.S. remains a critical public health and safety crisis. This study examines how specific policy interventions influence mortality rates, specifically focusing on the effectiveness of Child Access Prevention (CAP), Right-to-Carry (RTC), and Stand Your Ground (SYG) laws. Utilizing data from 2015–2024, the research analyzes homicide and suicide rates among youth (ages 0–19) alongside a 4-point effectiveness scale for state-level policies. Integral to this analysis is the impact of "Ethan's

Law"—legislation inspired by the accidental death of Ethan Song—which advocates for federal safe-storage requirements. By evaluating the implementation of Ethan's Law against national trends, this research argues that stricter CAP, RTC, and SYG regulations are essential to mitigating firearm-related fatalities and promoting public safety.
https://symposium.foragerone.com/2026-racas/presentations/80836

Examining the State of Gun Violence Legislation and School Safety in Colorado During 2013-2024
Valerie Jones, *Social Sciences & Humanities*
Mentor: Professor Courtney Leapley

Abstract:
Gun violence prevention remains an important topic in the U.S., frequently resurfacing in the aftermath of mass shooting events, specifically those affecting educational institutions. The focus of this study is to examine the landscape of publicly available prevention resources for students and educators, including their accessibility. Using descriptive statistics, the research assesses the landscape of school- and community-related gun violence legislation enacted between calendar years 2013 and 2024. By tracking legislative trends alongside gun violence statistics, this study identifies potential correlations between specific policy interventions and fluctuations in firearm-related incidents. This research provides a foundational assessment of current legislative impacts, supporting future causal analysis and evidence-based policy refinement in school safety.
https://symposium.foragerone.com/2026-racas/presentations/80839

Experiential Learning with the Office of Undergraduate Research and Creative Activities
Will Leary, *Social Sciences & Humanities*
Mentor: Elizabeth Evans

Abstract:
My experience working as an Undergraduate Research Assistant in the Undergraduate Research and Creative Activities (URCA) Office, and why I recommend student employment to others.
https://symposium.foragerone.com/2026-racas/presentations/81173

Exploring barriers to accessing behavioral parent training at a children's hospital: Considering if accessibility adaptations address adverse social determinants of health
Anthony Arredondo, *Social Sciences & Humanities*
Mentor: Jacob Holzman

Abstract:
Parenting interventions (e.g., behavioral parent training) are commonly referred by primary care physicians as the first-line treatments for early childhood mental health concerns. Behavioral parent training (BPT) is an effective early intervention addressing behavioral and emotional concerns by encouraging caregivers to practice alternative responses during challenging child behavior to reduce child maltreatment in the form of harsh, insensitive parenting. Although decades of research has shown the effectiveness of behavioral parent training (BPT), there are well-documented access and engagement issues. More research on BPT access and engagement for parents receiving accessible versions of BPT (i.e., brief, group-based, telehealth delivered) is needed. The present study utilized a retrospective chart review including 1,048 families referred to a six-session, group-based, telehealth delivered BPT program in a large children's hospital outpatient clinic. We explored whether parent self-reported health insurance coverage, representing a social determinant of health, was related to differential engagement in this accessible version of BPT. We expect that type of insurance (public or private) will be related to whether families participate in BPT and the number of BPT sessions attended (i.e., engagement). Understanding whether BPT models focused on increasing access and engagement are effective in reaching families is a critical step in addressing the wide treatment gap for early childhood mental health concerns. Adverse social determinants of health represent the broader systems that influence how families interact and engage with treatment. Future adaptations to BPT to further increase accessibility need to account for the impact of adverse social determinants of health on not only access but engagement in BPT.
https://symposium.foragerone.com/2026-racas/presentations/80689

Exploring Gentrification and Health Across the Denver Metro Area
Nancy Ahmed, *Social Sciences & Humanities*
Mentor: Dr. Ronica Rooks

Abstract:
Gentrification can cause vulnerable populations, such as older adults, to be at risk of having decreased health and a lower quality of life. This can be caused by increasing costs of living, limited resources, and loss of community belonging, all of which can act as stressors and negatively impact people. Nationally, we have seen trends that show a correlation between gentrification and quality of life. We will observe whether these trends can be seen in Denver metro neighborhoods, specifically in different census tracts. There is not much research examining the impacts of gentrification on health in communities, especially with older adults and various racial groups. This research will explore gentrification and older adults' health using secondary data from the American Community Survey (ACS), Community Assessment Survey for Older Adults (CASOA), and Denver Regional Council of Governments (DRCOG), with a focus on different racial groups. To determine differences in small geographical areas, we looked at percentages and trends across Denver city census tracts by housing, income, and well-being by race. The results can help in providing a better understanding on how gentrification-related factors can be stressors and negatively impact the health of older adults, with racial minorities and residents in disadvantaged neighborhoods being more at-risk. This is important in understanding more about the effects gentrification has in communities and its impacts on older populations.
https://symposium.foragerone.com/2026-racas/presentations/81014

Exploring Intergenerational Patterns in Parental Communication and Emotional Socialization
Valeria Rebeles, *Social Sciences & Humanities*
Mentor: Laurel Hyslop, Ph.D.

Abstract:
Parental emotional socialization practices are central to children's emotional development, influencing how emotions are understood, expressed, and regulated. The present study aims to examine the relationship between parents' current communication strategies and their recollections of emotional communications in their own childhoods. Additionally, the study explores whether demographic factors are associated with patterns in emotional socialization practices. Participants were recruited through a convenience sample method via personal networking and social media parenting groups. Data collected used self-report measures assessing current parent-child communication and recalled parental communication during childhood. By identifying intergenerational patterns in emotional communication, this study seeks to clarify how early emotional experiences may influence later parenting. Findings may contribute to future research on interventions aimed at improving emotional socialization practices and parent-child relationships.
https://symposium.foragerone.com/2026-racas/presentations/80925

Facilitating Tissue Repair and Wound Healing Response with Extracellular Matrix Scaffold
Brendan Card, *Biomedical Sciences*
Mentor: Dr. Christopher Erickson

Abstract:
Animals can evolve to have extraordinary capabilities and some can seem superhuman in nature. One example is the *Acomys Cahirinus*, a mouse that can heal their body without scars. The reasons behind this ability are unclear but, can be studied and defined. In this project, the biology that underlies regeneration in mammals more specifically, *Acomys Cahirinus* and the traditional lab mouse *Mus Musculus,* will be investigated in order to understand how to improve healing rate and outcomes in ourselves.
During this study, dorsal tissue (skin) from both species will be processed and used to create decellularized extracellular matrix (dECM) scaffolds, which retain the biological components that influence cell behavior. Using a process called mass spectrometry, the scaffolds from both species will be analyzed and compared to one another. They will then be tested by administering them as a treatment in a dermal model of injury for both species. Through both quantitative and qualitative data, their effectiveness in tissue repair will be evaluated. The hypothesis is that *Mus Musculus* will demonstrate improved healing when treated with the *Acomys Cahirinus* scaffold as compared to being treated with the Mus Musculus scaffold.
The focus is to find the ECM components that have regenerative potential. By identifying the driving forces that are linked to regenerative responses, a better understanding of the correlation between specific proteins and beneficial healing is achieved. This work aims to improve the design of scaffold therapies by moving from experimental methods and toward more targeted strategies. As a result of these findings, the foundation of the concepts of healing will expand. In doing so, this project could help create a comprehensive "ECM atlas," a detailed map needed for the rational design of scaffold therapies.
https://symposium.foragerone.com/2026-racas/presentations/80995

FASTLANE: Reinforcement Learning in Autonomous Cars
Manali Raut and Ronald Yu, *Tech, Engineering, & Math*
Mentor: Dr. Ashis Biswas

Abstract:
Think you are sitting in a race car, away from crossing the finish line, where success depends on both speed and precision. While racing in the era of Michael Schumacher symbolized human excellence, the landscape in 2026 is rapidly shifting toward autonomous intelligence. With companies actively deploying self-driving vehicles, the question is no longer whether machines can drive, but how well they can. Gov. Polis and Mayor Mike encourage technologies which improve safety and convenience.
We present **FASTLANE**, reinforcement learning-based framework designed to optimize autonomous racing performance beyond track-specific learning. This research is inspired by ongoing work with physical DeepRacer vehicles in our ML lab, emphasizing real-world experimentation beyond simulation. And we will display DeepRacer car on the event day!
Recent survey on autonomous racing highlights progress across perception, planning, and control, while identifying key limitations in current Reinforcement Learning approaches, namely, the lack of real-world validation in high-speed environments and insufficient incorporation of safety and robustness constraints. Furthermore, many existing systems are trained on fixed track layouts, leading to overfitting to track geometry, poor generalization to unseen environments, and instability under high-speed conditions. This work addresses a critical gap: *Can an autonomous vehicle drive at maximum speed on unseen tracks while maintaining safety and stability?,* especially in complex environments like winter conditions in Denver.
Our approach focuses on building *driver*, not just a vehicle, enabling adaptability across diverse environments. Using AWS DeepRacer platform, we develop and test models that bridge the **simulation-to-reality gap**, incorporating real-world constraints such as friction, lighting variability, and sensor noise through LiDAR. Performance is evaluated using **lap time**, **crash rate**, and **completion rate**.
This work extends beyond racing to broader domains, including **robotic navigation**, and **real-time systems**. FASTLANE contributes towards not just teaching cars *where* to drive, but teaching them *how to drive fast, safely, and anywhere*.
https://symposium.foragerone.com/2026-racas/presentations/80940

Fiber Reinforced Printing
Kestin Kuhn, *Tech, Engineering, & Math*
Mentor: Dr. Guoying Dong

Abstract:
Continuous Carbon Fiber (CCF) 3D printing can produce parts with improved strength coming from Carbon Fiber's specific anisotropic properties, but currently there is a limited availability of software that enables precise control over the placement of the fiber in the printing process. Many experimental parts can benefit from fiber reinforcement but the commercial slicers often enforce uniform tool paths that lead to wasted carbon fiber and increased production times without an increase in the parts performance. Prior work was limited to manual G-code generation, which limits the complexity of samples compared to a conventional slicer, which is limited to the same pattern throughout the part regardless of specific needs. Here we show a software for automated G-code generation while maintaining the ability to generate specific patterns for carbon fiber. The software imports STEP geometry to define regions, constraints for fiber placement, and allows user preferences for all fiber paths without needing to manually control where the automatic process of 3D printing already exists. This software coupled with a commercial slicer allows for increased sample complexity with the maintained control over the fiber placement process. By enabling repeatable control of the fiber printing process further research in reinforcement design studies are now realistic. In the future the software will allow for additional control over the fiber rather than just manual such as parametric design of fiber paths, or FEA driven reinforcement.
https://symposium.foragerone.com/2026-racas/presentations/81001

Field Testing a Non Ferrous Gradiometer Cart System
Gabriel Jeffers, *Natural & Physical Sciences*
Mentor: Michael Rogers

Abstract:
Magnetometers detect small changes in the Earth's magnetic field caused by buried archaeological features. The way these instruments are mounted and transported is vital to the quality of the collected data. This project hopes to test and improve the design of the MKII non-ferrous cart and prove if the cart can be operated without set gridlines. Testing will be conducted by surveying areas around campus and comparing data sets between the models of this cart and different cart set ups and data collection methods.
https://symposium.foragerone.com/2026-racas/presentations/81123

"Finally, the Doctor is...!": A Black Feminist Critique of *Doctor Who*
Lily Pszonowsky, *Social Sciences & Humanities*
Mentor: Katy Mohrman

Abstract:
Pop culture is increasingly attempting to provide audiences with strong, feminist leading characters. The NuWho era of *Doctor Who* is no exception to this trend. However, viewed from a Black feminist perspective, I argue the series has only presented superficial feminist – what scholars call popular feminist – characterizations that offer little substantive critique of patriarchy and white supremacy. More specifically, this presentation contends that *Doctor Who* is not a piece of feminist media based upon an analysis of NuWho era episodes as well as the portrayals of the Doctor and their companions by a variety of actors. Even though a few of the show's characters offer potential opportunities to challenge dominant systems, *Doctor Who*'s producers have not seen these opportunities through. I analyze recent NuWho episodes to examine if the show's use of popular feminist tropes, such as questioning hegemonic gender norms and representation of different types of masculinity – specifically hegemonic and (fragile) geek masculinity – actually challenge or rather uphold systems of (white) male domination. A show that offered an intersectional analysis and challenges to hegemonic systems would reflect theories of Black feminism. Instead, *Doctor Who* reflects theories of popular feminism, a media-friendly and highly visible form of feminism, and postfeminism, a feminism that individualizes systemic issues. I conclude that the show's shallow portrayal of women companions and presentation of misogyny and racism as purely historical phenomena in the series make it an easily consumable popular feminist television series, but not one that challenges ideologies coming from patriarchy, white supremacy, and other systems of oppression.
https://symposium.foragerone.com/2026-racas/presentations/80898

Foresight
Lisa Cho, Sybil Raphael, Paul Kim, and Kyungju Moon, *Tech, Engineering, & Math*
Mentor: Salim Lahkani

Abstract:
In dense urban environments, drivers often waste time and fuel searching for parking, increasing traffic congestion and emissions. **Foresight** is a smart parking assistance app designed to address this problem by providing real-time and predictive parking availability.
Instead of relying on costly IoT sensors, Foresight uses existing camera infrastructure—such as parking garages, lots, and public street cameras—to monitor parking occupancy at scale. Using computer vision, the system detects and segments vehicles from live or periodically updated camera feeds to determine which spaces are occupied.
To go beyond real-time data, Foresight integrates historical parking transactions, weather conditions, traffic patterns, and public event data. These inputs are used to train predictive models, including ARIMA, LSTM, clustering algorithms, and anomaly detection techniques. This hybrid approach enables both accurate live updates and short-term forecasts of parking demand.
Foresight also incorporates license plate recognition to distinguish between paid and unpaid vehicles, supporting automated enforcement and reducing operational workload for parking providers.
All insights are delivered through a cross-platform mobile app that guides users to optimal parking locations based on estimated arrival time, availability, and proximity to their destination. Features such as heatmaps and predictive maps help both drivers and city planners understand demand patterns and high-traffic areas.
The system will be evaluated through real-world testing by comparing average parking search times before and after use. By combining scalable camera-based sensing with data-driven prediction, Foresight aims to improve urban mobility, reduce congestion, and enhance the overall parking experience.
https://symposium.foragerone.com/2026-racas/presentations/80952

From Campus to Career: Exploring How On-Campus Student Employment Fosters Career Readiness
Summer Svedlow, *Social Sciences & Humanities*
Mentor: Daniel Young

Abstract:
On-campus student employment is more than a means of financial support—it is a powerful, high-impact practice that fosters career readiness, personal growth, and holistic student development. This session explores how thoughtfully designed student employment experiences in LynxConnect contribute to skill development, confidence building, and meaningful professional preparation.
https://symposium.foragerone.com/2026-racas/presentations/81047

From Campus to Career: Shaping Employment Into Student Success
Kendra Lupercio, *Social Sciences & Humanities*
Mentor: Daniel Young

Abstract:
This project documents my professional trajectory as an Administrative Specialist at LynxConnect, where I transformed an opportunity to be a student employee into effective professional development. My journey began in October 2025 with a clear challenge: transitioning from a commuter student with no prior office experience into a confident, direct communicator capable of managing administrative tasks.
This project described the formation of a professional identity grounded in the NACE Competencies. By applying my personality traits to office expectations, I learned to harmonize my natural enthusiasm with professional standards. I now have situational confidence to assess a need, prioritize the solution, and communicate it.
https://symposium.foragerone.com/2026-racas/presentations/81091

From Campus to Career: Showcasing Student Employment Success
Charlie Chimento, *Social Sciences & Humanities*
Mentor: Danny Young

Abstract:
Being a Peer Advisor has allowed me to improve my own skills in networking and resume writing. Additionally, I have been allowed to gather a massive amount of information related to personal career exploration in various fields. Because of this, and my development in the NACE Competencies and other transferrable skills, I feel much more prepared to venture into the unknown after graduation.
https://symposium.foragerone.com/2026-racas/presentations/81196

From Raw Data to Reliable Insights: Research-Ready Evidence in Marketing Analytics and Consumer Insights
Jazmia Victorian, *Tech, Engineering, & Math*
Mentor: Summer Cao

Abstract:
As marketing and consumer research become increasingly data-driven, one of the field's central challenges is transforming incomplete, inconsistent, and unstructured raw information into evidence that can support credible analysis and decision-making. Researchers frequently begin with fragmented datasets, noisy text, inconsistent firm identifiers, and case materials that are not immediately usable for interpretation. Yet this critical stage of the research process is often overshadowed by final models and outcomes. This presentation addresses the problem of how imperfect source material can be converted into research-ready evidence that improves the quality, consistency, and usefulness of downstream marketing and consumer behavior analysis.
Across several undergraduate research projects, I found that early-stage evidence-building plays a decisive role in shaping the value of later analytical work. Through data preparation, case labeling, computational text filtering, literature synthesis, and firm-name standardization, I helped transform fragmented source materials into structured datasets and documentation suitable for downstream analysis. These contributions supported RepRisk metrics panels, consumer-crime classification, article-based evidence gathering, scholarship synthesis on AI-powered consumer digital twins and tourism recommender systems, SASB topic documentation, and firm-level trend analysis.
The broader significance of this work is that it positions evidence-building as a substantive research contribution rather than a routine technical task. In marketing analytics and consumer research, meaningful insights depend not only on sophisticated methods but also on the strength of the underlying data foundation. By demonstrating how messy source materials can be refined into structured, relevant, and reliable research outputs, this work contributes to stronger analytics and a more transparent, scalable, and credible foundation for future research across academic and applied settings.
https://symposium.foragerone.com/2026-racas/presentations/80917

Functionality of Predictive Coding
Gunnar Enserro, *Tech, Engineering, & Math*
Mentor: Mazen Al Borno

Abstract:
Predictive Coding (PC) is a biologically inspired paradigm in artificial neural networks, first explored by Rao and Ballard (1999) and later iterated on by Karl Friston to form a mathematical foundation connecting it to the free energy principle. Rather than passively inferring the world, the brain continuously generates predictions, comparing them against received stimuli and

updating an internal hierarchical model via local prediction error signals. Though PC has been largely confined to computational neuroscience, this work explores it as a fundamentally more tractable paradigm for artificial intelligence than the prevailing deep learning (DL) framework.
PC differentiates itself from DL most critically in how error is computed. Where DL relies on global backpropagation, a centralized and synchronous error pass across the entire network, PC computes error locally at each layer. Predictions flow top-down through the hierarchy while errors propagate bottom-up, each layer adjusting only in response to its immediate discrepancy. The network learns by minimizing free energy, operationalized as prediction error or "surprise." When a predicted signal diverges from the observed signal at any level of the hierarchy, that mismatch propagates upward, dynamically driving the internal model toward better predictions.
These structural properties give rise to functional behaviors of interest for machine learning. PC networks learn continuously, updating their internal model with each new observation rather than requiring discrete training phases. This online learning dynamic, combined with the generative nature of the top-down pathway, suggests potential advantages in sample efficiency, robustness to distributional shift, and adaptability in non-stationary environments. This work investigates these behaviors empirically, examining how PC's inference and learning dynamics translate when applied to standard machine learning tasks, asking not whether PC is biologically accurate, but whether its computational principles are functionally useful.
https://symposium.foragerone.com/2026-racas/presentations/80987

Functionalization of Solid Supports for Coupling with RNA
Arlene Arreola, *Natural & Physical Sciences*
Mentor: Marino Resendiz

Abstract:
To functionalize controlled pore glass solid supports, a benzothiophene based spacer with a terminal trimethoxy silyl group was synthesized. Benzothiophene-2-methanol was first converted to benzothiophene-2-methyl bromide via an Appel reaction in good yields (75%). The resulting benzothiophene bromide was treated with 3-aminopropyltrimethoxysilane (APTMS) via a standard substitution reaction to form an 8-carbon linker. This synthesized spacer can then be used for covalent attachment to amine-functionalized silica surfaces.
https://symposium.foragerone.com/2026-racas/presentations/80964

Gas Chromatography-Mass Spectrometry of 1,4-Dioxane and Tetrahydrofuran for Use in Bacterial Degradation Studies
Jada Martinez, *Natural & Physical Sciences*
Mentor: Timberley Roane

Abstract:
While bacterial degradation studies of 1,4-dioxane and tetrahydrofuran-common groundwater contaminants-are being performed by microbiologists at the University of Colorado Denver, an analytical method from a paper written by Isaacson, Mohr and Field (2006) for the quantification of 1,4-dioxane and tetrahydrofuran within wastewater uses carbon disks that are too costly for running the number of samples needed for this project. The work proposed here is the development of a 1,4-dioxane and tetrahydrofuran quantification assay using gas chromatography-mass spectrometry and loose activated carbon in place of carbon disks. The objective of the work presented here was to modify the Isaacson, Mohr and Field method for the detection of 1,4-dioxane and THF in the contaminated groundwater at Lowry Landfill. Experiments involving head space analysis for solvents, soak time of samples in activated carbon, and drying times of the activates carbon are reported here. The method includes solid phase extraction of 1,4-dioxane and tetrahydrofuran from the sample using acetone as our solvent and activated carbon instead of Isaacson's carbon disks as well as external calibration curves for determining sample concentrations. So far, an optimal solvent, absorption and drying conditions, and a linear range has been found. The method proposed will help further investigation and inform the microbiologists on the project of concentrations of microbes at the Lowry landfill.
https://symposium.foragerone.com/2026-racas/presentations/80974

Grocery Store Placement Strategies for Equitable Food Access in Urban Environments
John Pflugh, *Tech, Engineering, & Math*
Mentor: Dr. Emily Speakman

Abstract:
An important question for urban planners is where to place new grocery store outlets in order to maximize equitable food access across the population of a given city. Traditional metrics of accessibility generally focus only on the average level of access, but equitable distribution of access is a critical factor in this planning application. In recent literature, the Kolm-Pollak equally-distributed-equivalent (EDE), was proposed as the most-principled metric of both average and equitable access simultaneously. The Kolm-Pollak EDE allows urban planners to analytically compare the impact of different strategies for facility

placement. In Operations Research, the uncapacitated facility location problem (UFLP) determines the locations of a set of facilities that minimizes some objective. A recent pair of papers establishes an improved integer programming (IP) formulation of the UFLP that minimizes the Kolm-Pollak EDE to determine optimal grocery store placements meeting select accessibility targets in the 500 largest U.S. cities. These papers calculate some solutions corresponding to the set walkability targets, but the IP remains impractical for computing solutions to many different numbers of outlets without the use of a high-performance computer. Using CU Denver's Alderaan Computing Cluster, we obtain solutions to the IP for the 500 largest U.S. cities for placements of all non-trivial numbers of grocery outlets. By implementing a greedy heuristic for the UFLP, we derive approximations to each of the solutions and empirically verify theoretical bounds for these approximations relative to the exact solutions. We show that this heuristic provides a close approximation both in terms of the value of the Kolm-Pollak EDE and the overlap between the stores placed, and we consider whether the practical performance of the heuristic is suitable for planners. Through statistical analysis, we determine which aspects of city data are good predictors of the accuracy of the heuristic.
https://symposium.foragerone.com/2026-racas/presentations/81005

Gun Violence and the Psychology Behind a Mass Shooting
Stephanie Karr, *Social Sciences & Humanities*
Mentor: Courtney Leapley

Abstract:
Gun violence in the U.S. is often precipitated by unrecognized or ignored psychological symptoms. Further, there remains an important controversy in the legal system regarding the distinction between "insanity defense" and standard guilty pleas and how mental health should be considered in examining criminal responsibility in mass casualty events. This study examines the landscape of mass shootings in the U.S., including behavioral warning signs that occur prior to mass violence, environmental influences, and how these are addressed in court proceedings and mental health strategies. Using Congressional reports, national research databases, existing gun violence research, and criminal justice research organizations that track mass shooting incidents and trends, patterns were identified and analyzed from mass shooting cases, including the number of victims, types of weapons used, and the locations where attacks occurred. To better understand the psychology behind mass shootings, several documented cases were compared for similarities in offender behavior, mental health indicators, and situational factors. Legal processing of offenders was also reviewed, including their pleas in court and whether mental health factors were considered. Descriptive analysis revealed that specific psychosocial factors, including personal grievances and behavioral changes, frequently precede attacks. Legally, the lack of a standardized definition for "mass shooting" creates inconsistencies in how cases are recorded and prosecuted. Data shows that while mental health is a primary trigger, its application in court pleas remains a complex and inconsistent legal hurdle. Identifying recurring psychological patterns and offender characteristics is essential for early intervention. By bridging the gap between clinical behavioral markers and legal accountability, policymakers can better address the root causes of gun violence and refine how the justice system treats mental health in violent crime.
https://symposium.foragerone.com/2026-racas/presentations/80834

HANA: A Novel Tool to Integrate Computer-Structured Models with NMR Data for Homodimer Structure Determination
Karen Pham, *Natural & Physical Sciences*
Mentor: Professor Woonghee Lee

Abstract:
Homodimer proteins are the simplest protein conformation that can be found in all domains of life. Understanding their structure can provide invaluable insights into protein-protein interactions and large-scale biological mechanisms. Due to the intrinsic properties of their symmetry, determining their structures has been challenging in structural biology, especially using nuclear magnetic resonance (NMR) spectroscopy. Building on recent breakthroughs in machine-learning-driven protein structure prediction, this paper presents HANA, a computational tool that integrates computer-structured models (CSMs) with experimental NMR data. By using CSMs to guide and refine structural calculations, HANA provides a streamlined hybrid approach to determining the structure of homodimer proteins. HANA is available as a Google Colaboratory Notebook within the POKY suite, providing a user-friendly solution for researchers at all levels of expertise to enhance the accuracy and efficiency of NMR-based structural studies.
https://symposium.foragerone.com/2026-racas/presentations/81052

How Density, Shade, and Urban Form Influence Pedestrian Comfort at Transit Stations
Hannah Rivera Hernandez, *Social Sciences & Humanities*
Mentor: Carrie Makarewicz

Abstract:
This project examines how micro-scale urban design qualities influence transit ridership and user experience by comparing three stations along the same Denver light-rail corridor: Alameda Station, Colfax at Auraria Station, and 10th & Osage Station. Although these stations operate on the same line, they differ in visibility, surrounding land uses, perceived safety, and pedestrian accessibility, making them useful for understanding why some stations attract more riders than others.
The study uses the built-environment frameworks developed by urban planners, including the Four D's: density, diversity, design, and distance and 16 measurable urban design qualities such as transparency, enclosure, imageability, and human scale. These metrics will help evaluate each station's block structure, land-use mix, job and housing density, building frontage, and pedestrian connectivity.
Data will be collected through field observations and secondary datasets. Site visits will occur during morning and afternoon peak hours and one evening period to document ridership, user behavior, and spatial conditions. Built-environment measurements such as window counts, entrance spacing, and street design features will be recorded and supplemented with census data, satellite imagery, and mapping tools.
By comparing the three stations, the study aims to identify which urban design and land-use factors most influence transit comfort, visibility, and ridership, helping inform safer and more walkable transit environments in Denver.
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How Do Human Trafficking Legal Frameworks Compare Across Trafficking in Persons (TIP) Tiers, and What Factors Facilitate Their Effectiveness?
Harron Mezgour, *Social Sciences & Humanities*
Mentor: Sheila Huss, Ph.D.

Abstract:
The project centers on the question How Do Human Trafficking Legal Frameworks Compare Across Trafficking in Persons (TIPS) Tiers, and What Factors Facilitate Their Effectiveness? The research question aims to identify how 5 countries in each TIP tier respond to human trafficking in comparison to the United States. There are 4 official TIP tiers as stated by the U.S Department of State. These include tiers 1, 2, 2 watchlist, and 3. Each country is organized into tiers based on the effort it invests in the 3 Ps (prosecution, protection, and prevention). Tier 1 indicates that a country adheres to these standards, whereas Tier 3 indicates that it fails to meet them. Tier 2 countries are actively working to meet these standards, but are not there yet. Tier 2 watchlist countries fit the Tier 2 category, but are experiencing higher levels of victims and/or have not attempted to improve their standards.
Additionally, the project is pursuing 3 themes for the collection and analysis of qualitative and quantitative data. Using a single theme, Tier 1 countries will be analyzed to determine how they employ strategies (e.g., laws addressing human trafficking and victim assistance) to meet this standard, and why lower-tier countries may not. Through a second theme, the examination will determine whether Tier 1 countries prioritize the prosecution of perpetrators or victim assistance (a criminal issue vs. a human rights issue). Lastly, training and education for professional personnel (e.g., law enforcement and medical personnel) will be analyzed to assess their effectiveness in preventing human trafficking.
The project is meant to highlight how countries can meet the U.S. Department of State's 3Ps standard to prevent and combat human trafficking on a global scale.
https://symposium.foragerone.com/2026-racas/presentations/80923

How Do Social Networks Influence Health in Native and Vietnamese Communities in Southwest Denver?
Autumn Sarsycki, *Social Sciences & Humanities*
Mentor: Paulina Erices

Abstract:
This project explores how social networks influence perceptions of health in Native and Vietnamese communities in Southwest Denver. Health is shaped not only by medical care, but also by cultural values, relationships, and community environments. Understanding how individuals define and discuss health within their social networks can provide insight into more culturally responsive approaches to care.
https://symposium.foragerone.com/2026-racas/presentations/80946

How Does the Circadian Rhythm Behave in Extreme Cold Temperature?
Adam Haddad, *Biomedical Sciences*
Mentor: Dr. Gregory Ragland

Abstract:
Circadian rhythms, or patterns in behavior and physiology over 24 hours, play an enormous role in governing the daily activities of animals, plants, and just about every organism on earth. These rhythms are intrinsic and are regulated by a Transcription-Translation Feedback Loop consisting of several core 'clock' genes. Recently, the Ragland lab discovered a strong and evolutionarily conserved pattern of clock gene expression in response to temperature that suggests that these genes (*e.g., period, vrille, and timeless*) may also play an important role in maintenance of homeostasis (keeping physiology stable) in the face of thermal stress. We were specifically interested in the 'clock' gene *period*.
We formed two hypotheses: 1) clock genes may play a direct homeostatic role in response to extreme temperature stress, and 2) *period* may contribute to "temperature compensation of the clock", whereby organisms maintain the same circadian rhythm oscillations despite temperature variation that speeds up or slows down physiology.
Here I describe experiments testing these hypotheses by manipulating the core clock *gene period*. I used a gene knockdown technique called UAS-RNAi to create *period*-absent, mutant *Drosophila melanogaster* flies and exposed them to cold stress, inducing chill coma - a natural state of paralysis. I then measured Chill Coma Recovery Time (CCRT), a standard measurement of stress tolerance.
Conducting experiments comparing mutant (non-functional *period*) and control (functional *period*) flies over repeated experiments, I showed that *period* does not have a consistent, direct effect on cold stress tolerance.
This is an important result because it fails to support our first hypothesis, opening the door for us to pursue the second hypothesis; the association of *period* expression with the temperature compensation of the clock in cold stress. We are now planning new experiments analyzing the long-term rhythmic behavior of control and mutant flies under cold stress.
https://symposium.foragerone.com/2026-racas/presentations/80914

How dopamine controls exercise depends on exercise history and sex
Micah Hsieh, *Biomedical Sciences*
Mentor: Benjamin Greenwood

Abstract:
Exercise is a beneficial activity for both mental and physical health, but a majority of the population does not achieve the recommended amount of exercise. Mechanisms underlying the acquisition and maintenance of exercise behavior is not fully understood, but understanding them could lead to new approaches for increasing exercise participation. Different regions of the dorsal striatum contribute to goal-directed behavior (dorsomedial striatum; DMS) and habit formation (dorsolateral striatum; DLS), and likely play a part in voluntary wheel running in rodents. We have found sex differences where the dorsal striatum governs wheel running: Males tend to depend on the DMS when acquiring wheel running, implying that goal-directed action drives their motivation. Females also use the DMS, but their DLS contributes sooner compared to males. This could be behind the rapid acquisition of habit running in females. We do not know the mechanisms behind how the DLS controls wheel running or what might explain the sex differences between females' faster usage of the DLS. Dopamine (DA) from the substantia nigra (SN) is one possibility, as the pathway between the SN to the DLS contributes to DLS function and formation of habits, but the role of DLS DA in wheel running is unclear. The goal of this study is to determine the role of the SN-DLS dopamine pathway in the acquisition and expression of exercise habits in adult, male and female Long Evans rats. Chemogenetic designer receptors were used to inhibit the SN-DLS pathway on days 1 and 28 of wheel running. Running markers (distance, duration, speed, and bouts) were collected (VitalView) and analyzed through a custom script. We hypothesize that inhibition of the SN-DLS pathway on day 1 of wheel running will reduce wheel running in females, but not males, and that inhibition of the same pathway on day 28 will decrease wheel running for males and females. The hypothesis, if supported, would suggest that DLS DA drives the rapid formation of habitual exercise in females.
https://symposium.foragerone.com/2026-racas/presentations/81019

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how mentors help students in life
Arnulfo Garcia, *Social Sciences & Humanities*

Abstract:
This project explains how mentors make a positive difference in students' lives. There are many ways mentors can guide students, support students, and help them make better choices for the future. From my personal experience I had a mentor growing up and they help me become the person I am today. I know if I did not have this person in my life, I would not be in the position I am in today. Overall, this project will find that mentors play a significant role in helping students grow and prepare for life beyond school.
https://symposium.foragerone.com/2026-racas/presentations/80907

How Water Behaves Near Proteins: Insights from ^{17}O NMR
Kusum Yadav and Bangyan Fu, *Biomedical Sciences*
Mentor: Liliya Vugmeyster

Abstract:
Water molecules surrounding proteins form hydration layers that help maintain protein structure and function. Changes in these water protein interactions can influence protein folding and may contribute to aggregation processes associated with diseases such as Alzheimer's disease. In this project, we investigate how water behaves near different types of proteins using oxygen-17 (^{17}O) nuclear magnetic resonance (NMR) spectroscopy.
Three systems were studied: phosphate buffer alone, buffer containing the globular protein myoglobin, and buffer containing amyloid β peptides associated with Alzheimer's disease. By comparing these systems, we aim to understand how protein structure influences the motion of nearby water molecules. Solution-state ^{17}O NMR experiments were performed across a biologically relevant temperature range. Spectral line shapes and relaxation times (T_1) were analyzed to evaluate differences in water mobility.
Initial results indicate that water in buffer alone shows fast, uniform motion, while interactions with protein surfaces slightly modify water dynamics. Water molecules near amyloid β peptides may experience different environments compared with those near the structured protein myoglobin. Understanding these hydration differences may provide insight into how protein water interactions influence aggregation processes relevant to Alzheimer's disease.
https://symposium.foragerone.com/2026-racas/presentations/81070

Hugo Chavez; Superstition, Magic, and Political Power in Venezuela
Claire Balmas, *Social Sciences & Humanities*
Mentor: Ryan Crew

Abstract:
Hugo Chavez's government was rife with rumors regarding his spiritual beliefs. These rumors affected the perception of him. Although he professed to be a Christian Chavez was well known to be extremely superstitious and a believer in the supernatural. This mixture of belief, superstition, magic, and the supernational is something extremely common in Latin American culture, however its presence and influence is often overlooked. One example of these ideas intersecting and influencing politics is the relationship between Chavez and Fedal Castro. Therefore, to truly understand the lasting legacy of Hugo Chavez an interdisciplinary approach through political science, history, religious studies, and anthropology is needed. This approach will add missing elements of culture and nuance. This paper shows how incorporating local cultural and religious perspectives into political science and history brings greater understanding to investigations of politics and power in Latin America.
https://symposium.foragerone.com/2026-racas/presentations/81034

Identifying the neural circuit underlying the stress-protective effects of exercise
Maria Londono Cano, *Biomedical Sciences*
Mentor: Benjamin Greenwood

Abstract:
Exercise reduces the risk of developing future stress-related mental health disorders such as anxiety, but the mechanisms remain unclear. Rats with access to running wheels are protected from anxiety-like behaviors (exaggerated freezing and social avoidance) which are typically observed in sedentary rats following exposure of inescapable stress. Exercise protects rats from stress by constraining activity of serotonin neurons in a brain region called the dorsal raphe nucleus (DRN). The goal of my research is to determine how exercise constrains the DRN. The nucleus accumbens (NAc) is a brain structure involved in the rewarding effects of exercise, which has long been assumed to contribute to the mental health benefits. The NAc sends inhibitory GABAergic projections to the DRN. We tested the hypothesis that the NAc constrains activity of serotonergic neurons in the DRN to provide exercise-induced stress resistance. We utilized chemogenetic inhibition of the NAc-DRN pathway to test this hypothesis. A retrograde virus was injected in the DRN which traveled back to the NAc and expressed cre-recombinase. A second virus encoding for cre-dependent designer receptor exclusively activated by a designer drug was injected into the NAc. The NAc-DRN pathway was then inhibited during stress in exercised rats by injecting the designer ligand, J60, which binds to the designer receptor and inhibits DRN-projecting NAc neurons. Preliminary results indicate that the inhibition of the NAc-DRN pathway restores stress-induced anxiety in exercised rats. These data suggest that the NAc-DRN pathway is a novel stress resistance pathway recruited by exercise to protect against stress.
https://symposium.foragerone.com/2026-racas/presentations/80977

Impact of tRNA Modifications on Codon Reassignment
Will Goodwin, *Natural & Physical Sciences*
Mentor: John D. (Nick) Fisk

Abstract:
Transfer RNA (tRNA) molecules contain extensive post-transcriptional modifications that play critical roles in maintaining translational fidelity and efficiency. Many of these modifications occur within the anticodon loop, impacting codon-anticodon interactions, such as the selection and proofreading steps of translation. These modifications may significantly affect the competitive balance between endogenous host tRNAs and orthogonal tRNAs in engineered genetic code expansion systems. We are investigating how modifications of nucleotide 37 in the anticodon loop in tRNAs influences codon reassignment efficiency. Nucleotide 37 is frequently modified in bacterial tRNAs that decode U-starting codons. In *E. coli*, UNN codons are encoded by tRNAs with a modified base ms2i6A37. The enzyme MiaA catalyzes the first step in modifying tRNAs with adenine to ms2i6A at position 37. Previous studies using MiaA knockouts have shown that loss of this modification can reduce rates and efficiency of translation. This suggests nucleotide A37 modifications may play a key role in translation kinetics.
To examine this effect, we are evaluating orthogonal *Methanocaldococcus jannaschii* tyrosyl tRNA (*Mj* tRNA) variants used for codon reassignments of U starting codons. Genetic code reassignment is the process of repurposing a codon to encode a non-native amino acid using orthogonal tRNAs that compete with endogenous decoding machinery. These tRNAs normally contain an adenine at position 37, making them potential substrates for MiaA catalyzed modification. We hypothesize that changing this position to guanine (A37G) will prevent modification by MiaA. By comparing reassignment efficiency between wild-type and A37G variants in both wild-type and MiaA knockout strains of *E. coli* we will evaluate how this modification influences competition in decoding UNN codons.
https://symposium.foragerone.com/2026-racas/presentations/80906

Improvement of Adolescent Depression Screening in Primary Pediatrics
Keinada Andereas, *Biomedical Sciences*
Mentor: Dr. John M. Guerrieri

Abstract:
Universal mental health screening in pediatric primary care is recommended to improve early identification of depression among adolescents. However, less is known about which patients successfully connect with integrated behavioral health services after screening. We conducted a quality improvement study aimed at evaluating and improving the management of depression among adolescent patients aged 13+ in a primary care pediatric clinic. A random sample of 100 adolescents who completed the GAD7 and PHQ9 during their well-child visits between July 2023 and February 2025 was retrospectively reviewed to assess patient demographics and behavioral health referrals. A chi-square test was used to analyze factors associated with an increased risk of screening positive for depression and following up with behavioral health. A total of 33 adolescents had a diagnosed mental health disorder, including 17 with depression. Among all patients who screened positive for depression, 58.8% were connected to a behavioral health provider. Black/African American race and Medicaid insurance were significantly associated with positive depression screening. While only 29% of the sample identified as Black/African American, they accounted for 58.8% of positive screens for depression ($\chi^2(1, N= 100) = 8.85$, $p = .003$). Similarly, while only 37% of the sample had Medicaid, they accounted for 64.7% of positive depression screens ($\chi^2(1, N = 100) = 7.707$, $p = .008$). There was no clear difference by race or insurance type regarding whether or not individuals were connected with a behavioral health provider. Findings informed clinical practice changes, including improved documentation of race/ethnicity and depression severity, a standardized workflow for patients' connection to a behavioral health provider, and further investigation of higher depression rates among Black/African American and Medicaid-insured patients. More specific data is needed to determine how depression severity impacts patients' connection to a behavioral health provider
https://symposium.foragerone.com/2026-racas/presentations/80957

Improvement of Spatial Reasoning in LLMs via Automated Prompt Optimization
Chloe Evans-Whitley, *Natural & Physical Sciences*
Mentor: Scott Reed

Abstract:
Despite their rapid evolution, large language models (LLMs) remain limited in their ability to spatially reason. LLMs lack comprehension of space, relationships between objects, environments, and physical constraints. LLMs rely on patterns in text to generate responses, which makes it difficult for them to interpret and manipulate information that relies on these concepts, limiting their utility for chemical and biochemical research. This project aims to explore solutions, including automated optimization of prompting, to improve LLMs' ability to use spatial reasoning and allow for more reliable use of LLMs in scientific research that involves complex physical interactions. Specifically, this project will evaluate how accurately base LLMs and optimized LLMs can predict the pKa values of titratable residues in proteins based on three-dimensional structure.
https://symposium.foragerone.com/2026-racas/presentations/81017

Individual differences in eye movements during visual search with distraction
Chelsea Freeman, *Social Sciences & Humanities*
Mentor: Dr. Carly Leonard

Abstract:
We gain valuable information by moving our eyes within our spatial environment. For example, when driving, saccadic movements allow us to quickly identify traffic signs and hazards, and to switch our attention between the road and our mirrors. Fixation allows us to process fine details while planning subsequent actions accordingly. Saccadic eye movements allow us to change the bottom-up input that guides our attention and cognitive processing. Previous research has shown reliable individual differences in *saccadic timing* and *fixation duration,* with abnormalities presenting in certain disorders like ADHD and schizophrenia. However, less is known about *why* this occurs.
The Laboratory for Integrative Vision is currently exploring this variability in the typical population. Previously, we demonstrated a speed-accuracy tradeoff; individuals who wait longer to move their eyes tend to produce first saccades closer to the target. The current experiment addresses a related question: how does this variability change with distraction? *Saccadic decisions* are often characterized as a race, a competition between goal-relevance and distractor suppression. In our search task, participants are required to quickly find the unique target shape, with half of the trials containing a salient distractor (color). These results will be compared with two other tasks. One serves as a measure of their ability to divide their attention (*attentional breadth*); the other provides data on their ability to inhibit planned motor responses (*stop signal reaction times*). We predict that individuals with weaker inhibitory control will make more incorrect saccades to this distractor (*oculomotor capture*), while those with stronger inhibitory control will make fewer. Preliminary results will be presented here. This work advances our understanding of the mechanisms underlying individual differences in where and why we move our eyes.
https://symposium.foragerone.com/2026-racas/presentations/80886

Instrumentation, Genre, and Soundscapes: How Style Enchances Musical Storytelling In The Metal World
Aiden Csapo, *Arts & Media*
Mentor: Peter Franks

Abstract:
Metal is a sprawling musical genre that has touched upon thousands of unique soundscapes over its nearly six decade lifespan. The general public observes only the surface of this genre with arena selling bands, such as Metallica or Guns N' Roses. This presentation delves deep into the underground, with emphasis on storytelling and how it's affected by instrumentation, lyrical content, production, genre, performance, and culture. Genres presenting atypical song structures, time signatures, instrumentation, etc. have unique ways of approaching lyricism, and the music has a substantial effect on how stories are told, usually on an emotional impact. Taking example from Nile's "The Burning Pits of the Duat" (2005), we see technical death metal taking ancient text literature of Egyptian history in *The Book of the Am-Tuat*, morphing its historical stories of ancient gods into a 1st person narrative, exploring the act of betrayal, defiance, and death. In another example, Mastodon's *Leviathan*, we observe the transformation of classic literature *Moby Dick* into a pioneering record of progressive sludge metal. Mastodon shapes the story within powerful, intensive riffs that give an epic, movie-like quality to the story. Different subgenres will experiment with unique sounds that change how a story is presented. Taking Sepultura for example on their records Roots & Against, albums lyrically influenced by corruption, Brazilian tribes, prosperity of the environment, etc. If Sepultura went the direction of Thrash metal as on their previous records Arise & Beneath The Remains, the songs would possess a direct, rage-fueled quality. Instead, Roots & Against utilize tribal world musical elements, including the music of the Xavante tribe from the Amazon, which gives personal connection directly to the Sepultura's heritage to the listener. Subgenres in metal are critical for shaping an artist's vision, which allows for new exploration of classical literature, ancient texts, fiction, and real life scenarios.
https://symposium.foragerone.com/2026-racas/presentations/80871

Investigating Cometabolic Degradation of 1,4-Dioxane by Wastewater Bacteria at the Lowry Landfill
Trivana Malla, *Natural & Physical Sciences*
Mentor: Timberley Roane

Abstract:
The chemical solvent, 1,4-dioxane, is a probable human carcinogen that contaminates the wastewater at the Lowry Landfill. The industrial chemical can be reduced by bacteria naturally present in the wastewater. Unfortunately, existing research has not adequately explained the bacterial mechanisms of 1,4-dioxane reduction in the Lowry Landfill bioreactors, leaving a gap in knowledge about the biological processes responsible for Lowry's wastewater remediation. This project addresses this gap by investigating whether bacteria in the Lowry Landfill water treatment systems are capable of cometabolically degrading 1,4-dioxane. Specifically, this study will evaluate microbial growth in media containing 1,4-dioxane and THF (as the co-substrate).

Using analysis of related literature to test different media and culturing conditions, this study will attempt to isolate cometabolically degrading bacteria from Lowry's wastewater.
https://symposium.foragerone.com/2026-racas/presentations/80869

Investigating how exercise modulates serotonin activity during inescapable stress
Minan Abdin, *Biomedical Sciences*
Mentor: Dr. Benjamin Greenwood

Abstract:
Stress-induced anxiety and depression are highly prevalent and pose a major global health challenge. Exercise is a powerful stress resistance factor that reduces the risk of developing stress-related mental health disorders. Voluntary wheel running in rodents prevents the behavioral consequences of inescapable stress that resemble anxiety and depression. Wheel running produces these stress protective effects by constraining the activity of serotonergic neurons in the dorsal raphe nucleus (DRN). Nevertheless, the mechanisms through which wheel running regulates the DRN response to stress remain unknown. One possibility is that wheel running modulates the activity of DRN inputs during stress, either by enhancing the inhibitory drive or diminishing the excitatory input to DRN 5HT neurons. To understand the impact of wheel running on activity of DRN inputs during stress, we injected an AAV/GFP virus into the DRN that travels retrogradely and labels DRN-projecting neurons in regions that project to the DRN. Following 3 weeks of sedentary or voluntary wheel running conditions, adult, female Sprague Dawley rats (n = 10/group) were exposed to inescapable stress. Immunohistochemistry for c-Fos was conducted to determine which DRN inputs are modified by prior wheelrunning. Females were selected for this study because wheel running induces rapid stress-protective effects in females. Data collection is ongoing. The results may reveal specific DRN projections that are influenced by exercise, providing insights into the mechanisms through which exercise constrain the DRN response to stress and promote stress resistance.
https://symposium.foragerone.com/2026-racas/presentations/81028

Investigating the Binding Between Amyloid-Beta Variants and Tricyclic Antidepressants Using NMR Techniques
James Beham, *Biomedical Sciences*
Mentor: Dr. Liliya Vugmeyster

Abstract:
Alzheimer's Disease (AD) is a widespread neurodegenerative disease affecting more than 50 million people worldwide, expected to double by 2050.[1] Amyloid-beta (Aβ) is the protein most famously associated with being the cause of AD development. Imipramine HCl is an FDA approved tricyclic antidepressant drug that is associated with improving cognitive efficiency in patients that developed AD. NMR techniques, nuclear Overhauser effect spectroscopy (NOESY) and saturation transfer difference (STD), were used to study the biophysical interactions between imipramine HCl and monomeric $A\beta_{1-42}$ and $A\beta_{1-40}$. Biophysical interactions between monomeric $A\beta_{1-40}$ and desipramine HCl, a daughter compound of imipramine HCl, was also studied via NOESY. Spectra data from NOESY and STD indicated that imipramine HCl does in fact bi[2]nd to $A\beta_{1-42}$, but not with $A\beta_{1-40}$. Desipramine HCl was found to not bind to $A\beta_{1-40}$ either. This study's preliminary data allows for further exploration towards the possibilities of imipramine HCl as a therapeutic drug for patients with AD.
https://symposium.foragerone.com/2026-racas/presentations/80889

Investigating the Effects of Restrictive Ribosomes on Sense Codon Reassignment
Liam Quille, *Natural & Physical Sciences*
Mentor: John (Nick) D. Fisk

Abstract:
Translation is the fundamental biological process converting information stored in DNA into the functional molecules: proteins. Understanding the molecular factors that control the speed and accuracy of translation are important for medical and biotechnological applications. The ribosome is the biological machine that catalyzes the mRNA directed polymerization of amino acids to produce proteins. The ribosome is a multi-subunit ribonucleoprotein, made up of large (50S) and small (30S) subunits in prokaryotes. The small, 30S subunit, consists of the 16S ribosomal RNA and 21 additional proteins. The 30S subunit directs the recognition of mRNA codons by tRNA molecules. Ribosomal protein mutations have been identified, in response to antibiotic challenges, that alter the fidelity of the tRNA selection processes. The small subunit protein, S12, is responsible in part for the proofreading of codon-anticodon pairings in the ribosomal A site and some specific mutations can increase proofreading1. An investigation into effects on sense codon reassignment by making mutations to S12 will highlight the mechanisms underlying this process.
https://symposium.foragerone.com/2026-racas/presentations/81054

Ion Transport Regulation Modulates the Response to Mucosal Acidosis in the Inflamed Intestinal Microenvironment
Faiz Minhajuddin, *Biomedical Sciences*
Mentor: Ian Cartwright

Abstract:
Inflammatory Bowel Disease (IBD) is a group of conditions characterized by chronic inflammation of the gastrointestinal tract; most commonly, ulcerative colitis and Crohn's disease. A well known aspect of IBD is the increased acidification of the intestinal environment, driven by immune cell recruitment, metabolic changes, and activation of epithelial cells towards a pro-inflammatory phenotype. The way epithelial cells respond to this acidification on the basolateral (bottom) versus apical (top) surfaces is not well described. Recent findings have suggested that transporters play a critical role in adjusting to the pH changes, particularly the Cl^-/HCO_3^- exchanger SLC26A3.
To further demonstrate the role of SLC26A3 in maintaining pH homeostasis, intestinal epithelial cells with SLC26A3 deficiency were put into acidic environments to examine the genetic changes. We found that when SLC26A3 was deficient, epithelial cells had only lost barrier integrity with adjacent cells when sensitized with acidic conditions on the apical side exclusively as compared to corresponding controls. This was indicated by a loss of tight junction formation, decreased barrier and increase in inflammatory markers.
Our work seeks to explore how epithelial cells are able to counteract and maintain pH homeostasis through a gene specific signature of the SLC26A3 transporter. Patients with IBD have been shown to have decreased expression of SLC26A3 contributing to further intestinal injury. Our work reveals that the SLC26A3 transporter is critical in being able to advance pH homeostasis in epithelial cells and the need to further investigate the role of ion transport in mucosal acidosis of the inflammatory microenvironment.
https://symposium.foragerone.com/2026-racas/presentations/80872

Ising Model: From Statistical Mechanics to Computational Neuroscience
Hanad Ali and Gabriel Adas, *Biomedical Sciences*
Mentor: Masoud Asadi-Zeydabadi

Abstract:
The brain is a complex system of coordinated information transfer between neurons, operating in a nonlinear and often statistical manner. In this poster, we introduce the Ising model and the statistical mechanics and thermodynamics behind it, then explore how this framework can be applied to better understand the intricacies of neural activity in mice through computational neuroscience.
The Ising model is used to describe magnetic properties of materials as a lattice of atoms, each assigned a spin value of either +1 or −1. The behavior of the system depends on the competition between local interactions that favor spin alignment and external influences of a magnetic field and thermal energy. At low temperatures, neighboring atoms influence each other to align, producing an ordered, magnetized state. As temperature increases, thermal fluctuations cause spins to flip, introducing disorder until the system reaches a state of randomness. The critical point is the boundary between these two states, where the system becomes highly sensitive, and small perturbations can produce large-scale effects.
Research has shown that neural populations in the cerebellum exhibit cascading activity known as neural avalanches, where the firing of one neuron triggers a chain of responses across the network. These avalanches follow power-law distributions characteristic of systems near criticality, making the Ising model a natural framework for studying how the cerebellum balances stability and adaptability in motor coordination. To apply this framework, neural spike data is mapped onto the model by representing firing neurons as +1 and non-firing neurons as −1. Pairwise coupling values, known as J-values, capture the interaction strength between pairs of neurons, while H-values represent the interaction with the external field. Together, these parameters allow us to analyze pairwise correlations across neural populations, revealing the relationship between order and disorder in neural activity.
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Isolation and Enrichment of 1,4-Dioxane–Degrading Microorganisms from the Lowry Landfill Superfund Site
Deborah Espinoza Varela, *Natural & Physical Sciences*
Mentor: Timberly Roane

Abstract:
Bioremediation of 1,4-dioxane can offer an environmentally sustainable alternative to conventional treatments of wastewater. The Lowry Landfill Superfund site has installed three in-line microbial treatment systems or bioreactors to reduce 1,4-dioxane levels from groundwater initially contaminated by the original landfill that served the Denver metro area. The source of the remediating, but unidentified, 1,4-dioxane degrading microorganisms is from the groundwater itself. This project focuses on determining the presence of bacteria capable of direct 1,4-dioxane degradation. This necessitates the development of media and culturing techniques designed to enrich and isolate microorganisms capable of using 1,4-dioxane as a sole carbon and

energy source. Initial attempts at the isolation of 1,4-dioxane degrading microorganisms will rely on media recipes available through published literature. The isolation of 1,4-dioxane degrading microorganisms from the Lowry Landfill Superfund site will increase our understanding of the wastewater treatment which can lead to further optimization of the bioremediation. The findings will contribute to the development of more efficient bioremediation strategies and support efforts to improve groundwater treatment processes.
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Japan and Bishonen Masculinity in the 1980s New Wave/New Romantic Scenes
Sapana Sanders, *Social Sciences & Humanities*
Mentor: Maria Elena Buszek

Abstract:
Undeniably, the late 1970s–1980s was an era that has had much influence on today's music and fashion. From the grittiness of Punk to the ornate glamour of New Romantics, the era's subcultures each tackled gender norms in their own ways. One of the lesser discussed (and perhaps lesser known) subcultures of this era were the New Wave and New Romantic scenes, which reshaped the status quo of gender expression and masculinity for 1980s Britain, and soon after, the Western world. A band that had much to do with this shift yet gets little recognition for it is Japan, a London-based group who got their start in glam rock and progressed to the eccentric genre of New Wave from there. In my research, I explored how Japan reshaped gender—specifically masculinity— as early pioneers of the New Wave/New Romantic scene.
Despite producing a well-known, commercial glam rock sound that other late 70s British bands had found success with, Japan failed to chart in Britain and the West in their initial years. However, perhaps the most important part of their debut career was their success in their namesake country: Japan. Through my research, I explored the Japanese "bishonen" male archetype that had become popular in 70s shoujo manga, and connected it to how Japan drew inspiration from this aesthetic to further their success in the New Wave movement in the West. I analyzed Japan as they evolved in the short time they were together, tracking their visual and sonic evolution from the glam and punk-oriented first two albums to their later New Wave ones.
https://symposium.foragerone.com/2026-racas/presentations/80875

K-pop in the Apocalypse
Lex Kopf *Arts & Media*
Mentor: Maria Buszek

Abstract:
My research project, "K-pop in the Apocalypse," revolves around a queer, indie, multi-media project entitled *Alien Stage*. *Alien Stage* combines animation, K-pop, comics, and other visual art to tell a story of queer love in a post-apocalyptic science-fiction world.
The first section of my research concerns K-pop, specifically queerness in K-pop. I began by looking at the exploitative nature of the K-pop industry and how idol culture shapes gender representation within this global market. I will be discussing how the modes of femininity and masculinity within K-pop shape perceptions of gender, and how *Alien Stage* presents a new model of queerness within K-pop. I will be focusing on three specific characters who represent the rebellion in *Alien Stage* to understand how this model functions in opposition to the norms of the K-pop world.
The second facet of my research was focused on the science-fiction/post-apocalyptic dystopian genre setting. I wanted to know how this setting influences the ways that *Alien Stage* represents and talks about queerness. The ultimate goal was to understand how the intersection of K-pop and science fiction is utilized, and how it is able to provide a space through which *Alien Stage* presents a complex model of queerness that pushes back against heteronormative structures.
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Kittn: a hybrid wavelet and AI-based tool for denoising NMR spectra
Qingxuan Fei, *Natural & Physical Sciences*
Mentor: Prof. Woonghee Lee

Abstract:
Nuclear magnetic resonance (NMR) spectroscopy is a valuable tool for studying the structure and interactions of biomolecules. However, obtaining high-quality spectra always faces many challenges, such as low protein concentration, sample aggregation, and the inherent instrumental limitations of NMR spectrometers. In real-life applications, the spectra are often accompanied by noise, which can affect the subsequent interpretation of spectra. Although existing NMR data processing tools such as NMRPipe and TopSpin offer zero filling and linear prediction functions for improving spectral quality, they are limited to processing data with a low signal-to-noise ratio while preserving weak or overlapping signals. To resolve this problem, I propose to develop an innovative NMR spectral processing tool called Kittn, Kreative Imaging Techniques Towards NMR spectra, that integrates

discrete wavelet transform (DWT) algorithms with a deep learning model. This tool will be integrated into the POKY suite. The wavelet transform reduces noise interference from true signals while preserving key spectral features across 1D, 2D, and 3D spectra. This deep learning model will learn from the noisy spectra and wavelet denoising spectra to correct the artifacts and improve peak reconstruction. By combining signal processing algorithms and artificial intelligence (AI)-based models, this tool is more robust than either approach alone. The development of this tool will improve the peak detection accuracy and resolve overlapping signals. Additionally, an interactive analysis model will be incorporated to support model evaluation and refinement. Large language model (LLM), such as Gemini, will provide structural feedback and suggest parameter adjustments after receiving the denoised spectra and quantitative metrics from the users. Overall, Kittn will not only support the structural analysis of dynamic biomolecules but also help other fields like materials science and cosmetics by providing more reliable and high-quality spectral data.
https://symposium.foragerone.com/2026-racas/presentations/80961

Light-Matter Interactions at the Atomic Level
Yohanis Mekonen, *Natural & Physical Sciences*
Mentor: Dr Kathryn Hamilton

Abstract:
Humans interact with light every day. We see light emitted from our phone screens, reflected off mirrors, or refracted when it passes through a glass of water. While these types of light-matter interactions are very familiar to us, I want to try to understand how light interacts with smaller objects, specifically atoms. When light interacts with individual atoms, the electrons within those atoms can exhibit interesting behaviors.
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Listening to Loss: Using Oral History to Understand Displacement and Reclaim Denver's Old Westside
Indira Saha, *Social Sciences & Humanities*
Mentor: Rachel Gross

Abstract:
In the late 1960s, the Denver Urban Renewal Authority and the Colorado Commission on Higher Education selected Denver's Old Westside as the site for a new higher education campus. It resulted in the displacement of more than 300 Hispanic families. The Westsiders lost their homes, churches, businesses, and a neighborhood that had served as a center of cultural and community life for generations. While this forced displacement is often depicted as urban renewal in institutional records, oral histories from displaced residents reveal a different story.
In this presentation, I will examine how oral histories allow former Westsiders to reconnect with the Denver neighborhood they lost. I will argue that remembering is an act of restoring relationships to the lost homes, churches, parks, and businesses that thrived before the 1970s. Through storytelling, residents reclaim the Old Westside symbolically, preserving their cultural identity and asserting belonging despite the physical displacement.
This work draws on my experience as a research assistant for the Recovering Auraria's Past project, where I helped develop a digital audio walking tour of the neighborhood using community testimonies. Their stories reveal that the Westside continues to exist as a lived landscape shaped by memory and emotion.
Oral histories help us understand the emotional dimensions of displacement that are absent from official records. Residents remember family homes, shared meals, and neighborhood festivals that defined everyday life. By sharing these memories with wider audiences, they assert that the Old Westside and its stories extend beyond its physical destruction. The act of remembering becomes a way of reclaiming those lost homes and businesses and ensuring that the neighborhood's cultural and emotional significance endures. The key goal would be to depict how oral history helps us understand displacement not only as a spatial transformation, but as an ongoing process of remembering and belonging.
https://symposium.foragerone.com/2026-racas/presentations/80962

Long-range Temporal Correlations in Cognitive Errors
Simon Ruland, *Natural & Physical Sciences*
Mentor: Michael Rogers

Abstract:
Many cognitive signals that at first appear random are in fact correlated over time. When an individual performs a repetitive task – like recalling a visual object – they will produce small errors on each repetition. These errors are not random, as may be expected from a computer performing a similar task. Instead, humans produce errors with "long-range" temporal correlations for which small errors have a particularly long-lasting effect on subsequent judgements.

Though LRTC in cognitive errors do not affect task performance, they may be a biproduct of task-specific supportive neural dynamics. If so, then LRTC may decay at a task-dependent rate. Task-dependent LRTC are observed in the data presented here: LRTC decay more slowly when the task requires individuals to recall visual information over a longer period. This bias towards temporally distant errors may result from a broader bias towards distant information that is necessary to support longer-duration recall.
https://symposium.foragerone.com/2026-racas/presentations/80989

Louisiana House Raising
Clayton Matthews, *Social Sciences & Humanities*
Mentor: Shirley Chen

Abstract:
House raising has been done since colonization in Louisiana, over time the practice has been standardized by governing bodies like the Federal Emergency Management Agency or FEMA and commercialized by companies specialized in house raising. With this established process the expectation might be that all houses raised would be done in a similar fashion, but that is not the reality. This research project is to document the compounding effects of applying a set of standard methods and construction techniques to unique existing conditions and the varying outcomes. Arrangements of scale models depicting different raising techniques like cribbing, piles, or piers and examples of formal arrangements based on the unique existing conditions of the house to be raised. A visual description of the different typologies and the spatial effects of each onto the environment. Houses raised in Louisiana are done most often for flood mitigation, the changing environment is increasing the frequency and damage done by storms. Old and new homes alike need to be protected against these forces and need a better understanding of how raising a house will change its formal and spatial qualities.
https://symposium.foragerone.com/2026-racas/presentations/80895

Mapping Cellular and Tissue-Level Pathology in Healthy and Injured Rat Ankle Tissue
Jimena Arias Escalante, *Biomedical Sciences*
Mentor: Michael A. David

Abstract:
Tendon injury induces structural changes at the cellular level that can be analyzed through histological imaging. Hematoxylin and Eosin (H&E) staining enables visualization of these changes, providing insight into tissue pathology during injury and healing. This study compares healthy and injured Achilles tendon and peritendinous tissues using H&E staining. We hypothesize that injured tissue will exhibit altered pathology compared to healthy tissue, reflected by changes in cellularity, nuclear circularity, tissue area, and hematoxylin-positive staining.
Rat ankles from a prior IACUC-approved Achilles tendon injury model were fixed, decalcified, paraffin-embedded, and sectioned for histological analysis. H&E staining was used to visualize tissue structure, where hematoxylin stains nuclei (DNA) purple and eosin stains cytoplasmic and extracellular components pink. Slides were imaged and analyzed using QuPath software for quantitative assessment. Automated cell detection focused on nuclei, with primary metrics including cell count and nuclear circularity to quantify variation in nuclear shape. Additional parameters included tissue area and hematoxylin-positive staining. Safranin O staining was also performed to identify proteoglycan-rich regions for comparison.
Differences in cellular and tissue-level pathology were observed between healthy and injured tendon samples. Injured tissue showed a broader distribution of nuclear circularity, with more elongated and irregular nuclei, and an overall increase in cell density compared to healthy tissue. Regions with higher hematoxylin-positive staining corresponded to increased cellularity. These findings suggest altered tissue organization in injured tendons. Similar patterns were observed between H&E and Safranin O staining.
Injured tendon samples exhibited measurable changes in cell density, nuclear circularity, tissue area, and hematoxylin-positive staining, indicating altered cellular and tissue-level pathology. These results support the use of quantitative histological metrics to assess injury-related changes. Ultimately, identifying these changes may help inform future therapeutic targets and improve clinical approaches to tendon injury and repair.
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Matrix Metalloproteinase-Deactivating Therapeutic Contact Lens for Corneal Disease
Andrew Bui and Ryan Hoang, *Biomedical Sciences*
Mentor: Jung-Jae Lee

Abstract:
Chemical burns of the eye can cause severe corneal damage, inflammation, and vision impairment. Excess activity of zinc-dependent matrix metalloproteinases (MMPs), particularly MMP-9, contributes to prolonged extracellular matrix degradation and impaired healing following ocular injury. In this study, we investigated a zinc-chelating contact lens hydrogel designed to

locally reduce MMP activity at the corneal surface. The hydrogel, based on poly(2-hydroxyethyl methacrylate) (pHEMA), incorporates dipicolylamine (DPA), a zinc-binding ligand with strong affinity for Zn^{2+}. Hydrogels were characterized for zinc absorption, ion selectivity, and their ability to reduce enzymatic activity. Increased DPA incorporation enhanced zinc uptake and significantly decreased MMP activity. These findings support localized zinc sequestration through a therapeutic hydrogel lens as a promising strategy to protect corneal tissue and improve healing after ocular injury. Additional material optimization studies are ongoing.
https://symposium.foragerone.com/2026-racas/presentations/81022

Measuring the Covalent Character of the Halogen Bond in the XB51 Data Set
Zane Youssef, Richard Nguyen, and Blake Bui, *Natural & Physical Sciences*
Mentor: Dr. Emilie Guidez

Abstract:
Noncovalent interactions are fundamental to how molecules assemble, recognize one another, and react in chemical and biological systems. While hydrogen bonding has traditionally served as the primary interaction used to organize molecular structures, other directional interactions have emerged as powerful alternatives. Among these, halogen bonding has gained increasing attention due to its ability to influence molecular organization and its growing applications in materials science, catalysis, and drug design.
Halogen bonds occur when an electron-rich site interacts with an electron-deficient region on a halogen atom that is already bonded to another chemical group. These interactions are highly directional and can be tuned by modifying the surrounding chemical environment. Despite the growing use of halogen bonding in molecular design, the fundamental electronic structure principles at the origin of these interactions remain an active area of research. In particular, the extent to which halogen bonds exhibit characteristics similar to those of traditional covalent bonds remains poorly understood.
This project investigates the nature of halogen bonding across a diverse collection of molecular systems in the XB51 benchmark data set. The XB51 data set comprises previously reported halogen-bonded complexes whose structures were reoptimized at the MP2 level for consistent analysis. This work aims to quantify the covalent character of halogen bonding interactions and how it is affected by the chemical structure of the halogen donor molecule and the electron-donating partner.
Developing a clearer understanding of the electronic structure of halogen bonds will help clarify the physical origin of these interactions and support the rational design of molecular systems that exploit halogen bonds for applications in chemistry, materials science, and biological systems.
https://symposium.foragerone.com/2026-racas/presentations/81303

Michigan and Colorado Water Quality Bill Comparison
Irving Lopez, *Social Sciences & Humanities*
Mentor: Sullivan Esther

Abstract:
Having dark grey, nearly black, water flow from your home's faucet sounds impossible to be a reoccurring problem. However, residents of manufactured and mobile housing communities live this impossibility throughout most, if not all, their residency in their communities. Although there are regulations that secure better water infrastructure, these regulations come from the state level. Colorado had passed a bill that implemented a water quality testing program for residents of manufactured/mobile home communities, House Bill 23-1257, to improve their water quality. In contrast, Michigan attempted to pass a bill, Senate Bill 46, that gave their department of Environment, Great Lakes, and Energy (EGLE) more authority for water testing in these communities, however it had passed only the Senate. Why did Senate Bill 46 get stuck in the Seante, what policies of the bill would have worked, and what would not have? As a result of the bill being stuck in the senate, data and water quality improvements have been lost for Michigan manufactured/mobile home communities. Studying the framework for future water quality bills for manufactured/mobile home communities will aid in gathering water quality data and improve water quality for community residents across multiple states. A comparative policy analysis of Michigan's Senate Bill and Colorado's House Bill and reviewing interviews from both Colorado and Michigan manufactured/mobile home residents was for the study. Comparing why Senate Bill 46 passed only in the Senate, to why House Bill 23-1257 passed will provide policy for future similar bills. This comparison indicated the lack of in-depth framework for Michigan's testing program to resident protection oversights, and landlord grant support to be contributing factors in Senate Bill 46 failure to be signed off. Overall, when it comes to the improvement of water quality for communities, strong testing programs make strong policy suggestions and work.
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Microbial Community Composition Across Source Waters at the Lowry Landfill Superfund Site
Caroline Popenuck, *Natural & Physical Sciences*
Mentor: Dr. Roane

Abstract:
1,4 Dioxane is a potentially carcinogenic solvent and common industrial byproduct that has contaminated groundwater at the Lowry Landfill Superfund site in Aurora, Colorado. While chemical treatment methods for 1,4-dioxane removal exist, they can be expensive and their effectiveness can be limited by the presence of other compounds in the groundwater. To address this contamination, three bioreactors at the site sustain microbial communities capable of degrading 1,4-dioxane. These bioreactors are fed by four inlet pipes that draw from source water at points across the landfill, but whether the microbial communities across these source waters are similar or distinct to those in the bioreactors remains unknown.
This study aims to compare the microbial communities present in each of the four source waters supplying the bioreactor system. Water samples from each pipe will be filtered to collect microbial cells, followed by DNA extraction and PCR amplification of the 16S rRNA gene, a standard marker used to identify and compare bacterial communities. The resulting data will reveal which bacteria are present and how community composition differs across the four sources.
Understanding how microbial communities vary between the contaminated groundwater sources feeding the bioreactors can provide insight into the distribution of potential 1,4-dioxane degrading bacterial species entering the treatment system. These findings can be used to optimize bioreactor performance and improve the efficiency of 1,4-dioxane bioremediation at the Lowry site.
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Microbial Community Structure in a 1,4-Dioxane Bioremediation Facility Upon Addition of Tetrahydrofuran
Soumaya Osman, Talija Strautins, and Faris Bannoura, *Natural & Physical Sciences*
Mentor: Dr. Christopher S. Miller

Abstract:
1,4-dioxane is a persistent contaminant of groundwater that is challenging to remove because of its solubility in water and resistance to degradation. Recent studies show co-metabolic substrates like tetrahydrofuran (THF) may improve the microbial breakdown of 1,4-dioxane. However, it is still unknown how THF concentration affects the structure of microbial communities and how this relates to degradation efficiency. The Lowry Landfill site in Aurora, CO operates a successful pump-and-treat bioremediation facility that relies on microbial communities for breakdown of 1,4-dioxane. The aim of this study is to assess the effects of THF on microbial community structure and how they relate to the breakdown of 1,4-dioxane at the Lowry Landfill. Support media from one of three replicate bioreactors were sampled from January 7th to September 2nd, 2025, under increasing THF concentrations. Three noodles per sampling date were quartered, microbial DNA was extracted and quantified from two quarters, and a phylogenetically diagnostic genomic region was amplified via polymerase chain reaction (PCR). The PCR products were then sequenced for characterization of microbial community structure. We hypothesize that the addition of THF will lead to measurable shifts in the microbial community within the bioreactor used for 1,4-dioxane-degradation. By comparing the sequence data over time, we aim to identify trends indicating increases or decreases in the relative abundance of specific microbial groups correlated with THF concentration. Identifying microorganisms whose abundance changes over time may provide insight into their potential roles in the degradation of 1,4-dioxane. These findings may contribute to a better understanding of how microbial communities respond to THF addition in 1,4-dioxane degrading bioreactors, which in turn has the potential to inform site management.
https://symposium.foragerone.com/2026-racas/presentations/81088

Microglial Targeting to Restore Sleep and Enhance Recovery After Traumatic Brain Injury
Princesa Rodriguez-Herrera, *Biomedical Sciences*
Mentor: Rachel Rowe, PhD

Abstract:
Traumatic Brain Injury (TBI) frequently causes persistent sleep disturbances that can prolong neurological and behavioral symptoms. These symptoms may be a result of microglia-driven neuroinflammation, suggesting that microglia, the brain's resident immune cells, may offer a therapeutic target, where modulating neuroinflammation may improve overall sleep outcomes following TBI. We hypothesize that repopulating microglia after TBI in a mouse model will enhance sleep quality relative to injured mice with overactive and unhealthy microglia. To investigate this, we induced TBIs in both female and male C57BL/6J wild-type mice using the midline fluid percussion injury (mFPI) model and manipulated microglia using a microglia-depleting diet (PLX5622) to achieve either sustained depletion or controlled repopulation. Injury condition, SHAM or TBI, was assigned blindly, whereas diet condition was openly designated. Sleep across all groups was quantified noninvasively with home-cage piezoelectric monitoring. Affective and cognitive performance are to be assessed at one week, one month, and two months post-injury using various behavioral tests. Our initial findings have shown that the repopulation of microglia in mice that

received TBI showed significantly improved performance compared to the sham and depletion-injury groups in cognitive tasks. Additionally, the repopulated-TBI group slept significantly less than the other TBI groups. These results suggest that the repopulation of microglia has the potential to improve cognitive defects following TBI. This study is ongoing, and future results could reveal the therapeutic capabilities of targeting microglia or microglia-mediated inflammatory pathways to restore sleep and mitigate chronic TBI symptoms.
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Modulation of Gamma-aminobutyric Acid by *Lactobacillus rhamnosus* in *Caenorhabditis elegans* Modeling Alzheimer's Disease

Saige Tinker and Emery Doser, *Biomedical Sciences*
Mentor: Kayla Ahr

Abstract:
Alzheimer's disease (AD) affects 55 million people worldwide, leading to progressive cognitive decline, brain cell death, and brain shrinkage. Current treatments offer only limited relief, underscoring the need for innovative approaches to better understand the disease. One potential area of exploration is the gamma-aminobutyric acid (GABA) system, which plays a central role in regulating brain signaling. Another aspect is *Lactobacillus rhamnosus* (*L. rhamnosus*), a psychobiotic bacterium indicated to influence cognitive health through the gut-brain axis. This research tested the effects of *L. rhamnosus* on GABA levels in the genetically modified *Caenorhabditis elegans* (*C. elegans*) CL2006 strain, which models AD. We hypothesized that introducing *L. rhamnosus* would increase GABA abundance and provide therapeutic benefits for AD symptoms. Three groups of *C. elegans* were fed a diet of OP50 *Escherichia coli* (*E. coli*), *L. rhamnosus*, or a combination of both bacteria. After the feeding, worms were homogenized, and GABA levels were quantified using an enzyme-linked immunosorbent assay (ELISA). An ANOVA yielded a statistically significant p-value of 5.40 x 10^-11 for *E. coli* B vs. *L. rhamnosus* 2X isolated B, indicating a statistically significant increase in GABA production in *L. rhamnosus* compared to *E. coli*. The study involved no human participants or vertebrate animals, and all biologics are Biosafety Level 1 (BSL-1). This research suggests *L. rhamnosus* has potential as a new therapeutic target for AD and gut-brain axis research.
https://symposium.foragerone.com/2026-racas/presentations/80739

Motor Learning and the Survival of Premyelinating Oligodendrocytes

Katelyn Diep, *Biomedical Sciences*
Mentor: Dr. Ethan Hughes

Abstract:
Oligodendrocytes and their precursor cells (OPCs) play a central role in brain development, plasticity, and function. OPCs proliferate, initiate differentiation, and generate mature oligodendrocytes that contribute to myelination and neural circuit function throughout life. However, their specific contributions to neural pathways have been the subject of extensive interest in neuroscience. Despite a growing body of research characterizing these cells at molecular and cellular levels, there remains a gap in our understanding of dynamic lineage progression in the intact, living brain, particularly in relation to behavioral contexts. This lack of longitudinal in vivo analysis limits our ability to connect cellular processes with real-time changes in brain function and biological outcomes. This project addresses this gap by examining oligodendrocytes and OPCs via live in vivo two-photon (2P) imaging in transgenic mice together with cell tracking approaches that allow lineage dynamics to be observed directly over time. Specifically, we use quantitative lineage tracing to access individual OPCs undergoing proliferation, differentiation initiation, and oligodendrocyte generation across motor learning. Imaging is performed prior to training, during the learning period, and following task mastery to capture specific cellular dynamics while animals engage in motor learning tasks. This approach enables the study of these cells within physiologically relevant conditions. By combining longitudinal 2P imaging and behavioral monitoring, the study examines how oligodendrocyte lineage cells respond to and potentially support neural activity changes in the living brain. Integrating live cellular imaging with behavioral interventions provides a more comprehensive and accurate account of oligodendrocyte lineage function than approaches that rely solely on ex vivo methods. Our results reveal that OPC proliferation is temporarily suppressed during motor learning, while OPC differentiation and survival only show minor, non-significant changes. Overall, this project advances our understanding of glial cellular dynamics by directly linking oligodendrocyte lineage cell behaviors to real-time biological processes in intact animals, shedding new light on the functional roles of glial cells in motor learning and brain function.
https://symposium.foragerone.com/2026-racas/presentations/80920

Multiscale Modeling of the NarK Nitrate/Nitrite Antiporter using Adaptive-Partitioning Algorithms Based on Hierarchical Truncated Many-Body Expansion (PAP-HMBE)
Julia Lourenco Roma, *Natural & Physical Sciences*
Mentor: Dr Hai Lin

Abstract:
The NarK antiporter operates in a wide variety of organisms by selectively transporting nitrate and nitrite ions across biological membranes in opposite directions, providing both a way for nitrogen nutrition to enter the cell and for toxic metabolites to be expelled. Despite extensive biochemical investigations and crystal structure determinations, many details of Nark's transport mechanism remain elusive. Computer modeling can offer atom-level insights, complementing experiments. For example, recent quantum modeling of the NarK binding sites revealed that in the R89K mutant, nitrite is trapped in the pore because it competes for a proton with the mutated lysine, disrupting the transport cycle, despite the arginine-to-lysine mutation preserves the charge.[1] Such competition of proton does not occur in the wild-type protein. This discovery highlights the importance of high accuracy quantum mechanical (QM) descriptions for the interactions between the ion and its surroundings. However, full high-level *ab initio* QM simulations of the protein are computationally too demanding to be feasible. In this work, we develop a novel multiscale method to tackle this problem. We combine a recently proposed hierarchical many-body expansion (HMBE) method[2] with the permutated adaptive-partitioning (PAP) algorithm[3,4] that allows the descriptions of atoms to be switched *on-the-fly* between different levels of accuracy (e.g. *ab initio* QM, semi-empirical QM, or even molecular mechanics) as needed. We present the preliminary results from our test calculations on a series of models. This advancement opens the door to more efficient modeling of diffusion processes in large and complex systems.
https://symposium.foragerone.com/2026-racas/presentations/80960

Nanoscale SQUID-on-Tip Substrate Optimization
Dennis Pradhan, *Natural & Physical Sciences*
Mentor: Martin E. Huber

Abstract:
We present an overview of the nanoscale SQUID-on-TIP (SOT) fabrication process with emphasis on the substrate fabrication process development for optimized geometry. A commercial pipette puller is used to draw 1 mm diameter quartz glass capillaries down to patch-pipettes with diameters ranging from 50 to 300nm. Normal-metal electrical contacts are then applied to the patch-pipette via self-aligned thermal vacuum deposition in separate vacuum cycles. Superconducting (SC) films of Pb are then deposited to form the SOT in a cryogenic ultra-high vacuum (UHV) chamber, where in-situ rotation of the substrate is utilized to form the SC leads and SC ring with two Josephson junctions. The operational parameters of SOTs are governed by the geometric qualities of the SC films, which in turn are determined by the geometry of the initial substrate. Different sensitivities can be achieved with varied SC ring diameters, and the quality of the Josephson junctions strongly depends on the geometries at the apex of the pipette. To ensure an optimal substrate geometry, the substrate fabrication process was closely examined using Design of Experiment methodology to statistically quantify the effect of different fabrication parameters involved with forming the patch-pipette geometry. This study includes the use of Orthogonal Fractional Factorial Design (OFFD) to determine the optimized set of parameters and a Response Surface Method (RSM) to provide a means to predict the substrate geometry from a given set of parameters. Data was acquired by measuring the geometries of varied parameter values from images acquired by optical microscopy, and, time pending, scanning electron microscopy (SEM) for achieving nanometer resolutions.
https://symposium.foragerone.com/2026-racas/presentations/80997

Native vs. Non-Native Speech Preference in Infants: Behavioral and Maternal Influences
Ashlee Lorquet, *Social Sciences & Humanities*
Mentor: Peter Kaplan

Abstract:
Infants in their first year of life tend to prefer the sounds and faces of people who speak their parents' native language. This preference may direct the infant's attention to adults with the motivation and ability to guide their early language learning and future social interactions. The purpose of this study was to attempt to replicate previous findings and explore whether maternal postpartum depression influences this preference. Infant's spontaneous preferences for the still, silent faces of the two adult women who would serve as video models were first assessed. Then, infants were shown videos with alternating 10-second presentations of the two speaking faces, one speaking English in baby talk intonation and the other speaking Hungarian in baby-talk intonation. Next, infants were again given side-by-side presentations of the still, silent faces to test for preferences. No effect of the infant's mother postpartum depression status was seen on face preferences. Overall, we found that girls showed an increase in preference from pretest to posttest for the face of the native (English) speaker's face, whereas boys showed an increase in preference from pretest to posttest for the non-native (Hungarian) speaker's face. These findings may reflect difference in the rate of communicative development in girls and boys.
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Neighborhood Food Quality Disparities Revealed Through DNA Degradation Analysis
Edna Abel and Genesis Archila-Ochoa, *Social Sciences & Humanities*
Mentor: Rachel Gano

Abstract:
The goal of this project is to gain insight into economic inequalities based on food quality. We tested the DNA yield and integrity from fruits in different income areas. Strawberries and bananas were purchased from grocery stores in comparatively high-income and low-income neighborhoods in the Denver Metropolitan area. A variety of household items were used to extract the DNA, including soap, salt, water, and chilled 91% isopropyl alcohol. We compared the extracted DNA based on visibility, clumping, DNA thickness, and opaqueness. We devised a "Qualitative Integrity Scale" for the overall structure of the DNA from 1-5, which considered visibility, clumping, DNA thickness, and opaqueness. The larger, intact strands suggest a higher DNA integrity (thus nutrient retention), and receive a higher score. Using statistical analysis helped confirm that differences between neighborhood types were not coincidental. The results of the experiment displayed that fruits from higher-income areas had more visible and cohesive strands, while fruits from lower-income areas showed the opposite, with smaller and more fragmented strands. These observations suggest that socioeconomic factors such as transit time and storage in varying neighborhoods may affect the food quality differences on a molecular level. This project can serve as a simple and approachable method for people to understand how median neighborhood income influences biological food quality.
https://symposium.foragerone.com/2026-racas/presentations/81301

Neural mechanisms of the perception-action cycle in athletes
Lauren Hamilton, *Natural & Physical Sciences*
Mentor: Dr. Carly Leonard

Abstract:
Decisions in sports must be made in fractions of seconds. Elite athletes in particular have intense demands for visuomotor integration because they make game-time decisions that require translating perceptual information into near instantaneous precise motor responses. This clearly relies heavily on sensory processing as the visual scene has to be rapidly taken in and analyzed for temporal and spatial information. But the brain does not just passively experience the world. It integrates previous experience and knowledge with the new incoming information, actively shaping how sensory and motor systems interact. Miller and Clapp (2011) discuss this perception-action cycle as a hierarchal chain of neural processes that are required to take place to effectively guide action decisions. In my poster, I will summarize the literature on this perception-action cycle, focusing on the neural mechanisms that enable fast performance in elite athletes. This will include discussion of the thalamo-cortical loops, functions of the visual system, as well as the influence of feedforward and feedback interactions. For example, if a basketball player expects their teammate to appear in one area of the court due to the playbook, they are likely to shift their attention there in advance. It is well known in the brain that these types of spatial expectations can lead to changes in activity in early visual cortex, which can facilitate the rapid processing of new visual input at that location. Overall, this field of research shows that the training and game experience of elite athletes changes their neural pathways which in turn enables them to perform in high pressure game situations. The reciprocal nature of the neural refinement and practiced action over time allows elite athletes to perform high quality visuomotor integration with increased accuracy and speed compared to novice athletes.
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New Application of CaMPARI to Study Beta Cell Subpopulations and Calcium Dynamics
Sraosi Dey Upama, *Biomedical Sciences*
Mentor: Evelyn Ibarra

Abstract:
Calcium-modulated Photoactivatable Ratiometric Integrator (**CaMPARI**) is a genetically encoded protein-based fluorescent activity sensor, originally used to assess and study neural activity involved in specific animal behaviors, that permanently converts from green to red fluorescence when bound to calcium ions and in the presence of violet light. CaMPARI has not been previously used as a calcium indicator to study *calcium dynamics*, and we aim to utilize it to study pancreatic beta cells. Calcium plays a major role in stimulating insulin secretion in beta cells, with changes in cytosolic calcium providing important insights into their function and serving as a proxy for visualizing insulin secretion.
This ongoing research aims to validate CaMPARI as a *calcium indicator* to be an alternative to calcium-sensitive dyes. Common dyes, such as Fluo-4, Fura Red and Rhod 2, have several limitations, including limited islet penetration, and a lack of cell-type specificity, often labeling non-β-cell populations within the islet. In contrast, CaMPARI can permanently record calcium-dependent activity, can work well in intact islets, and avoids the inconsistencies that come with dye loading, allowing better categorization of β-cell subpopulations and visualization of their calcium dynamics.

Using confocal microscopy and staining techniques with well-established calcium dyes on isolated mouse islets that express CaMPARI in the beta cell, we can compare the effectiveness of CaMPARI as a tool for visualizing calcium activity in β-cells. We will use calcium indicator dyes, such as Fluo-4, Fura Red, Rhod-2, and drugs that alter the calcium activity, like potassium chloride and diazoxide, to determine whether CaMPARI can help *identify different β-cell subpopulations* and *study their calcium activity* to improve our understanding of what drives β-cell heterogeneity in metabolic conditions such as Type 2 Diabetes.
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Nothing About Us Without Us: Student-Led Research in Action on AANHPI Undergraduate Experiences at CU Denver
Lucie Dao, Vic Deguzman, Daranee Taychachaiwongse Teng, and Jie Soo Hong, *Social Sciences & Humanities*
Mentor: Dr. Faye Caronan and Dr. Robin Brandehoff

Abstract:
Asian American, Native Hawaiian, and Pacific Islander (AANHPI) students are often treated as a monolithic population in higher education research, obscuring meaningful within-group differences in student experiences and support needs. This action research study examines the experiences of AANHPI undergraduate students at a large urban public university in the western United States to better understand factors related to belonging, help-seeking behaviors, academic self-efficacy, and institutional support. Using a mixed-methods design, undergraduate and graduate student researchers from the the university's Asian American, Native American, and Pacific Islander-Serving Institution (AANAPISI) action research team surveyed all AANHPI undergraduate students enrolled at the institution during the Fall 2025 semester (n = 1,383). The following research question frames the descriptive study: How do AANHPI undergraduate students experience belonging and institutional support, and what factors shape their engagement with campus support services?
A total of 302 valid responses were analyzed using descriptive statistics and constant comparative qualitative analysis. The sample represented approximately 22% of the institution's AANHPI undergraduate population. Findings reveal a gap between comfort and perceived institutional value: while 73% of respondents reported feeling comfortable at the university, only 42% reported feeling like an important member of the campus community. Help-seeking patterns indicate that students are more likely to contact faculty than institutional support services, with only 37% reporting regular engagement with academic advising. Disaggregated analyses highlight important subgroup differences, including higher reported rates of discrimination among multiracial and SWANA students. Financial stress, mental health concerns, and balancing work and school emerged as the most significant barriers to persistence. Findings suggest the need for culturally responsive advising, better equipping faculty to refer students to campus support services, increased visibility of AANHPI student organizations, and targeted programming to address subgroup-specific experiences within the AANHPI student population.
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Occupational Cognitive Load and Cognitive Aging: Longitudinal Evidence from the Health and Retirement Study
Saikruthi Allareddy, *Social Sciences & Humanities*
Mentor: Dr. Ronica Rooks

Abstract:
As the population ages, identifying everyday factors that shape cognitive health has become increasingly important. While continued employment has been associated with better cognitive outcomes in older adults, most research treats employment as a binary exposure, with less attention on how the cognitive demands of different occupations may influence cognitive trajectories over time. This leaves a gap in understanding of whether occupational complexity itself contributes to aging.
This research examines the relationship between occupational cognitive load and cognitive function using longitudinal data from the Health and Retirement Study (waves 3-15). Cognitive performance was measured using the 27-point Langa Weir HRS cognition scale. Analyses were restricted to employed respondents with occupation data (21,735 observations; 5,542 individuals). Occupations were grouped into high cognitive load (managerial, professional, sales, clerical) and low cognitive load (service, manual, and production) roles. Linear mixed-effects models were used to estimate trajectories of cognitive change and logistic mixed-effects models were used to understand odds of cognitive impairment (score 11), adjusting for age, gender, education, and survey wave.
It was found that individuals in high cognitive load occupations had consistently higher cognitive scores than those in lower load roles. Cognitive scores declined with age in both groups; however, the interactions between age and cognitive load was not statistically significant, indicating similar rates of decline. In contrast, high cognitive load occupations were associated with substantially lower odds of cognitive impairment (OR=0.06, pThese findings suggest that cognitively demanding work is associated with higher levels of cognitive functioning and lower likelihood of impairment in later life. Rather than slowing the rate of decline, occupational cognitive load appears to influence where individuals start in older age, consistent with a cognitive-reserve framework in which early and midlife exposures shape resilience to later-life impairment.
https://symposium.foragerone.com/2026-racas/presentations/80994

Office for Roundtable Affordable Housing Crisis Research
Zach Beck and Lorelai Brunner, *Social Sciences & Humanities*
Mentor: Leyuan Li

Abstract:
Denver faces one of the most severe housing shortages in the United States, with an estimated deficit of between 45,025 and 115,012 units as of 2023. Projections suggest that an additional 26,971 to 40,968 housing units would need to be constructed each year through 2028 in order to meet growing demand (Common Sense Institute, 2026). This shortage has significantly challenged housing affordability across the metropolitan region, placing increasing pressure on low- and middle-income households. The situation is further exacerbated by the predominance of the single-family housing model favored by many American cities. In response to these conditions, our research investigates the gaps within the current affordable housing landscape and explores how architectural strategies might contribute to addressing them. We develop a series of small-scale architectural competitions, installation proposals, and analytical studies that examine affordable housing typologies across the United States. These initiatives operate both as research tools and as speculative design platforms, allowing us to test alternative spatial and social models for housing production. Through an interdisciplinary approach, the research focuses more closely on Denver in order to understand the local dimensions of this crisis. Our analysis suggests that restrictive zoning regulations and gentrification incentives have contributed to the shortage of affordable housing in the city. Together, these factors constrain the ability of communities to adapt to demographic and economic changes. By examining these systemic challenges alongside design speculations, this research broadens our understanding of the structural forces shaping the housing crisis. It also demonstrates how architecture can serve as a productive medium for rethinking housing models and mitigating some of the negative impacts of this ongoing crisis.
https://symposium.foragerone.com/2026-racas/presentations/81025

Oligodendrocyte precursor population homeostasis following demyelination
Moises Izquierdo-Velasco, *Biomedical Sciences*
Mentor: Ethan G. Hughes

Abstract:
Demyelinating injuries, such as those in multiple sclerosis, lead to cognitive and physical disabilities. One therapeutic avenue to reverse this damage is to enhance the endogenous repair process (remyelination) by increasing the differentiation of oligodendrocyte precursor cells (OPCs). Several drugs currently in clinical trials, termed “remyelination therapies,” stimulate oligodendrocyte regeneration by promoting the initiation of OPC differentiation. A potent driver of OPC differentiation are thyroid hormones (including Triiodothyronine or T3). However, remyelination is an inefficient process, with most differentiating precursors undergoing apoptosis at the premyelinating oligodendrocyte (preOL) stage. While previous studies show that T3 enhances remyelination, how T3 alters oligodendrocyte lineage progression is unknown. Therefore, we aimed to clarify the mechanisms through which T3 acts on oligodendrocyte lineage cells. Using live *in-vivo* two-photon imaging, we performed quantitative OPC lineage tracing to assess OPC proliferation, differentiation, and preOL survival in healthy *Olig2-CreER*; *R26-lsl-tdTom*; *Mobp-eGFP* mice treated with T3 or vehicle via intraperitoneal (IP) injections. In health, we found that T3 drives remyelination by enhancing OPC differentiation initiation, without altering preOL survival. T3 driven differentiation initiation subsequently increased proliferation to maintain the homeostatic OPC pool. To investigate the effect of therapeutic timing of T3 in demyelinating injury, we induced demyelination by feeding these mice a 0.2% cuprizone diet and administered T3 or vehicle during and after demyelination. T3 administered after demyelination, increased myelinating oligodendrocyte (mOL) generation, due to enhanced OPC differentiation initiation, without changing preOL survival. Interestingly, mOL generation was impaired when T3 was administered during demyelination. While OPC differentiation initiation and proliferation were both enhanced, preOL survival was reduced relative to vehicle. This impairment suggests that enhanced differentiation and/or proliferation during demyelination alters the capacity of preOLs to successfully integrate as mOLs. This work highlights the importance of proper therapeutic timing to harness the effects of remyelination therapies on myelin regeneration.
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Optimizing Hybrid Materials and Structures through Voxel Printing and ML-Driven Analysis
Idris Tinwala, *Tech, Engineering, & Math*
Mentor: Dr. Guoying Dong, Ph.D.

Abstract:
Voxel printing is an advanced 3D manufacturing method that builds objects using 3D pixels (voxels) in multiple materials, allowing for highly customizable physical properties. Base materials with varying characteristics (i.e. flexible and rigid material) can be arranged in specific layouts in 3D space, allowing for highly customizable physical properties. However, designing these structures is incredibly difficult due to the unpredictable ways that flexible and rigid materials interact at the voxel level. Traditional computer simulations often fail to accurately predict how these objects will behave under compression as they

struggle to account for the complex, chaotic interactions happening where the different materials meet. To overcome this issue, this study introduces a specialized Machine Learning (ML) framework called a Physics-Informed Inverse Design Network (PI-IDN) that is designed to learn the relationship between the voxel layout and the compressive properties of the entire structure through deep learning processes. This approach pairs two Neural Network (NN) systems: a 'creator' network known as a Conditional Variational Autoencoder (CVAE) that drafts perfectly symmetrical, high-resolution structural blueprints, and a 'judge' network known as a Visual Geometry Group (VGG) that acts as an integrated physics consultant. Together, they learn the hidden behaviors connecting a physical voxel pattern directly to five core mechanical property parameters. These are then compared to previous experimental cyclic compression testing data as well as data outputted from a computerized homogenization simulation model in MATLAB. The generated results demonstrate that the physics-aware AI model framework can successfully capture the complex structural behaviors that traditional software methods overlook, while drastically reducing design time. Ultimately, this allows engineers to work backward by inputting the exact compressive profile and properties they need to instantly generate ready-to-print 3D patterns, tailored to their specifications.
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Optimizing Parameters for Analog Variational Quantum Eigensolvers
Lucas Mural, *Natural & Physical Sciences*
Mentor: Dr. Kathryn R Hamilton

Abstract:
Quantum computing is a powerful new tool still in its infancy, but it can be used along with classical computing methods to efficiently solve certain types of problems. One method that uses this hybrid approach are Variational Quantum Eigensolvers (VQEs), which are a class of algorithm that calculates expectation values or eigenvalues of an operator, usually the Hamiltonian. VQEs function on noisy intermediate-scale quantum devices, which are quantum computers with a small number of qubits. VQEs operate via the variational principle, where a “guess” wave function is used and progressively tuned until the aforementioned eigenvalues are minimized. These are mostly used to acquire the ground-state energy of a system, but can be used for excited states as well. In this work we will explore how laboratory parameters affect the performance of a VQE algorithm, with the goal of minimizing both solution time and error.
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Photogrammetry Replications of Surgical Windows to Quantify Visible Bone Surface Area
Hunter Swartwout, *Tech, Engineering, & Math*
Mentor: Michael "Bodhi" Rogers

Abstract:
While 3D modeling is essential for advancing surgical research, traditional medical imaging often lacks the accessibility or surface resolution required for detailed intra-operative simulation. This study evaluates the viability of digital photogrammetry as a high-fidelity, cost-effective tool for quantifying surgical exposure, using the distal radius—the most commonly fractured long bone—as a clinical model. To overcome the challenge of replicating real surgical conditions, a photogrammetric workflow was developed to generate accurate digital twins of cadaveric specimens. These models allowed for the precise digital measurement and elliptical approximation of visible articular surface areas through volar and dorsal surgical windows. By comparing these captures to fully disarticulated models, this research demonstrates that photogrammetry can reliably quantify anatomical visibility. The results indicate that photogrammetry is a robust alternative to expensive traditional imaging, providing a scalable method for bone geometry replication and surgical protocol refinement.
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Polycyclic Aromatic Hydrocarbons Measured Following Electronic Dabbing of Terpenes
Gregory Brusoe, *Biomedical Sciences*
Mentor: Alison Bauer

Abstract:
Background and Purpose: Dabbing is the heating concentrated Cannabis-derived products to high temperatures. Terpenes are found naturally in Cannabis and are responsible for the aroma profiles characteristic of dabbing. At high temperatures, terpenes such as a-cedrene and b-caryophyllene are known to undergo pyrolysis to form polycyclic aromatic hydrocarbons (PAHs). However, the production of PAHs from dabbing are not well known. There are 16 U.S.E.P.A priority PAHs and many are known or suspected carcinogens. Our hypothesis is that electronic dabbing of terpenes will lead to PAH production.
Methods: A novel method was developed for analyzing PAHs produced during electronic dabbing by collecting vapor produced at 1000° F from an electronic dabbing rig. Vapor was captured using C18 SPE cartridges, followed by measurement of the 16 EPA priority PAHs using gas chromatography/mass spectrometry (GC/MS). PAH testing with a terpene mixture was performed

followed by unknown analysis using the NIST17 GC/MS database. Our protocol was validated by measuring samples spiked with PAHs before and after dabbing.
Results: Our findings suggest the presence of multiple priority PAHs, particularly those of lower molecular weight, such as naphthalene and its methylated derivatives, produced from the dabbing of the terpene mix. However, some PAHs were present at low concentrations in un-dabbed samples, prior to any heating in the lab. Other unknowns were also observed in an exploratory search to find other potentially toxic compounds.
Conclusions: We successfully developed of a method for the analysis of PAHs from dab vapors. Our findings suggest that dabbed terpenes results in significantly increased production of PAHs. Our overall goal is to understand potential user exposures to prevent and protect the public health of Coloradoans by providing evidence to improve regulations. This research was supported by the Institute for Cannabis Research and the R25ES025476.
https://symposium.foragerone.com/2026-racas/presentations/80910

Portfolio Robustness Under Market Uncertainty
Jesus Valles Miranda, *Tech, Engineering, & Math*
Mentor: Yosef Bonaparte

Abstract:
Portfolio Robustness Under Market Uncertainty (PRMU) is a research framework that examines the stability of diversified portfolios under changing market regimes. Traditional portfolio construction methods assume that diversification reduces risk through low or stable correlations between assets. However, during periods of market stress, correlations tend to increase, reducing the effectiveness of diversification and exposing portfolios to concentrated risk.
This study analyzes how asset correlations evolve across different market conditions using sector-level data from the S&P 500. Multiple portfolio construction methods, including equal-weighted, mean-variance optimized, and volatility-adjusted portfolios, are evaluated to assess their sensitivity to correlation shifts and regime changes. The objective is to identify structural weaknesses in conventional diversification approaches and explore how portfolios behave when underlying assumptions no longer hold.
To support this analysis, a custom-built application visualizes real-time correlation dynamics, enabling a more intuitive understanding of when and how diversification begins to fail.
PRMU is an early-stage framework aimed at reframing diversification as a dynamic process rather than a static allocation strategy. The long-term goal is to contribute to the development of more adaptive portfolio construction methods that remain robust under uncertainty.
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Predicting bacterial host and pathogen types using virulence factors
Sarah Mentzer, *Biomedical Sciences*
Mentor: Janani Ravi

Abstract:
In the face of emergent and resurgent bacterial infectious diseases, researchers study the evolution and function of the mechanisms underlying pathogenesis. Among these mechanisms, bacterial genes known as “virulence factors” (VF) have been linked to infection mechanisms in humans. However, while prevalent in pathogens, many VFs can play roles in metabolism, motility, and surface adherence that are also fundamental to survival for free-living and non-pathogenic microbes. Given this, we asked whether virulence factors are useful predictors for bacterial pathogen potential, or if their utility is largely confined to better understanding species that have already been determined to be pathogenic. To evaluate whether specific VFs or VF classes can be robust virulence markers, we extracted VF conservation and frequency within diverse bacterial genera containing pathogens and non-pathogens.
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Preliminary Feasibility of a Multi-Sensor Protocol for Nighttime Care Monitoring
Saron Solomon, *Tech, Engineering, & Math*
Mentor: Dr. Becky Breaux

Abstract:
Individuals with neurological conditions that result in body shape distortions, such as cerebral palsy, frequently experience difficulties maintaining comfortable sleeping positions. Early studies suggest that a potential intervention for improving sleep quality and reducing the frequency of posture-related nighttime interventions by caregivers is the use of nighttime positioning systems, which are therapeutic aids designed to promote safe sleeping positions. However, high-quality evidence supporting their effectiveness remains limited due to a lack of objective, reliable methods used in earlier studies to monitor the impact of

these systems. As a first step toward building a reliable evidence base, a pre-feasibility study was conducted to evaluate whether a multi-sensor system could accurately detect nighttime caregiving events in a home-like setting. A Lorex 4K infrared video camera, Aqara FP2 mmWave presence sensor, and Withings Sleep Mat were installed in a mock bedroom. A caregiver proxy performed three trials of seven scripted care tasks (e.g., repositioning, bed entry) on a volunteer participant simulating a sleeping child. The system performance was assessed using six metrics: Detection Rate, Consistency Index, Collaborative Detection Rate, Unique Contribution Score, Relative Detection Accuracy, and Latency. The system detected 100% of all events with full consistency across trials and an 86% collaborative detection rate. While the video camera had the highest unique contribution, each sensor supported reliable, cross-validated detection. These findings support the use of this multi-sensor system in a future in-home feasibility study, and ultimately in a case study evaluating the effectiveness of nighttime positioning systems.
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Protonation States of Proton-Sensing Glutamate Residues in Sialin Transport
Muhamadjon Dzhalolov, *Biomedical Sciences*
Mentor: Dr. Hai Lin

Abstract:
Sialic acids are a diverse group of nine-carbon monosaccharides that are ubiquitously present in animals and bacterial species and are engaged in a wide spectrum of biological processes. Sialin, a member of the SLC17 family, is a lysosomal sialic acid/proton symporter protein that transports sialic acids across membranes between lysosomal lumen and cytosol, playing a critical role in sialic acid metabolism. Although cryoEM structures have provided a framework, the molecular mechanism of sialin operation and proton-coupled alternating access is yet to be fully understood. We present here a computational study that probes the role of two conserved glutamate residues, E171 and E175, in substrate movement. We carried out steered molecular dynamics (SMD) simulations of the transport of N-acetylneuraminic acid (Neu5Ac), the most widely spread natural derivative of sialic acids, through sialin with E171 and E175 in various protonation states. Multiple trajectories were generated for both uptake and release, and the changes of key salt bridges and gate dimensions were monitored to directly connect local interactions to global conformational changes. The simulations suggest that protonation of E171 and/or E175 may reorganize charge networks involving arginines R57 and R168 and modulates opening and closure of luminal and cytosolic gates. Additional quantum calculations provide a possible explanation for why mutation R168A retains most of the transport activities, but R168K does not.
https://symposium.foragerone.com/2026-racas/presentations/80900

Pueblo 1921 Flood: A Social Biopsy
Daniel Torres Diaz, *Social Sciences & Humanities*
Mentor: James Walsh

Abstract:
Natural disasters devastate communities leaving behind destruction and a long lasting legacy. That was the case for Pueblo Colorado during the great flood of 1921. The flood left a long lasting legacy and it is remembered by the community of Pueblo to this day. The legacy of the flood is not only one of death and destruction but one that highlights inequality for people of color, working class people, and women. This legacy is shown when you look into how the flood is remembered and look at the lasting effects that exist even 100 years later. This presentation will be the culmination of research that began almost two years ago. Through the research process there has been a commitment to untold stories of marginalized communities. Outside of the community of Pueblo very little is remembered about the flood and as a result marginalized communities are the first to be forgotten. The goal of this presentation is to share the conclusion and culmination of research of the Pueblo flood of 1921.Natural disasters devastate communities leaving behind destruction and a long lasting legacy. That was the case for Pueblo Colorado during the great flood of 1921. The flood left a long lasting legacy and it is remembered by the community of Pueblo to this day. The legacy of the flood is not only one of death and destruction but one that highlights inequality for people of color, working class people, and women. This legacy is shown when you look into how the flood is remembered and look at the lasting effects that exist even 100 years later. This presentation will be the culmination of research that began almost two years ago. Through the research process there has been a commitment to untold stories of marginalized communities. Outside of the community of Pueblo very little is remembered about the flood and as a result marginalized communities are the first to be forgotten. The goal of this presentation is to share the conclusion and culmination of research of the Pueblo flood of 1921.
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Puerto Rican Music as Gendered Resistance and Matrifocal Cultural Power
Carla Martínez, *Arts & Media*
Mentor: Dr. Maria Elena Buszek

Abstract:
This project examines Puerto Rican music as a gendered form of resistance, cultural expression, and political agency, emphasizing the foundational role women have played in shaping musical traditions across the island and the diaspora. In contrast to many Latin American societies, Puerto Rico has long demonstrated matrifocal and, at times, matriarchal social patterns in which women serve as cultural anchors, household heads, and principal transmitters of tradition. These gender dynamics profoundly influenced the development of bomba, plena, and reggaetón, all of which have served as vehicles through which women confront colonialism, patriarchy, racial inequality, and state violence. From the embodied authority of the bomba dancer to the feminist interventions of modern reggaetón artists, Puerto Rican music reveals how gender and performance intersect to articulate resistance, reflecting collective trauma while nurturing community empowerment. Drawing on scholarly research, lyrical analysis, and feminist cultural theory, the paper argues that Puerto Rican music not only documents marginalized communities' experiences and injustice but also actively reshapes gender power relations by foregrounding women's voices, bodies, and leadership. Ultimately, Puerto Rican music emerges as both a historical archive and a gendered force for social change, sustaining cultural pride, collective memory, and ongoing movements for justice and liberation.
Keywords: Puerto Rico, gender, music, matrifocality, oppression, resilience, colonialism, cultural identity, Afro Caribbean culture, feminism, resistance
https://symposium.foragerone.com/2026-racas/presentations/81117

Purple Summer
Mason Grande, An Duong, and Savannah Londo, *Arts & Media*
Mentor: Eric Jewitt

Abstract:
Our film "Purple Summer" is a story about two men who have to suppress their love for each other in order to be accepted in their small Appalachian town. Our goal with this film is to directly explore the dynamics of queerness within the rural South and how the social pressure to adhere to the status quo contributes to abuse and toxic masculinity. This film explores the cycles we find ourselves in during our pursuit of loving and being loved in return.
We supported our message with visual signs of Americana decay to create the feeling of a rural town. This is achieved through the score and sound design of the film, using silence to indicate something is not quite right. The equipment used were vintage Soviet-era lenses: a Miranda 50 mm and a Jupiter 135 mm lens for extreme close-ups. The aim was to give an almost voyeuristic feel into these coal miners' most vulnerable moments.
Our final edit captured the claustrophobic feeling of a small town, where nothing private stays private. We plan to submit it to several film festivals to reach wider audiences.
Every character is doing what they think they're "supposed to" do. This movie is an omen against that. We hope that, by watching our film, people will hold more tolerance; not just for the queer experience, but the questionable decisions made under the pressure to fit in. We hope the audience can understand why someone would want to leave, and sympathize with their decision to stay.
https://symposium.foragerone.com/2026-racas/presentations/80855

Quantifying Immune Cell Biomarkers in RET + Lung Adenocarcinoma-Bearing Mice
Daniel Skhisov, *Natural & Physical Sciences*
Mentor: Dr. Lynn Heasley

Abstract:
This projects goal is to better understand the host and tumor response while undergoing TKI treatments. If lung adenocarcinoma-bearing mice are treated with TKIs, then the tumor will eventually shrink and become stable, or grow out again.
During this process immune cell biomarkers may be tracked to better understand the overall host response and predict the duration of benefit. CD8 T-Cells have been observed and quantified during multiple stages in treatment, and more T-Cell markers may be tracked. In addition, the project may identify mechanisms accounting for the wide variation in lung cancer patient response to TKIs and highlight ways to increase the duration of therapy in those who would otherwise undergo rapid treatment failure. Thus, allowing providers to create improved treatment plans and improve treatment outcomes.
https://symposium.foragerone.com/2026-racas/presentations/81008

Raices, Puentes, Florecer
Adriana Fierro, *Arts & Media*
Mentor: Megan O'Connor

Abstract:
Educational research has consistently shown disparities in access to advanced coursework and academic opportunities between Black and Latino students compared to their White peers. In previous research, I examined these systemic inequities and how they shape educational pathways for underrepresented students. Studies on school segregation and systemic barriers have demonstrated that schools with predominantly marginalized student populations face lower achievement rates, fewer resources, and higher disciplinary actions are factors that contribute to racial gaps in academic success. Research on Denver Public Schools highlights severe racial and socioeconomic segregation, leading to some of the widest achievement gaps in the state. (Campbell, 2018) Building on this work, this project uses my personal experiences and artistic expression to transform research on educational inequities into visual storytelling, allowing audiences to better understand how these systemic gaps are lived, felt, and navigated in everyday life.
Using nail design as a form of wearable art, this project presents three nail sets that visually tell the story of growing up in a traditional Mexican household in the United States and navigating educational spaces. The first set, *Raíces* (Roots), represents childhood and cultural upbringing, highlighting the traditions, family values, and early influences that shape identity and aspirations. The second set, *Puentes* (Bridges), reflects the transition into higher education and symbolizes the bridges built between home, culture, and academic institutions while navigating spaces where Latino students have historically been underrepresented. The final set, *Florecer* (To Bloom), looks toward the future, representing growth, opportunity, and the continued pursuit of equity and representation.
By translating research on educational inequities into visual storytelling, this project demonstrates how art can communicate complex social issues and lived experiences in a powerful and meaningful way.
https://symposium.foragerone.com/2026-racas/presentations/80864

Reaching Opportunities to Women in STEM: Mentorship and Outreach for High School Girls
Sandy Elderinky, *Social Sciences & Humanities*
Mentor: Jose Flores

Abstract:
This research project explores how high school girls experience and access opportunities in STEM (Science, Technology, Engineering, and Mathematics), with a focus on identifying the barriers that limit their participation. Using a survey of 35 students across various STEM-related classes, the study found that while most participants are interested in pursuing STEM careers, many report only moderate confidence in their ability to succeed. Key challenges include time constraints, lack of information about opportunities, financial barriers, limited access to programs, and lack of mentorship. The findings also show that students with strong support systems, such as teachers, family, and involvement in STEM clubs, tend to have higher confidence. Based on these results, the project proposes a mentorship and outreach program aimed at increasing access, representation, and confidence for high school girls, especially those from under-resourced communities, and to better support their pursuit of STEM education and careers.
https://symposium.foragerone.com/2026-racas/presentations/80823

Redefining the UX in Automotive Infotainment Systems
Justin Perry, *Arts & Media*
Mentor: Darija Medic

Abstract:
In the automotive industry, there's been a wide shift with integrating large touchscreens to meet modern tech demands in vehicles. This shift has become counterintuitive to safe and comfortable driving because current interfaces are not user-friendly, making driving experiences more distracting and difficult. Distracted driving results in 27% of all accidents and as touchscreens become more prominent every year, how can in-vehicle infotainment systems satisfy the growing digital demands without exceeding a driver's cognitive threshold? I hypothesize that developing an accessible UX/UI framework in vehicles enhances driver safety while balancing the demand for technology. The ultimate goal of this project is to develop a system that will minimize "eyes off the road" time by making every user task accessible with one click. Through primary and secondary research, user interviews, and usability testing, my work focuses on a user-centered driving approach. Conducting user interviews and surveys allowed for a better understanding of an individual's preferences/experiences. Findings presented a preference for simplified UI patterns, consisting of clear iconography and purposeful UX writing to minimize distraction. The final design solution is an interface that centers around accessibility through simple UI patterns (clear iconography, colors), and an optimized task flow for proper user experience. It will address the gap between digital expectations and automotive safety requirements. I am applying my digital design expertise to develop a design system that reduces cognitive load to improve task completion time

and confidence. My professional interest lies in designing for safety in the automotive user experience and this project, in particular, will further establish my ability to present a UX framework for safer driving.
https://symposium.foragerone.com/2026-racas/presentations/80958

Reducibility Using Kempe Chains
Grace Truong, *Tech, Engineering, & Math*
Mentor: Stephen Hartke

Abstract:
Vizing conjectured that planar graphs with Δ(G) 6 are class 1. It has been proven that planar graphs with Δ(G) 7 are class 1 graphs leaving the Δ(G) = 6 case open. Many have provided partial results for the conjecture using Vizing's Adjacency Lemma to prove reducibility for their discharging proofs. This paper develops a technique for proving reducibility using Kempe chains instead of Vizing's Adjacency Lemma. Our method is inspired by Bonduelle and Kardoˇs's proof of a case of a related conjecture.
https://symposium.foragerone.com/2026-racas/presentations/80856

"Reimagining Harm Reduction: Indigenous And Local Knowledges Among Individuals Who Self-Administer Legal "Psychedelics" In Colorado"
Arthur Mason, *Social Sciences & Humanities*
Mentor: Dr. Marty Otañez

Abstract:
Harm reduction as a process and practice to minimize the negative consequences of drug use is fundamental in the emerging global "psychedelic" sector. Individuals who self-administer psilocybin-containing mushrooms in Colorado, for example, engage in harm reduction activities during preparatory, "journey" and integration phases. However, mainstream (e.g., white) culture in "psychedelics" conceptualizes harm reduction as disconnected from nature and the history of colonization and intergeneration trauma experienced by communities that have stewarded sacred plant medicines for centuries. We discuss the indigenizing harm reduction model, while showcasing findings from the qualitative and visual-based CU Denver BIPOC Psilocybin Study.
https://symposium.foragerone.com/2026-racas/presentations/80955

Relativistic Atomic Structure Calculations for Xenon Using the DBSR Code
Jake Hooning, *Natural & Physical Sciences*
Mentor: Dr. Kathryn R. Hamilton

Abstract:
Xenon is a noble gas with the atomic number 54. It has a very wide variety of applications across a range of fields, such as generating thrust in satellites, and is a uniquely effective tool in medical imaging. Xenon might have significantly more applications but identifying them will require a more complete picture of the properties of the element. The core of these properties lies in the atomic structure (meaning the arrangement of electrons within the atom), which in a heavy atom like xenon can be difficult to model due to the large number of electrons it contains. Electrons are quantum particles, meaning they exhibit properties such as correlation. This means that the motion of one electron in xenon will influence the motion of all 53 other electrons, so we need to keep track of the behavior of each electron individually. To generate an atomic structure for xenon I will use the Dirac B-Spline atomic R-matrix code (DBSR), which solves the many-electron Dirac equation and is appropriate for precise calculations with heavy elements. The code is resource intensive, so I will perform these calculations on the Frontera supercomputer at TACC (Texas Advanced Computing Center). Once I have successfully generated my atomic structure, I will compare it with existing literature values, and make my results available to collaborators and the wider scientific community.
https://symposium.foragerone.com/2026-racas/presentations/80937

Resting Among the Erased: The Catholic Pauper Section of the Evergreen Cemetery
Prabina Acharya, *Social Sciences & Humanities*
Mentor: James Walsh

Abstract:
From the late 1870s through the early 1890s, Leadville was a prominent mining town where many people, especially men, worked labor jobs, such as Mining. This population was seen as what is now called "the Invisible Work Force". These men are buried in the Catholic pauper section in the Leadville Evergreen Cemetery; a section that is reserved for burying individuals who are unclaimed, unknown, or cannot afford a traditional burial. The primary focus of this research is to analyze the history of this

time period and the men buried in this section of the cemetery. These men are named in the Leadville Irish Memorial and it is crucial to deepen our understanding of who is being honored on that memorial. The goal is to uncover aspects of their lived experiences and identities, while analyzing the socio-economic conditions that impacted the lives of working-class men in this community. By examining their lives and origins, the aim is to understand the lives behind laborers whose important contributions are often undermined in narratives. Through different data collection methods like cataloging through church records, newspaper articles, library records, marriage and birth records, and ancestral websites, we were able to find information on their lives including cause of death, birth place, nationality, the names of their family members, and occupations. This research is crucial because these men died without receiving formal documentation or recognition for their contributions to the development of the Leadville community. This is not just an issue in the community of Leadville, but the erased history of marginalized communities is a problem that is evident in many places and by uncovering their life histories and identities, this research aims to revive visibility towards individuals who are missing from historical narratives.
https://symposium.foragerone.com/2026-racas/presentations/80863

Robotic Arm Controls Development
Safa Hama, *Tech, Engineering, & Math*
Mentor: Jaedo Park

Abstract:
Robotic Arm Controls Development Abstract
With the rapidly increasing application of robotic systems in various industries such as healthcare, manufacturing, automation, and assistive technologies, the study of robotic kinematics and controls is becoming increasingly important for students interested in the field. This project sought to develop the controls for a six-servo robotic arm to support a future robotics kinematics course offered next fall semester, providing students with hands-on experience working with embedded code while applying kinematic theory learned through the course.
For this project, a single LX-225 HiWonder servo motor, a Hiwonder communication board, an Arduino microcontroller, and a LAUNCHXL-F28069M Texas Instruments microcontroller were initially used to establish correct wiring configurations across both platforms. Serial communication interface (SCI) protocols, GPIOs, and interrupts were initialized in Code Composer Studio for use with the Texas Instruments microcontroller, and company-provided Arduino-based rotation code was adapted to function within this architecture. During development, communication signals were monitored and compared against expected data packets to verify correct transmission between the microcontroller and the servo motors, ensuring correct system behavior. Once rotation control for a single servo motor was established, the code was scaled to support the movement of multiple servo motors, specified by the user based on the servo ID, allowing each motor to move to user-defined positions. In addition to the functions developed to control all six servo motors of the robotic arm, functions were also implemented to receive real-time position data for each motor. These controls were executed through a computer console, also using SCI communication, allowing users to easily send commands and observe system responses.
The final system provides a functional interface for controlling a six-degree-of-freedom robotic arm using embedded systems. Students using this platform will be able to understand hardware connections and embedded code while directly applying concepts of forward and inverse kinematics through simple console-based commands.
https://symposium.foragerone.com/2026-racas/presentations/80999

Room 988
Holly Mathews and Theo Henderson, *Arts & Media*
Mentor: Andrew Bateman

Abstract:
Room 988 is a CU Denver short film about a hospital janitor, contemplating suicide, who must clean the room of a grieving woman whose son died by suicide. We want to make a film that discusses suicide, but importantly, does not sensationalize or glorify it. Depictions of suicide can be dangerous; those without mental illness might need to see an intense scene to better understand one's struggles, but those with mental illness who could be dangerously triggered by the exact same scene. This film is an attempt to walk that line – to make something for both those who struggle and those who do not. We wanted to tell a story that shows the deep suffering of those who struggle with suicide, while also depicting suicidal characters taking realistic steps to find help and stay alive.
https://symposium.foragerone.com/2026-racas/presentations/80973

Roy Story: No Trees, No Sky
Madeleine Finch, *Arts & Media*
Mentor: Andrew Bateman

Abstract:
Our project *Roy Story* is a film about a man living in New Mexico called Roy. The film follows Roy's reflection upon his life as he analyzes his career, collection of worldly media, moving process, and hopes of getting back together with the wife he left. In his younger days, Roy received multiple scholarships to multiple universities, taught for a number of years, and often found creative ways to make a living, however his anger and tendency to run away led to a life of lost opportunities, regrets, and life lessons painfully learned. *Roy Story* is a character study on a man that has much to offer in terms of wisdom and life advice, but it also analyzes how the elderly are systemically mistreated and given a lack of resources. As a once feature length documentary, the goal of recreating this project is to combine footage of Roy in his 60s with footage of him now in his 80s in order to create a more meaningful, concise film. Through the creation of a documentary, the story is created in the editing process with dozens of hours of interview footage, but also silent footage, called b-roll. Crafting this project together has included searching through the talking footage for b-roll and searching for important themes and messages within the footage. Our main themes include being broke, books, media, a collection of things, health and dying friends, housing, Roy's ex-wife, Sandy, and his past life. By creating this project, we are reflecting on a life of profound wisdom, analyzing lost potential, as well as understanding how our society treats the elderly and leaves them lost and without resources. This project helps us to understand the pain of not fitting into the system and what happens to those of us who do not.
https://symposium.foragerone.com/2026-racas/presentations/80885

Scalable Segmentation-Free Analysis of Xenium-Scale Spatial Transcriptomics Reveals Anatomical and Glial Signatures in Traumatic Brain Injury
Yaseer Sabir, *Biomedical Sciences*
Mentor: Alberto Cruz-Martin

Abstract:
Recent advances in spatial transcriptomics (ST) enable transcriptome-wide profiling at subcellular resolution, generating ultra–high-resolution datasets capturing billions of transcripts across complex tissues. Segmentation-free analytical frameworks, including topic- and factor-based approaches such as FICTURE (Si et al. 2024), which employs Latent Dirichlet Allocation (LDA) for pixel-level topic modeling, demonstrate that biologically meaningful structure can be recovered directly from transcript coordinates without reliance on cell boundaries. These methods improve scalability while preserving fine-grained spatial signals but have largely been developed outside the context of Xenium-scale brain datasets, where extreme transcript density, anatomical heterogeneity, and multi-sample comparisons introduce additional challenges.
Here, we optimize and adapt segmentation-free ST analysis for Xenium mouse brain data acquired from sham and traumatic brain injury (TBI) conditions. TBI is a heterogeneous neurological disorder in which transcriptional organization often extends beyond discrete cellular compartments and may be obscured by boundary-centric analyses. Building on segmentation-free methodologies, we introduce a region-aware cropping strategy coupled with interactive visualization to manage extreme data density while preserving anatomical context. We further optimize model parameters for high-density data and implement multisample joint modeling to enable consistent inference across brains.
These optimizations enable recovery of cortical layers, hippocampal subregions, and spatially distributed glial-associated transcriptional programs reflecting tissue environments. By extending segmentation-free analysis to Xenium-scale brain datasets, this work establishes a scalable computational foundation for comparative studies of spatial transcriptional organization in complex neurological conditions such as TBI.
https://symposium.foragerone.com/2026-racas/presentations/80674

Setting Up a CAP Exhibition: Neeraj Bhatia's Life After Property
Catherine Nguyen, *Arts & Media*
Mentor: Sarah Hearne

Abstract:
The College of Architecture and Planning's Lecture and Exhibition Series is one of the most valuable resources of contemporary thought in the architecture discipline for the Denver community. As attending lecturers collect artifacts representative of their research and work, it is important to give their pieces a suitable space to stand out. Neeraj Bhatia's *Life After Property* was displayed in the CU Building in the Fall 2025 semester. As part of the CAP Student Assistant team, there was a deliberate process in ensuring that Neeraj's vision for the exhibit was properly adapted to the CAP environment. From starting with remote conversations to gathering materials and weeks of fabrication, it is vital to understand the background effort and coordination possible to install in both a timely and elegant manner. Most significantly, fabricating the furniture that was to hold Neeraj's artifacts was a balance of practical spatial considerations and design that would highlight the work displayed.
https://symposium.foragerone.com/2026-racas/presentations/80862

Sex differences in dopamine neural activity in response to exercise
Joshua Slim and Joshua Quigley, *Biomedical Sciences*
Mentor: Dr. Benjamin Greenwood

Abstract:
Exercise can protect against the development of stress-related mental health disorders, but the mechanisms aren't clear. Rodents allowed access to running wheels are similarly protected from depression- and anxiety-like behavioral consequences of stress. Importantly, there are sex differences in the duration of wheel running required to produce stress-resistance, with males requiring 6 weeks but females only requiring 3 weeks of exercise. The nucleus accumbens (NAc) is a brain region sensitive to dopamine that is involved in exercise reward and linked to stress resistance. Notably, the NAc is thought to mediate rapid stress protection in females by inhibiting stress-producing serotonin neurons in the dorsal raphe nucleus during stress. What is unclear, however, is the signal that is required to change the NAc that allows it to inhibit the dorsal raphe and protect female rats from stress. We hypothesize that exercise activates midbrain dopamine neurons that project to the NAc, causing sensitivity of NAc neurons so that they now respond to future stress. To test this hypothesis, we injected a retrograde viral tracer into the NAc, which labels midbrain dopamine neurons that project to the NAc. Rats were then allowed to run in wheels for 3 weeks. After the last running bout, rats were euthanized, and activity of NAc -projecting midbrain dopamine neurons was quantified with immunohistochemistry for the neural activation marker cFos. Tissue will be mounted on slides for analysis, and cell counts will be performed using ImageJ. We expect that after a history of 3 weeks of exercise, an exercise bout will activate NAc-projecting midbrain neurons more in females than in males. Data collection is ongoing, but this result would support the hypothesis that nucleus accumbens dopamine is the signal causing rapid stress protective effects from exercise in females.
https://symposium.foragerone.com/2026-racas/presentations/81003

Sex Differences in Heart Rate Variability in Chronic Kidney Disease: Associations with Cerebrovascular and Cognitive Function
Christopher Fitzgerald, *Biomedical Sciences*
Mentor: Ester Oh

Abstract:
Background: Chronic kidney disease (CKD) is associated with greater cardiovascular risk, partly mediated by autonomic dysfunction. Heart rate variability (HRV) is a noninvasive electrocardiographic measure of beat-to-beat variation in RR intervals that reflects autonomic regulation of cardiac function. Impaired HRV has been reported in CKD and is associated with adverse cardiovascular outcomes. However, whether autonomic dysfunction differs by sex in CKD remains unclear. This study aimed to evaluate sex differences in HRV in patients with CKD.
Methods: In this cross-sectional analysis, baseline data were pooled from two clinical trials (NCT04911491 and NCT04040959) including patients with stage 3–4 CKD. Five-minute resting electrocardiograms obtained during paced breathing were analyzed using an automated HRV analysis tool in LabChart software. HRV metrics included the standard deviation of RR intervals (SDRR), root mean square of successive differences (RMSSD), and the percentage of successive normal-to-normal RR intervals differing by >50 ms (pRR50). Sex differences in HRV metrics were assessed. Associations between HRV indices and cardiovascular risk factors, including arterial stiffness measured by carotid-femoral pulse wave velocity (CFPWV) and systolic blood pressure (SBP), were evaluated separately by sex.
Results: A total of 86 patients with CKD were included (30% women; mean ± SD age 70 ± 8 years; eGFR 43 ± 11 mL/min/1.73 m^2)**.** There were no significant sex differences in SDRR, RMSSD, or pRR50. There was a positive association between and CFPWV (r=0.41, P=0.046) in women, but not in men. A trend toward a positive association between SDRR and SBP was observed in women (r=0.35, *P*=0.088), but not in men.
Conclusion: Interestingly, among women with CKD, better HRV (higher pRR50) was associated with greater arterial stiffness. These findings warrant further investigation in larger, longitudinal studies to clarify sex-specific associations between autonomic function and cardiovascular risk in CKD.
https://symposium.foragerone.com/2026-racas/presentations/80803

Sex Matters: Molecular and Structural Differences in TTN- and LMNA-Associated Cardiomyopathies
Abigiya Abate, *Biomedical Sciences*
Mentor: Brisa Peña

Abstract:
Heart failure (HF) is a leading cause of morbidity and mortality worldwide, with dilated cardiomyopathy (DCM) as a major underlying etiology. Genetic variants, particularly titin truncating variants (TTNtv) and lamin A/C (LMNA) mutations, contribute significantly to DCM and are associated with sex-specific differences in clinical outcomes.

We hypothesized that sex-specific differences in TTNtv- and LMNA-associated cardiomyopathies influence cardiac tissue mechanobiology, altering structural organization at tissue and subcellular levels. To test this hypothesis, we performed transcriptomic comparisons of non-failing (NF) and TTNtv human hearts stratified by sex using Ingenuity Pathway Analysis (IPA), integrating these data with tissue-level analyses of both TTNtv and LMNA samples.
Cardiac organization was assessed using histology, tissue stiffness by atomic force microscopy (AFM), and subcellular architecture by transmission electron microscopy (TEM). Transcriptomic analysis revealed sex-specific differences in TTNtv samples, with male hearts showing increased activation of fibrotic and immune-related pathways. Correspondingly, TEM demonstrated compacted sarcomere lengths in male TTNtv samples compared with female TTNtv and NF tissues, while AFM revealed increased stiffness in male TTNtv hearts. In contrast, LMNA-associated cardiomyopathy exhibited sex-dependent alterations in nuclear structure with preserved sarcomere organization; female LMNA hearts showed increased stiffness relative to female NF tissues. No significant differences were observed in collagen deposition or cellular infiltration in both TTNtv and LMNA tissues, potentially due to long-term tissue storage and protein degradation.
These findings demonstrate that sex significantly influences the molecular, structural, and mechanical landscape of TTNtv-associated cardiomyopathy, whereas LMNA mutations primarily affect nuclear and mechanical architecture.
https://symposium.foragerone.com/2026-racas/presentations/80971

Silence as Embodied Communication: An Autoethnography of Chinese Women in U.S. Classrooms
Yining Wang, *Social Sciences & Humanities*
Mentor: Patrick Dodge

Abstract:
This project explores silence as an embodied and culturally shaped form of communication among Chinese women in U.S. classrooms. Drawing on autoethnographic reflection, it examines how silence is experienced, interpreted, and often misread within intercultural contexts.
While U.S. classroom norms frequently equate participation with verbal expression, silence in this study emerges as meaningful—linked to respect, self-regulation, relational awareness, and at times subtle resistance. The project highlights how cultural expectations and gendered socialization shape communicative practices, and how these differences can lead to misunderstanding and exclusion.
By reframing silence as a valid and meaningful mode of participation, this research contributes to more inclusive understandings of communication in intercultural educational settings.
https://symposium.foragerone.com/2026-racas/presentations/80921

Simulated Smearing of Beamline Time-Of-Flight with Energy-Variant Integral Operator
Ryan Arquette, *Natural & Physical Sciences*
Mentor: Dr. Amy Roberts

Abstract:
AZURE II is a program that performs R-Matrix calculations that can be compared with experimental nuclear physics data, allowing scientists to assign nuclear spin states and energy levels. Spin states are highly sensitive to the peak height of experimental yield data, and therefore any simulation aspect of AZURE II that affects peak height is extremely important. One issue is the spread in beam energy, which is a parameter that can be set in AZURE II but was previously energy independent. This is inaccurate; the spread in beam energy increases with increasing energy for time-of-flight measurements. A computational algorithm with an energy-variant kernel was developed to generalize the convolution within AZURE II and tested against analytical and numerical convolution results. This algorithm mitigates misattribution of spin states due to experimental resolution and energy ranges by ensuring that AZURE II correctly simulates the effect of the energy resolution of beam-based experiments when it calculates a dataset based on user-defined nuclear states.
https://symposium.foragerone.com/2026-racas/presentations/81062

Space-Terrestrial Risk, Access, Communications, and Exposure (S-TRACE)
Robert Stewart and Stephanie Peacock, *Tech, Engineering, & Math*
Mentor: Data Mine of the Rockies (DMR)

Abstract:
Space missions depend on tightly coupled ground, space, and networked information systems. Operators and cyber defenders often lack a single mission-aware view that combines orbital access/visibility windows, end-to-end communications paths, and cyber exposure tied to deployed technologies. This fragmentation makes it difficult to plan assessments, anticipate limited access windows or visibility gaps, trace data flows, and prioritize mitigations fast enough to support mission timelines.

S-TRACE explores how integrating orbital access prediction with cyber-risk context can improve space-cyber situational awareness. The team will develop a proof-of-concept decision-support prototype that (1) renders an animated, “graphical representation” of a satellite(s) in Low Earth Orbit (LEO) using current and historical trajectory playback derived from TLE/ephemeris data.(2) Computes and forecasts access windows and expected visibility gaps (“blackout periods”) for selected ground stations, including estimated times when connectivity is re-established,(3) Lastly, fuses these access predictions with an initial, explainable risk scoring method while incorporating the SPARTA Framework. The prototype is intended to help users answer three operational questions: “Where has the satellite been and where is it now (relative to selected ground stations)?” “When is it accessible, and when will it be in a blackout period until link is re-acquired?” and “What level of cyber exposure may exist during that black out period window?”
https://symposium.foragerone.com/2026-racas/presentations/80832

Spatial and Temporal Changes in Urban Heat Patterns Across Denver, CO
Danya Manyak, *Natural & Physical Sciences*
Mentor: Benjamin Crawford

Abstract:
Urban heat vulnerability is a pressing issue in cities around the world. In Denver, rapid urbanization has contributed to the formation of urban heat islands (UHIs), developed locations with hotter temperatures compared to surrounding less-developed regions. This study uses remote sensing data to analyze spatial changes in UHIs in the greater Denver area from 2014 to 2024, the impact of vegetation change on UHIs, and the relationship between heat patterns and socioeconomic factors. Landsat 8 Collection 2 Level-2 imagery is used to examine land surface temperature (LST) and the normalized difference vegetation index (NDVI), which are used to generalize about relationships between heat distribution and vegetation cover. A cloud-masked, multi-temporal image collection is created with Google Earth Engine to produce yearly image composites. UHIs and severe UHIs are delineated as pixels one and two standard deviations above the mean LST, and time series are used to depict change over time. Case studies then compare temperature patterns to census tract-level socioeconomic data from the Colorado SDO Resource Page. Results indicate that UHIs exhibit spatial variability over time, with increasing clustering in the eastern and north-central regions of the study area. Vegetation decline is also concentrated in these regions, revealing an inverse relationship between vegetation coverage and heat. Case studies further illustrate this variability, with lower-income areas, areas with higher proportions of vulnerable populations, and areas with distinct building strategies often exhibiting elevated or more distinct land surface temperature patterns. By identifying where UHIs are and how they have changed, this research highlights how urban heat trends align with vegetation coverage and patterns of urban inequity in Denver.
https://symposium.foragerone.com/2026-racas/presentations/80951

Spectral Analysis of Changing-Look Blazars
Emily Debruyne, *Natural & Physical Sciences*
Mentor: Dr. Sadun

Abstract:
Galaxies with active galactic nuclei are among the oldest and most distant objects in astronomy. These galaxies contain supermassive black holes that actively draw in material and subsequently eject particles along magnetic field lines, resulting in jets that can extend hundreds of thousands to millions of light-years. Studying distant objects poses several challenges, and this project attempts to address variability in the spectra of a subcategory of active galactic nucleus called a changing-look blazar. These active galactic nuclei are categorized by orientation relative to the observer. The jets are pointed almost directly at the observer, with small variations off the axis, defined as theta in this project. In astrophysics, spectra are used to study objects like blazars that are billions of light-years away. The Doppler effect causes shifting and broadening of spectral lines, as well as variability in their intensity. For objects at these distance scales, photon wavelengths stretch predictably as they move away from the source due to the Doppler effect. The Doppler effect in this case shifts their spectra to shorter wavelengths as theta decreases. The spectra are additionally less defined as the Doppler shift increases, due in part to particle interactions within the jets, including Compton scattering and thermal radiation. This poster presents an attempt to mathematically quantify the Doppler effect in spectra and develop an algorithm to analyze data from a subcategory of active galactic nuclei referred to as blazars.
https://symposium.foragerone.com/2026-racas/presentations/80991

SPIN – Advancing & Validating a Multi-Sensor System for Real-World Wheelchair Mobility Assessment
Sienna Phipps, *Biomedical Sciences*
Mentor: Morris Huang

Abstract:
The way manual wheelchair users propel themselves in real-world environments is a major determinant of their independence and injury risk. Yet most clinical assessments of wheelchair mobility occur in controlled, artificial settings that may not reflect real-world performance. This significant mismatch can limit the effectiveness of user training and cause poor wheelchair fitment, reducing the user's mobility and thus quality of life. SPIN (Sensing Propulsion In Natural environments) is a multi-sensor system designed to characterize multi-day wheelchair mobility patterns in everyday environments. The SPIN system integrates inertial measurement units (IMUs) with encoder-based sensing to capture propulsion kinematics continuously and unobtrusively. This project focuses on two key development phases: (1) advancing the SPIN sensor hardware and firmware for multi-day data collection deployments, and (2) validating SPIN through both controlled benchtop testing and real-world data collection with manual wheelchair users traversing a standardized wheelchair skills course. Benchtop validation targets sensor accuracy, synchronicity, and drift across the multi-IMU array. In-situ validation aims to demonstrate the system's ability to capture meaningful, ecologically valid mobility patterns across a diverse group of participants. Outputs from this project will include a validated SPIN sensor system and a training dataset of manual wheelchair user mobility patterns, with long-term goals of empowering clinicians to make more informed decisions.
https://symposium.foragerone.com/2026-racas/presentations/80825

Structural Characterization of CHCHD10 and its Role in ALS-FTD Pathogenesis
Yukthika Boddeda, *Natural & Physical Sciences*
Mentor: Dr. Woonghee Lee

Abstract:
Mutations in the mitochondrial intermembrane protein coiled-coil-helix-coiled-coil-helix domain-containing 10 (CHCHD10) are critically linked to the progression of neurodegenerative diseases such as Amyotrophic Lateral Sclerosis (ALS) and Frontotemporal Dementia (FTD). While CHCHD10 is known to be essential for maintaining mitochondrial cristae integrity and cellular respiration, the specific structural mechanisms by which its mutations disrupt metabolic pathways remain a significant knowledge gap. This project utilizes recombinant DNA and stable isotope labeling technologies to produce CHCHD10 and its pathogenic S59L mutant for high-resolution analysis.
Building on observations that the protein's partially disordered nature hinders standard purification and stability, we are designing specialized constructs that isolate structured regions. This strategic approach streamlines the purification process and enables the use of Nuclear Magnetic Resonance (NMR) spectroscopy to obtain multidimensional structural fingerprints. Furthermore, we characterize the stability and molecular binding affinities of these constructs through Circular Dichroism (CD) and Isothermal Titration Calorimetry (ITC).
By defining how the interactions between secondary structures and protein dynamics influence overall stability, this research aims to illuminate the neurobiological pathways underlying ALS-FTD.
https://symposium.foragerone.com/2026-racas/presentations/80945

Structural Characterization of the hsACP-Zn-Ppant Complex from in Fe-S Cluster Biosynthesis
Banin Ghafoori, *Natural & Physical Sciences*
Mentor: Dr Woonghee Lee

Abstract:
Iron-sulfur (Fe-S) clusters are fundamental components of gene activation, electron transport, and mitochondrial function, which are essential for cellular processes. These clusters integrate into proteins to mediate electron transport. The dysfunction of Fe-S clusters has been associated with metabolic and hematological disorders, like cancer, myelodysplastic syndrome, and Friedreich's ataxia.1 The three-dimensional (3D) structure of the human acyl carrier protein complexed with zinc and phosphopantetheine(hsACP-Zn-Ppant) remains poorly understood. Since this complex affects the formation of Fe-S clusters, determining its 3D structure can provide data needed to map cluster distribution throughout the cell. In this study, we are determining the structure of hsACP-Zn-Ppant by using nuclear magnetic resonance (NMR) spectroscopy. We utilized the POKY suite2 for data interpretation, resonance assignment, and identification of sequence-binding sites. While the hsACP holo-form was built in POKY2 with I-PINE3 and AUDANA4 automations, XPLOR-NIH5 was used for the subsequent structural determination and refinement of the full complex. Finally, MolProbity was used to validate structural quality by verifying that the model adheres to physical and geometric constraints. These structural insights deliver a framework for developing targeted therapeutics for conditions driven by iron-sulfur dysfunction.
https://symposium.foragerone.com/2026-racas/presentations/81020

Student Employment and Workforce Readiness
Savannah Brooks, *Social Sciences & Humanities*
Mentor: Danny Young

Abstract:
This project examines the impact of student employment on workforce readiness through my experience as an Employer Relations Assistant in Lynx Connect. Workforce readiness is defined through the core competencies of career and self-development, communication, critical thinking, equity and inclusion, leadership, professionalism, teamwork, and technology.

My role in Lynx Connect has provided a practical setting to develop these competencies. Through engagement with career counselors and employment resources, I have strengthened my career awareness and ability to balance academic and professional responsibilities. Daily communication across teams and with external employers has enhanced my confidence and proficiency in professional correspondence. Additionally, reviewing and approving job postings through Handshake requires critical thinking, as I evaluate employer submissions, identify missing information, and make informed decisions regarding approval.
Participation in a student focus group reviewing the CU Denver Exit Survey further developed my equity-focused perspective, requiring me to assess inclusivity and representation within institutional data collection. Leadership skills were reinforced during large-scale events such as the spring career fair, where I managed student check-in processes and navigated technical disruptions while maintaining efficiency. Professionalism has been central to my role, particularly when corresponding with employers to ensure transparency and accountability in job postings.
My contributions to team operations of supporting logistical preparation and improving workflow efficiency show the importance of teamwork in achieving organizational goals. Finally, adapting to updates within the Handshake platform has strengthened my technological proficiency, particularly in data organization and system optimization.
Overall, I found that my experience demonstrates that student employment serves as an important bridge between academic learning and professional skill development.
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Study of the E318Q Mutant of CLCF Proton/Fluoride Antiporter : Comparison Between Fluoride and Chloride
Sam Fredrick, *Natural & Physical Sciences*
Mentor: Hai Lin

Abstract:
Commonly expressed in oral bacteria, CLC^F is a fluoride/proton antiporter that selectively exports fluoride ions to confer resistance against environmental fluoride toxicity. Despite its high discrimination for fluoride over the chemically similar chloride ion, the structural and energetic basis of this selectivity remains incompletely understood. A proposed windmill transport mechanism suggests that rotation of gating residue E118 plays a central role in driving anion movement through the pore, yet the free energy landscape governing this process has not been fully characterized. This study employs atomistic molecular dynamics, steered molecular dynamics (SMD), and umbrella sampling simulations to obtain quantitative free energy profiles for ion transport in the E318Q mutant of CLC^F. Using the experimental structure (PDB: 6D0J) embedded in a fully solvated protein-membrane system, SMD simulations were first performed to generate trajectories for anion moving along the pore, with the reaction coordinate defined by the advancement of the anion starting from the central ion binding site. Saved snapshots in these trajectories were subsequently used to set up umbrella sampling windows for the computation of potentials of mean force. By characterizing the energetic barriers associated with each anion, we will gain atomistic insights into the molecular basis of fluoride/chloride ion selectivity in CLC^F and its E318Q mutant.
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Targeting Mitochondrial Respiration to Overcome Therapy Resistance inAcute Myeloid Leukemia (AML)
Aditya Singh Jaiswar, *Biomedical Sciences*
Mentor: Mercedes Rincon

Abstract:
AML is the most common adult leukemia, making up about 20% of childhood leukemias. Venetoclax with azacytidine (VenAza) offers an alternative to chemotherapy, but many patients show primary resistance, and almost all develop resistance and relapse. Our lab identified methylation-controlled protein J (MCJ) as a negative regulator of Complex I of the electron transport chain (ETC). Loss of MCJ in cancer cells correlates with chemoresistance. We developed an N-MCJ mimetic, MITOx30, targeting Complex I to reduce oxidative phosphorylation and resensitize AML cells to VenAza. We hypothesize that MITOx30 will overcome VenAza resistance and decrease mitochondrial respiration in AML cells lacking MCJ.
Expression of endogenous MCJ was determined by Western blot in primary AML cells and cell lines (OC-1, Molm14, Molm13). Molm14 and Molm13 were grown on a 24-well culture plate for 72 hours with either a) vehicle, b) Venetoclax, c) MITOx30, d)

combination (Venetoclax and MITOx30), or e) a control peptide. All cells were stained with Trypan Blue and counted by hand using a hemacytometer.
Endogenous MCJ expression was low in Molm14, Molm13, and AML 070815, but high in OC-1 and MCF7. In Molm13, there were significantly fewer live cells in the combination treatment compared to venetoclax alone.
Our data indicate that MITOx30 enhances the efficacy of venetoclax against AML cell lines lacking endogenous MCJ in vitro. Therefore, developing mitochondrial-targeted drugs, such as MITOx30, aims to restore sensitivity to standard therapies in AML patients who are resistant to standard treatment regimens.
https://symposium.foragerone.com/2026-racas/presentations/80967

The 150 Year History of Emmanuel Art Gallery: A Short Documentary
Nathaniel Smith, *Arts & Media*
Mentor: Dr. Rachel Gross

Abstract:
My project is in support of the Emmanuel Art Galleries 150th Anniversary Exhibit, set to open this summer. Filling a gap in the exhibit's multimedia, I have created, in collaboration with many participants and organizations, a film that provides an overview of 150 years of Emmanuel's history, from its start as an episcopal church to its present-day function as Auraria campus's primary art gallery. The film explores the many phases the building has gone through, its role as a physical pillar of community, and the ways its identity has changed over time-and remained the same. This short documentary provides the perfect format for communicating history quickly and digestibly, in support of the traditional labels and objects that will soon decorate the building. It also brings to the exhibit unused yet compelling sources-such as newsreels covering the controversial vote to demolish the old Auraria neighborhood-which can only be included here. This documentary makes use of these unique research and visual resources, as well as audio taken from short interviews with knowledgeable people including exhibit designers, historical researchers, past artists who have displayed their work at Emmanuel, gallery coordinators, and residents of the original neighborhood who were displaced in the campus's construction. The outcome is a 7-minute-long film, featuring visuals and audio from a variety of sources, which will enhance the overall exhibit and engage visitors' curiosity. Emmanuel Gallery is not just special as one of Denver's oldest buildings, a physical reminder of Colorado's status as the Centennial State-it is a space alive with cultural and community uplifting where people have gathered to celebrate spirituality and creativity for 150 years. Putting this history of diversity, hardship and remembrance to film has given the exhibit a more permanent presence past its temporary physical display while celebrating the many people who have shaped the Auraria of today.
https://symposium.foragerone.com/2026-racas/presentations/81029

The Cost of Judgment: A Multimedia Study on Psilocybin
Tony Pizano, *Arts & Media*
Mentor: Marty Otanez

Abstract:
The social culture for stigma surrounding drug use, particularly the medicinal and recreational use of psilocybin, has been a subject of intense opinions from either side. While many people feel like they know what's best for them, the deeply personal, lived experiences of those marginalized by this stigma remain frequently overlooked. It's easy to judge something that you don't know because it will never affect you.
However, existing academic and media perspectives often fail to address the internal emotional toll and the behind-the-scenes reality of individuals who explore psilocybin use amidst being constantly judged about it. This gap in understanding fuels harmful stereotypes and reinforces a disconnection between users and their communities, including their own family and friends.
This project addresses the issue of psilocybin-related stigma with special attention to the day of light that film and first-person interviews can bring. This project has allowed individuals to be vulnerable without the fear of judgment and allowed them to tell their story, and hopefully, this project will be able to show others that it's okay to deal with pain in different ways.
Specifically, in this project, I will utilize lots of filmed interviews showcasing people from all over the country who now reside in Colorado. With this extensive documentary footage, I will create a visual and auditory experience that captures the truth of these users' feelings. Through rigorous editing and narrative storytelling, I examine the lasting impact of social judgment, such as family members viewing loved ones differently, people being judged in public or by those who are around them, to reveal the previously misunderstood emotional complexities of the user experience.
I'm arguing that by recording these untold stories, we can shift the narrative from one of judgment to one of empathy, recognizing psilocybin users not as clinical subjects or "drug users," but as complex human beings seeking relief and personal understanding. Stigma is something that everyone goes through, and it's not fair to those who are trying to heal to be scrutinized under everyone's eye.
In conclusion, this project, by closely examining the intersection of psychedelic use and social stigma through a cinematic lens, shows new light on the forgotten issue of the personal tolls that come with drug-related use.
https://symposium.foragerone.com/2026-racas/presentations/80953

The Cramps: Monsters, Sexuality, and Psychobilly
Violet Dempsey, *Arts & Media*
Mentor: Maria Buszek

Abstract:
The music of The Cramps had been a part of my life for years. Their raunchy, ghoulish lyrics always called out to me in fantastical ways. Yes, their songs were engrossing, but what about the individuals behind the band? What were their stories, and what did they stand for? These questions spurred me to enter the raucous, slime-steeped world of Lux Interior and Poison Ivy. Within the class "Gender, Art, and Popular Music", I investigated the iconic psychobilly band and how their music was representative of feminist theory, shattering traditions, and amplifying queer monstrosity. The Cramps utilized the monstrous to put a spin on the classic rockabilly genre that was so binary. Monsters have always represented something deviating from the norm and have been adopted by queer individuals throughout the decades as figures of admiration. For example, there is a certain transness to Frankenstein's monster, and a lingering homosexuality to Dracula. This was a new spin on a very Americanized genre that encouraged a "boy meets girl, then they fall in love and get married" ideology. By shifting the meaning of rockabilly from straight love to deviant monsters, thus Psychobilly was born. Because of the LGBTQ connotations that monsters had to certain folks, The Cramps' music was inherently liberating and totally, terrifically queer. As a part of my research, I delved into the genre of Psychobilly itself. I found that the band ended up being misfits in the very genre that they founded. Much of the culture has clung to the misogynist ideology of the 1950s and has centered on the oversexualization of women. Many bands have also rejected female members, or only sought them out for a "token girl" figure. The Cramps were a far cry from this exclusion, and highlighted powerful female figures such as Poison Ivy (the founder of the band along with her husband Lux Interior), and a myriad of lady musicians in the band, such as Pam Balam. In conclusion, my findings only cemented how revolutionary The Cramps truly were, even in their own subculture. They highlighted the monstrosity of being different, which can be directly linked to queer connotations of classic monster flicks of yesteryear. They also defied the values of the rockabilly genre by placing female figures in the forefront of not only their lyrics, but the band itself.
https://symposium.foragerone.com/2026-racas/presentations/80882

The Digital Empowerment Program
Miguel Hernandez, *Social Sciences & Humanities*
Mentor: Emily Tow

Abstract:
Access to laptops is crucial for first-generation college students. First-generation college students have responsibilities outside of class, such as working part-time jobs or caring for family members, and laptops can provide work-life balance flexibility. According to FirstGen Forward, "First-generation students represent 54% of all college students," which means that 54% of first-generation students may not have access to a laptop. This notion can be supported by the fact that 43% of lower-income adults lack a laptop, according to Pew Research (Vogels, 2021). This technology gap worsens the achievement gap and limits access to higher education, especially for first-generation students, since they aren't able to access the flexibility a laptop would give them. Moreover, the COVID-19 pandemic demonstrated the importance of laptop access since it provided a bridge to education when flexibility was needed. However, laptops are expensive, especially for low-income individuals, which is why non-profit organizations help in that endeavor.
For example, organizations like PC's for People seek to achieve digital equity by bridging the digital divide, offering technology, such as laptops and routers, for education, work, and essential services that help with higher education or personal work. They specifically provide low-cost, refurbished computers (desktops and laptops), affordable high-speed 5G LTE internet, and digital skills training.
Ultimately, I aim to create a program for low-income, first-generation college students that equips them with essential skills for academic success at CU Denver. Participants will complete a free Coursera course on Microsoft 365 Fundamentals to enhance their technical skills and employability. After certification, they'll take part in a mock interview with Lynxconnect and gain access to campus resources. Additionally, each student will receive a free laptop and Wi-Fi router to support their college journey. Ultimately, this program aims to help first-generation students stay in college and build a brighter future.
https://symposium.foragerone.com/2026-racas/presentations/80809

The Effects of Glaze Icing on the Fluid-Structure Interactions of Power Transmission Lines
Gabriel Elftman-Hanson, *Tech, Engineering, & Math*
Mentor: Linyue Gao

Abstract:

The flow around bluff bodies is a classic topic in fluid mechanics and is related to several engineering applications. Cylinder structures are of particular interest because of their common occurrence across various industries such as heat exchanger tubes in mechanical engineering, risers and smokestacks in civil engineering, and power transmission lines in electrical engineering. There is an extensive body of work on fluid-structure interactions for single and multi-cylinder configurations, but much of the existing literature has focused solely on circular cylinders. For the application of power transmission lines, dynamic ice accretion alters the geometry and aerodynamic force. Power cable icing reduces the reliability of electrical power distribution and leads to major damage to power lines such as flashover. This work aims to investigate the effects of dynamic ice accretion on cylinders in tandem at various spacings and configurations. Cylinder conditions were smooth (S) or iced (I) and were placed in the following upstream-downstream configurations in a low-speed wind tunnel: S-S, S-I, I-I, and I-S. The iced cylinder geometry was obtained from previous work conducted in the Icing Research Tunnel of Iowa State University by the lead investigator. Both cylinders were elastically mounted (two-free), or the upstream cylinder was rigidly mounted with the downstream cylinder elastically mounted (one-fixed-one-free). Results are presented in the form of vibration amplitude response, oscillation frequency, and vortex shedding frequency.
https://symposium.foragerone.com/2026-racas/presentations/80943

The Effects of Remyelination Therapy and Motor Learning on Myelin Pattern Restoration
Faith Montemayor, *Biomedical Sciences*
Mentor: Ethan Hughes

Abstract:
Multiple sclerosis (MS) is the most common demyelinating disease of the central nervous system, in which loss of oligodendrocytes and their myelin sheaths leads to axonal dysfunction and cognitive and motor deficits. Despite significant improvement of MS management via immunomodulatory therapies which suppress the immune system from attacking myelin, these therapies fail to protect against progressive damage and disability. Recently, we found that restoring oligodendrocyte numbers or myelin levels following demyelination is insufficient to restore function; instead, restoring myelin to its original location is key for behavioral recovery. Unfortunately for many remyelination-enhancing interventions, which aim to repair damage to myelin, their ability to restore the original pattern of myelin deposition remains unclear.
We investigated whether two distinct remyelination-enhancing interventions can restore myelin patterns in the adult cortex: clemastine, a first-generation antihistamine currently in clinical trials as a remyelination therapeutic in MS, and motor learning, a behavior-mediated activation of motor cortical axons. Both of these interventions increase oligodendrogenesis, and motor learning via engagement of neuronal activity-dependent mechanisms may be able to restore myelin sheaths in specific locations. We visualized oligodendrocytes and myelin sheaths via longitudinal *in vivo* two-photon imaging using *Mobp-EGFP* mice, where oligodendrocytes and myelin sheaths are fluorescently labelled. Next, we used this approach throughout cuprizone-induced demyelination and subsequent recovery. We then quantified oligodendrocyte loss and regeneration, tracked individual myelin sheaths over time, and assessed whether newly generated sheaths reoccupied the same axonal locations as prior to demyelinating injury.
While we and others showed that therapeutic strategies can restore myelin levels, not all remyelination-enhancing interventions may be able to support the restoration of the spatial pattern of myelination necessary for functional recovery. Assessment of myelin pattern restoration *in vivo* can instruct development of better therapeutic interventions with the goal of slowing or reversing MS progression and improving patient symptoms.
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The Formation of Territorial Cores and the Implications of Their Disruption
Fern Curtiss-Kauer, *Social Sciences & Humanities*
Mentor: Jamie Hodgkins

Abstract:
The process of politically and ideologically appropriating a landscape is contingent upon the ways that individuals conceptualize, perceive, and experience it. These methods of connection are formed in part by the structures in which one has experienced their life and are formalized and grounded within the landscape. Newcomers tend to shift the original inhabitants' identity-centered claim to the land. The westward expansion of white American settlers extended the ideological hand of the United States government, which promised riches unknown and landscapes beyond comprehension, even upon land which was legally barred from settlement. This incursion interrupted the formation and permanency of Native identity tied to the physical and ontological landscape. When white settler groups invaded known Native land on behalf of the government, many likely did not intend to commit dispossession, but rather desired to engage in individualistic endeavors. Settler colonialism as defined by Roberts (2021) includes justifying spatial expansion through the combination of "rhetoric, American governmental structures, and individual action" (9). North America has been deeply affected by the colonial actions of the United States government, who borrowed legal pretext from Great Britain to subjugate the landscape. *Terra nullius*, a legal fiction which justifies the imperialistic desire for westward expansion, allowed for colonizers to claim land which "belonged to nobody" (Fitzmaurice 2007). I argue that

this justification gained a residual permanency in the imperialistic expansion of America through settler colonialism, reshaping the territorial cores and identities of Native Americans. I explore the methods and theoretical background that justify territorial expansion, including the formation and reformation of territorial cores, utilizing archaeological examples from North America, Australia, and Çatalhöyük.
https://symposium.foragerone.com/2026-racas/presentations/80874

The History of the Army Navy Store
Ronnie Karanja, *Social Sciences & Humanities*
Mentor: Rachel Gross

Abstract:
World War II's conclusion turned billions of dollars of military equipment all over the world into surplus for the United States. Surplus being property and materials no longer needed for military operations; thus, it is sold or distributed by the federal government. The immense scale of surplus, paired with the pressure of families waiting for their sons to return home led to multiple methods for disposal, from dumping and burning, to mass public sales stateside. This spawned a generation of former vets and businessmen who started companies, primarily Army-Navy stores, which were dedicated to selling military surplus. Academic research on the history of Army-Navy stores, primarily in the last few decades, is lacking. My research aims to be an introductory study about the surplus store since WW2. The research comes primarily from interviews with current and former surplus store owners across the country, research extending from their accounts, along with sifting through a large amount of primary source material about surplus abroad. The surplus industry has gone through 4 main stages. From the booming WWII days, to Korea and Vietnam, civilians *knew* what surplus was, and the government had plenty of it to sell. It became less visible by century's end of the century with policies like George H.W. Bush's 1208 program, and Bill Clinton's 1033 program. Reduced global intervention also slowed military production, dwindling supply for stores. The industry is in further decline in 2026, and its status offers a direct example of the changes in the U.S. Military, and its trickle-downs. The U.S. government hasn't stopped going to war and interfering abroad, just changed their methods, with less total wars and a more efficient reutilization of goods. And for good or bad, the surplus store has been left behind as a result.
https://symposium.foragerone.com/2026-racas/presentations/80972

The Impact of Decriminalization on Psychedelic Use, Mental Health, Labor Market Outcomes, and Criminal Activity
Isabel Wolf, *Social Sciences & Humanities*
Mentor: Laura Argys

Abstract:
As the potential for mental health improvements associated with the use of psychedelic drugs is attracting attention, decriminalization movements are gaining momentum around the country. To date, three states and many municipalities have passed legislation to decriminalize psychedelic possession and use. Recent research and media attention have highlighted a new wave of research that links psychedelic use to positive outcomes for individuals dealing with treatment resistant depression, PTSD, pain management, and addiction. Reducing these adverse mental health outcomes can impact other aspects of an individual's life. While other types of drug use have often been found to be associated with less successful labor market outcomes and increased crime, these improvements in mental health suggest that psychedelic use may improve these outcomes. Recent research has also shown that psychedelic use is linked to lower rates of crime, compared to the use of other drugs. In contrast to that study, in my project I will examine the impact of decriminalization on the use of psychedelics, reported mental health outcomes, employment, and criminal activity rather than simply using data on observed drug use. My analysis illustrates patterns of psychedelic use over time, across groups, and the correlation with reported mental health, labor market outcomes, and crime. Using a difference in differences approach, I plan to exploit recent implementation of state and municipal policy decriminalizing the use and/or possession of psychedelics to understand the effect of policy on initiation and use; and assuming a sufficiently strong first stage, to examine the causal impact of increased use of psychedelics on mental health, employment, and crime.
https://symposium.foragerone.com/2026-racas/presentations/80938

The importance of trees in our ecosystem and in society
Jaime Hernandez, *Social Sciences & Humanities*
Mentor: Karina de Jesus

Abstract:
Trees are essential for the earth, for ecosystems and human societies, by providing economic, social, and environmental benefits(Kozlowski & Song 2022).Yet, current efforts to protect trees in both public and private property are insufficient. Research shows the significance and impact of trees by improving air quality as well as influencing air movement, depending on

both, environmental and pollution sources (Grylls & Reeuwijk, 2022). For example, a good friend of mine who lives in silver plume stopped a pit stop for semi trucks from being built in his back yard in the mountains. He got his community together and contacted local politicians, which was a huge inspiration for me, showing me that it can be done. Another example is how studies in Chile's Metropolitan Region have demonstrated how some tree species can even act as biomonitors, allowing us the ability to track and manage air pollution (Vera & Prendez, 2025). If we could implement effective urban forest management on private land, it would be a significant opportunity to expand tree canopy and better achieve environmental goals. Successful strategies include but are not limited to, financial incentives, planning policies, political involvement, and community engagement. This project focuses on tree protection along with tree plantation, in efforts to support healthier ecosystems and communities. By recognizing the importance of trees, as well as raising awareness on this social issue, we can apply strategies of mixed regulations allowing for improved air quality, improved environmental monitoring, and stronger urban forest management.
I currently have teamed up with Cottonwood, as I reconnected with the founder, Ford Church, here at CU Denver, after finding out I was in his program back in middle school. I have volunteered with Cottonwood by stratification in one of their programs, and have come up with the plan to contact and work with Cal Wood. They mainly work and focus on post-wildfire forest restoration, and as a Puksta scholar I plan to volunteer with them as well as try to expand the impact of restoring trees, but most importantly the protection of trees by contacting local Colorado politicians.
https://symposium.foragerone.com/2026-racas/presentations/80975

The Journey of Latino Immigrants in Higher Education
Genessi Hernandez, *Social Sciences & Humanities*
Mentor: Adriana Alvarez

Abstract:
Latino first-generation and immigrant students face numerous challenges throughout their journey in higher education, which ultimately decreases their likelihood of graduating with a bachelor's degree. Their citizenship status limits the number of resources available, specifically their access to financial aid. Navigating through higher education becomes even more difficult for this community due to systemic disadvantages from their backgrounds. With my research, I look forward to providing this community of students at the University of Colorado Denver with the resources necessary to help them succeed in this institution. For example, helping with financial aid, their degree audits, jobs/internships, and other obstacles students face in college. Furthermore, by conducting interviews, I aim to gain a better understanding of their experiences in pursuing higher education and highlight their amazing contributions to society overall. What they have encountered in this journey allows me to learn about what resources would be the most beneficial and encourages them to keep going. Latino excellence is prevalent, and I aspire to assist this group of students in accomplishing their dreams. Everyone deserves the opportunity to continue their education and reach for the stars.
https://symposium.foragerone.com/2026-racas/presentations/81000

The Nature of Inspiration: Great Writers, Poetry, and Identity Making
Evyn Garrington, *Arts & Media*
Mentor: Peter Franks

Abstract:
This poetry portfolio, composed of three parts, is an extension of my final project for the course ENGL 2600 Greatest Hits. I asked, "what is the significance and value of taking inspiration?" To address this, the artist's statement first briefly overviews my studying and writing process. It includes the poetic forms I extracted from each of the 7 sources of inspiration (Shakespeare, Emily Dickinson, Edgar Allen Poe, Walt Whitman, Langston Hughes, Jack Kerouac, and Nate Harrison) and an exploration of how each facilitated discovery. Next, the poems themselves are designed and printed on postcards people may take. This provides an entertaining way to present the work, promote audience interaction, and continue the cycle of inspiration that I am ideologically discussing. Third, I create a chart that includes summaries of my reflections on each of the poems. In and of themselves, these great writers draw from historical and literary precedence. They act as case studies for inspiration and cultural development. By examining them, especially in tandem, human "universalities" of form, theme, and topic are revealed. In my experience authoring the poems, in addition to exposing universal truths, my "person" was also revealed. This simultaneous movement towards discovering the relationship between universal and personal truth is the identity-making process. In conclusion, the questioning of inspiration which initially spawned this portfolio became evidence of the importance of this process, particularly relevant in a world of technology-sponsored ease. I identify the difference between reflective imitation and unreflective imitation. The latter may improve writing skills, but the former is marked by its identity-building properties. Being critically derivative compelled me to not only analyze sources but personally reflect on them. This enhanced the overall purpose of poetry, which attempts to make linguistically tangible that which is not.
https://symposium.foragerone.com/2026-racas/presentations/81015

The Poison Tester.
Gale Khayut, *Social Sciences & Humanities*
Mentor: Eliot Khalil Wilson

Abstract:
It's well documented that LGBTQ+ individuals experience more intimate partner violence than their heterosexual counterparts, yet studies also show that abuse within queer relationships remains significantly underreported. This project will start conversation about abuse in relationships without diminishing the fight for LGBTQ+ acceptance, particularly among adolescent readers. If teenagers are only treated with consideration for their immaturity, they're unable to gain the necessary skills to extricate themselves from harmful situations, especially in circumstances of queer adolescents.
I completed the first draft of my 24-chapter novel, *The Poison Tester*. An omniscient narrator who withholds as much as they reveal. A world where natural poisons are reworked into antidotes for various ailments. Nellaf and Eris find themselves surrounded by shallow company and bottomless solitude, threats of the world just as intoxicating as the poisons that Eris forced onto Nellaf. This narrative follows two girls who turn to each other for support, their coping methods quickly becoming dangerous. This story explores trauma bonding and emotional dependency in the lens of queer theory.
While queer representation in literature has increased, narratives portraying abuse in queer dynamics have not been as widely executed or acknowledged as narratives portraying abuse in heterosexual relationships. Without representation of vituperative queer relationships, individuals don't have a place where they feel comfortable to speak out. It's crucial to, now, more than ever, show them that they do have a place, and that the existence of their experiences doesn't set the LGBTQ+ movement back.
https://symposium.foragerone.com/2026-racas/presentations/80894

The Quantum Suite: A Web-Native Ecosystem for Quantum Computing
Paul Nguyen, *Tech, Engineering, & Math*
Mentor: Yosef Bonaparte

Abstract:
My project is a comprehensive, web-friendly quantum computing software suite. It provides a modular framework designed to simulate, analyze, and apply quantum computing principles. The project is divided into specialized domains, such as quantum logic, complex algebra, quantum algorithms, hardware simulation, system characteristics, and practical applications. This project helps make advanced quantum mechanics accessible to anyone.
The primary objective of this project is to build an accessible, strongly-typed, and highly modular software ecosystem that enables developers and researchers to simulate quantum hardware, implement sophisticated quantum algorithms, and explore quantum algebraic models natively within a TypeScript/JavaScript environment.
The framework was architected as a collection of multiple specialized, interconnected repositories: Logic, Characteristics, Algorithms, Hardware, Algebra, and Applications. The architecture cleanly separates theoretical mathematics (Algebra and Logic) from practical execution (Algorithms and Hardware simulation), culminating in the Applications module for end-use integration.
The outcome is a cohesive ecosystem that collectively provides an environment for quantum computing simulation. The project bridges the gap between complex quantum mechanics and modern web-based software engineering, resulting in a deployable suite capable of handling everything from quantum logic and hardware characteristics to algorithm execution and application development.
The quantum suite shows that complex quantum computing concepts can be made approachable. Organizing the quantum stack into modular components makes quantum computing more accessible to developers and provides a scalable foundation for research, education, and quantum-inspired web applications.
https://symposium.foragerone.com/2026-racas/presentations/80969

The Relationship Between Consumption, Self-Expression, and Life Satisfaction Among University Students
Rachael Thompson, *Social Sciences & Humanities*
Mentor: Jae Tsyitee

Abstract:
This study investigates how patterns of consumption and self-expression relate to life satisfaction among emerging adults. Life satisfaction, defined as a cognitive evaluation of overall life quality, may be influenced not only by time use, but by the intention, value alignment, and developmental context underlying behavior. In modern environments, frictionless access to digital media and consumer goods has made consumption increasingly passive, raising concerns about behavioral displacement and reduced identity development. We propose that consumption is not inherently harmful, but becomes maladaptive when it is passive, value-misaligned, or displaces identity-building activities. Self-expression is expected to enhance life satisfaction when it aligns with personal values and supports meaning-making; however, externally driven or high-pressure forms of expression may

undermine these benefits. We have conducted a cross-sectional survey among University of Colorado Denver students investigating life satisfaction's correlation between free time spent participating in consumption of activities involving self expression in conjunction with a qualitative study and interviews with professionals in the field of psychology. Free time being defined as time outside of required obligations (such as work or school). Participants report weekly hours spent in consumption activities (such as shopping, food and drink, movies/TV, short-form content, reading, other) and self-expression activities (e.g., art, music, writing, research, cooking, content creation, exercise, etc). While also rating life satisfaction through a survey (on a 1–10 scale), and responding to a free-response prompt describing how they would ideally spend their time. A consumption-to-expression ratio will be calculated using weekly hours and examined in relation to self-reported life satisfaction. Value alignment will be assessed as a moderating variable, while autonomy and belonging will be explored as mediators. This study aims to clarify whether behavioral imbalance, rather than consumption alone, predicts reduced life satisfaction, and to inform more precise, intention-based models of well-being.
https://symposium.foragerone.com/2026-racas/presentations/81072

The Relationship Between Social Media Consumption and Perceptions of Gun Violence
Vania Villalobos, Kyah Dacosta , and Payton Lamonica *Arts & Media*
Mentor: Courtney Leapley

Abstract:
Social media's prevalence in today's society presents opportunities for important information to be amplified, framed, twisted, and exaggerated. As a result, it shifts the way the public consumes and perceives gun violence and crime-related media. This research is meant to increase understanding of the relationship between social media exposure to gun violence and desensitization to violent content over time. This study took a mixed-methods approach, collecting both quantitative and qualitative data. The distribution of this survey to a convenience sample of college students via Qualtrics was used to compare contrasting perspectives that aim to deepen understanding of the public's perceptions of consistent exposure to violent content and examine the long-term effects it produces. The analysis of qualitative data collected from these surveys using descriptive statistics was interpreted by identifying information that revealed patterns of desensitization and normalization. This study is crucial in analyzing the effects of crime-related media to identify how exposure can influence how the public responds emotionally to violent events, and form their opinions about crime, including gun violence. The results of the survey show that frequent exposure to violent media desensitizes, reduces sympathy for victims, and shifts what individuals perceive as normal. It demonstrates the significant role that media consumption plays in shaping public awareness and promotes claims that target individuals' beliefs and attitudes, ultimately resulting in the power to shape policies regarding gun violence. It raises the question of how various platforms contribute to constructing mediated reality and its long-term effects on repeated exposure to violence.
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The role of eye movements and previous exposure in human ability to correctly identify AI generated images
Michelle Markevych, *Social Sciences & Humanities*
Mentor: Carly Leonard

Abstract:
While AI image generation has made remarkable strides in realism and accessibility, its integration into digital media ecosystems raises significant concerns regarding authenticity and trust. There is a proposed understanding of perceptual expertise that may play a part in correctly identifying aspects of AI generated images with regards to previous exposure (Gauthier et al., 2010). To address the underlying decision-making processes involved with AI generated image identification, this experiment will examine previous AI exposure and eye movements during image viewing and self reported surveys. The proposed experiment aims to examine participants' accuracy in AI image identification, survey their interpretation of presented AI images, and interpret their social media usage and work experience with AI generative image software. The first part of the study employs an experimental approach in which participants engage in tasks on a computer while having their eye movements recorded using a desktop eye tracker. The images shown are either human made–images taken by the experimenter of a single object in foreground and contextual environment– or a similar one generated by ChatGPT. The second part of the study examines a participant's previous exposure and experience with AI generative visual content through the means of a survey taken on paper. Data collected will include the accuracy of identification using d-prime, confidence ratings in relation to the decision-making process, and meta-d-prime for understanding the confidence interval relations. Eye movement behavior will be quantified in terms of fixation count, fixation duration, and spatial gaze distribution for human-made and AI-generated images. Concerning the survey, experience is analyzed in terms of Pearson correlations between experience variables and performance measures. The results gathered will help understand how eye movements during image viewing and previous exposure to AI generated content impact a participant's decision on identification.
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The Role of Media Bias in Gun Violence Narratives: A Comparative Study
Kenadee Matarazzo, *Social Sciences & Humanities*
Mentor: Courtney Leapley

Abstract:
This study explores how two major U.S. media outlets construct narratives in the immediate aftermath of highly publicized school shootings, and whether such coverage reflects underlying political ideologies. While prior research has focused on gun violence itself, less attention has been given to comparative media framing and its influence on public understanding.
Using a comparative descriptive analysis, this study examines news reports and articles published by CNN and Fox News within the first two weeks following five major school shootings between 2010 and 2025. For consistency, the first ten relevant articles from each outlet were selected using standardized search queries. This approach captures initial reporting, when emotional intensity and narrative framing are most pronounced.
Findings show that CNN more frequently references mental health, gun control, and partisan language. Fox News, however, emphasizes gun rights more often than CNN. Across both outlets, mental health is discussed more frequently than gun policy, with many articles relying on psychological experts. Despite dramatic headlines, reporting in both sources remains relatively measured, with few overtly hostile statements.
Overall, the results suggest that early media coverage prioritizes explaining "why" these events occur, reflecting a broader societal need to make sense of tragedy before engaging in policy debates, while still aligning with each outlet's ideological tendencies.
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The Sakuga Phenomenon: Exploring "the Instant" in Contemporary Japanese Animation
Michael Cullis, *Arts & Media*
Mentor: Maria Buszek

Abstract:
The Japanese word "sakuga" () translates to "drawing pictures" or "animation," but in Western contexts, the term "sakuga" has assumed an entirely new significance to describe a specific type of scene in Japanese anime: one that possesses high-quality animation that conjures feelings of fascination and wonder within viewers.
Animation scholar Tom Gunning recognizes the wonder that viewers feel when consuming the medium of animation, crediting the sensation to what he describes as the "production of the instant" and its possibility of motion. Through technological innovation, perceptions of "the instant" have transcended the natural, human eye, revealing exciting visual landscapes that continue to inform and inspire animators to this day.
While anime episodes are created by large, comprehensive teams of animators, it is the layout animators that create dynamic cuts resulting in what is often considered "sakuga." A superstar animator during the anime boom of the 1980s, Yoshinori Kanada pioneered dynamic techniques and assisted in creating a culture in which individual animators possessed greater creative freedom and expression.
Returning to the present moment, the anime industry has never been so spoiled with talented animators and artists alike making their own stylistic marks. This presentation will utilize Gunning's framework of "the instant" to analyze a sequence within the popular anime Frieren: Beyond Journey's End.
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The time of day that exercise occurs determines how exercise impacts stress and the dorsal raphe nucleus
Aaliyah Valdez, *Biomedical Sciences*
Mentor: Dr. Benjamin Greenwood

Abstract:
It is well established that exercise reduces the risk of future stress-related mental health disorders, such as anxiety. One mechanism thought to be involved is constriction of activity in the dorsal raphe nucleus (DRN) that occurs after several weeks of regular exercise. Prior research has shown that rats with unlimited access to voluntary wheel running are protected from the behavioral consequences of inescapable stress and have decreased activity in the DRN. However, it is unknown if restricted access still enables these effects and constrains the DRN. In addition, exercise-related stress-protection involves central serotonergic systems, which operate in alignment with the natural body clock, or the circadian rhythm. This suggests that developing stress resistance may be affected by the time of day that exercise occurs. The goal of initial experimentation was to determine if exercise-induced stress resistance could be enabled with 3 hours of exercise, and if so, if the time of day impacted its effects. Initial experimentation showed that restricted wheel running still prevented stress-elicited fear in both males and females, but did not prevent social avoidance behaviors. To further examine these results, neural activity in the DRN was evaluated. Neural activity was measured by assessing overlap between a protein marker of recent neural activity (cfos) with serotonin in both rats that had unlimited access to exercise and rats that had limited exercise to the first 3 hours of the active

cycle. We found that the rats whose access was limited to three hours had more neural activity in the DRN than those with unlimited wheel access. This suggests that the mechanism responsible for reducing fear behaviors is enabled in fear regions such as the amygdala rather than the DRN, as previously thought.
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The Tower of Boobylon: A Monument to the Diverse Body
Sam Barnum-Freese *Arts & Media*
Mentor: Rian Kerrane

Abstract:
The Tower of Boobylon is an art piece designed as a testimonial of people's relationships to their breasts with an integrated critique of social control and idealization of traditionally female bodies. During the life casting process, individuals' breasts were molded and immortalized in bronze and iron. To further understand and appropriately convey each person's relationship to their boobs and how society impacted that relationship, each subject was interviewed during the 2-hour long molding process and through a digital pre-casting survey.
By compiling and documenting a variety of forms of breasts, I created a monument to the multiplicities of the feminized body itself. Herein, I present the creation of an archetypal tower that I hope reaches towards something feminine and divine, not flawed, and thus deeply human.
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The Trans Gaze: Desire and Beauty in Contemporary Trans Photography
Anya Ortiz, *Arts & Media*
Mentor: Maria Buszek

Abstract:
Desire and the body have been major themes in queer and feminist photography. The erotic nude has been used by various photographers to express gay desire, reclaim the female body, or rebuke the male gaze. The extensive history of queer visibility in photography was recently compiled in the Getty Museum exhibition Queer Lens, exploring images of desire from the 19th to the 21st century. Yet, despite featuring a plethora of images of gender diverse subjects across its timeline, it seemed like these representations focused on themes of transitioning or empowerment and almost no examples of sexual desire.
The transgender body especially has been a neglected subject of both art and scholarship, especially when depicted with desire. Most commonly, these images have been made with either an othering or empowering framing. With the hypervisibility of transgender people in media and politics today, their bodies have been repeatedly labelled as disgusting and censored, even within queer spaces. The few photographers that work with the trans body offer a distinct queer feminist perspective that has only recently harbored academic attention.
For this presentation, I will examine the work of artists whose photographs center trans beauty and desire, and their place within queer and feminist art history. Using theory and current scholarship, this presentation will advocate for embracing transgender images as examples of queer joy and resistance.
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To Make Seen: What is Already There
Gabriel Herrada, *Arts & Media*
Mentor: Alex Yueyan Li

Abstract:
The research considers how architectural practice can operate through acts of display, translation, and encounter to engage broader conversations about the built environment. The work focuses on ways of working with what is already present, including materials, structures, and spatial conditions, and how these can be leveraged to reach more meaningful outcomes. Through carefully designed public-facing interventions, the work explores how processes of reuse, repair, and transformation can be communicated beyond disciplinary boundaries.
Architectural ideas are approached not as fixed outcomes but as evolving narratives shaped through material evidence, spatial arrangement, and community interaction. In this context, design functions as a way of directing attention, shaping how existing conditions are perceived and understood.
We approach engagement as both a spatial and social construct. Installations and events are developed to encourage movement, participation, and multiple forms of interpretation, allowing visitors to form their own relationships to what is presented. This approach avoids overly didactic modes of communicating and instead emphasizes curiosity, openness, and dialogue.

It suggests that adaptive reuse is not only a technical or formal challenge, but also a cultural one. To navigate unstable grounds, we have to bring the conversation to every table we can.
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Uncovering Student Experience: A Factor Analysis of STEM vs Non-STEM Courses at CU Denver
Ohioma Akhihiero, *Tech, Engineering, & Math*
Mentor: Emily Speakman

Abstract:
The work presents a two-stage exploration of what classroom components predict a student's engagement and sense of both belonging and being valued. The study uses fall 2025 data from the College of Liberal Arts and Sciences (CLAS) at the University of Colorado Denver Student Survey and the mean course ratings from the 22 questions on that semester's Faculty Course Questionnaire (FCQ). For stage one, exploratory factor analysis (EFA) was used to uncover four latent constructs in the FCQ data related to perceived instructor concern for students, grading criteria, methods of student engagement, and clarity of grading criteria. That is, EFA was used to transform the original FCQ data into new variables for each of these four revealed constructs. Similarly, EFA was used to aggregate the Student Survey data into two new variables related to department efforts and a student's sense of being respected.Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin measure demonstrated the data was appropriate for EFA, parallel analysis was used to choose the number of factors, and both the Tucker Lewis Index and the root mean square of the residuals confirmed the validity of the new variables created with EFA. For the second stage of the analysis, differences in the new variables were explored by (i) the academic level of a student — Freshman, Sophomore, Junior, Senior, or Graduate, (ii) STEM or not-STEM major, and (iii) general department descriptors. Results suggest meaningful differences in students' reported sense of engagement and belonging for different features of a classroom, curriculum delivery, and department.
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Urban Heat Island Classification Using AI for Climate Risk and Resilience
Akanksha Gutal, *Tech, Engineering, & Math*
Mentor: Dr. Ivan J. Ramírez, Ph.D.

Abstract:
The escalating public health and environmental risks in U.S. cities are driven by Urban Heat Islands (UHIs), where dense infrastructure and limited vegetation elevate urban temperatures above surrounding areas, intensifying extreme heat exposure. As a critical component of broader climate risk assessment, UHI analysis plays a key role in advancing climate resilience and informing data-driven urban policy. While prior research has applied machine learning to UHI detection, most studies focus on single cities, leaving a gap in scalable, multi-city frameworks capable of handling diverse climatic and urban environments. This study addresses this gap by developing a geospatial deep learning framework for Urban Heat Island Classification using Landsat-8 remote sensing data. Land Surface Temperature (LST) is derived from thermal infrared imagery (Band 10) and segmented into image patches, which are processed through a high-capacity neural network to classify High, Medium, and Low UHI intensity zones. The dataset spans multiple U.S. cities with varying climatic and urban characteristics, enabling improved model generalization. Data acquisition and preprocessing are conducted using Google Earth Engine, forming a scalable geospatial data pipeline, while the modeling workflow is implemented in Python. Preliminary results indicate that this automated approach generates high-resolution heat zone maps and captures spatial variability in urban thermal patterns across heterogeneous environments. By integrating satellite imagery, cloud-based geospatial workflows, and advanced modeling, this framework demonstrates the potential of AI for urban climate applications, supporting decision-making for heat mitigation, climate adaptation, and the development of more sustainable, climate-resilient cities.
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US Space Force Multimodal Anomaly Detection
Landon Mottel, *Tech, Engineering, & Math*
Mentor: Dr.Grant Huang

Abstract:
Machine learning models have been widely adopted across many domains to support classification, prediction, and pattern-recognition tasks at scale. Within this landscape, data-fusion models play an increasingly important role by integrating information from multiple data sources to capture richer system dynamics than any single modality can provide. These approaches—ranging from statistical fusion frameworks to modern graph-based and multi-modal deep learning architectures—enable more comprehensive situational understanding and improved model robustness. Building on these advances, this project aims to learn baseline patterns of activity across multiple types of data sources, such as logs, sensors, behavioral signals, and

telemetry, and to explore graph-based fusion methods, multi-modal deep learning, and transfer-learning techniques to improve pattern recognition and reduce false alarms in complex systems.
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Using Wastewater as a Media to Identify 1,4-Dioxane Degrading Microorganisms
Elaine Lin, *Natural & Physical Sciences*
Mentor: Timberley Roane

Abstract:
Coming from industrial and domestic sources, exposure to 1,4-dioxane is a carcinogen risk as rising levels of 1,4-dioxane are found in water and soil, and in personal care and household products. In the environment, 1,4-dioxane does not readily degrade, making it a persistent contaminant, especially in groundwater. One such affected location is the Lowry Landfill Superfund Site, where the current method for remediating and removing 1,4-dioxane involves pumping contaminated groundwater, already containing 1,4-dioxane degrading microorganisms, into bioreactors designed to support microorganism growth and removal of 1,4-dioxane from the water. However, the identities of the microorganisms responsible for this degradation remain unknown. To identify the microorganisms responsible for degrading 1,4-dioxane, wastewater from the NTES line at the Lowry Landfill Superfund Site, which contains 1,4-dioxane, tetrahydrofuran (THF), per- and polyfluoroalkyl substances (PFAS), and other compounds, was collected, filter-sterilized, and used to prepare an agar growth medium for use in petri plates. Once the preparation of the growth medium is successful, microorganisms collected from the bioreactor support media will be used to inoculate the **Lowry wastewater-based agar (LWA)** medium. This allows microorganisms capable of utilizing the various chemical compounds in the wastewater as nutrients to grow and form colonies. Isolates can then be tested for their ability to degrade 1,4-dioxane by collecting colonies from the agar medium, transferring them into sterile liquid wastewater, and observing whether they degrade the 1,4-dioxane present in the wastewater.
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Utilizing Visual Tasks to Uncover the Sensorimotor Processes of Tourette's
AJ Lorenzo Carson, *Natural & Physical Sciences*
Mentor: Carly Leonard

Abstract:
Visual systems gather information actively, making largely unconscious decisions about where to make eye movements next. Sometimes, we move our eyes towards places of interest in order to get a better look at them and assess them by importance. Other times we may look away from objects, to avoid looking at and processing them. By creating experiments that track eye movements and observe how the eyes interact with a request to observe and perform certain tasks, some knowledge on the reasoning for pro and anti saccadic movements can be determined.
In this presentation, I will explore the role that motor and inhibition systems play in visual processing, specifically examining how people with Tourettes perform in visual tasks differently than neurotypical individuals. Are their tics disruptive to their visual systems ability to inhibit movement when compared to neurotypical individuals? Do differences in motor and/or inhibition systems influence prosaccadic and antisaccadic movements? The Stop Saccade task in our lab works on this exact idea but for more neurotypical individuals. An experiment dedicated to observing the workings of young individuals with tourettes may provide more insight into how the syndrome can be managed. This would also provide an effective behavioral biomarker for Tourette's and would be an important discovery in Tourette's research, while also specifying the diagnosis for the disorder.
For example, one article, titled "Enhanced Cognitive Control in Young People with Tourette's Syndrome", by Mueller et al (2006) explores how young individuals perform in a prosaccade and antisaccade task. Not only are the findings interesting, they contribute a certain amount of curiosity about how their inhibitory visual systems work. I will be performing a literature review that collects as much relevant information to this topic, and exploring how inhibitory systems may be affected by Tourette's.
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Vegetation, Mean Radiant Temperature, and Inequitable Heat Exposure in Denver, CO
Megan Nelson, Krystle Harrell, Anna Blevins, Lydia Marino, and Danya Manyak *Natural & Physical Sciences*
Mentor: Ben Crawford

Abstract:
Background and Motivation
Situated at the border between Colorado's eastern plains and the Rocky Mountains, Denver is a city characterized by rapid urban growth and extreme climate shifts. In the past few decades, Denver has experienced high rates of urban expansion, as shown by the growth in urban land from 150 sq. miles in 1950 to 499 sq. miles in 2000 (USGS, 2021). Although this urban growth has helped build the city's economy, it has led to the intensification of the urban heat island (UHI) effect. The UHI effect occurs

when urban environments experience higher temperatures compared to surrounding suburban and rural areas. According to a literature review by Vujovic et al. (2021), four main factors related to urban expansion contribute to UHI formation: the structure of urban corridors, the variance in urban construction materials and land surfaces, the layout of urban areas, and human activities that release heat and pollutants. These factors cause landscape changes that impact the surface energy balance, increasing sensible heat flux and decreasing latent heat flux. This raises surface and air temperatures, leading to the formation of UHIs. In this study, Vujovic et al. also discuss the consequences of UHIs, ranging from human health issues to environmental degradation. Drawing from existing literature, Vujovic et al. state that consistent heat exposure raises mortality levels and causes adverse health effects within vulnerable populations. Consistent warm temperatures also raise energy consumption through increased cooling system use and cause thermal pollution in waterways (Vujovic et al., 2021). Our research seeks to expand on the information provided in this study by examining the spatial pattern of UHIs in Denver. By visualizing urban heat trends throughout the city, we will expose inequities in heat exposure between neighborhoods and infer which population groups are the most vulnerable to heat impacts.
Mean radiant temperature (MRT) is especially relevant for outdoor heat exposure because it represents the total radiant amount an individual receives both from direct sunlight and heat emitted by surrounding surfaces (Li et al., 2023). In sunny urban settings like Denver, MRT can vary significantly over short distances, and explains why two places with similar air temperatures can feel vastly different. Because tree canopy cover can change the radiation environment—by blocking incoming solar radiation and cooling surfaces via evapotranspiration—MRT is a useful tool for detecting and mapping the cooling impact of tree canopy cover. To examine how the effects of tree cover play out locally, this study aims to compare the Auraria Campus to the Cheesman Park neighborhood, which differ heavily in both land cover and tree canopy. Auraria is built with primarily impervious surfaces and has fewer mature trees, while Cheeseman Park contains large greenspace and substantially higher canopy cover (American Forests, n.d.). The stark contrast makes them useful locations for testing whether differences in vegetation offer measurable differences in MRT at the pedestrian scale (Li et al., 2023). Therefore, identifying where MRT is highest can help target cooling strategies—such as what types of trees to plant, shade structures, or types of building materials—for communities with higher heat vulnerability, and less infrastructure for remedy.
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Visualizing Urban Farming: Autonomous Food Production in Denver
Ismael Zapien-Moran, *Arts & Media*
Mentor: Marty Otañez

Abstract:
In an urban farming project administered by the Denver-based non-profit organization The Consumption Literacy Project (CLP) in Montbello in Northeast Denver, paid garden workers (ages 14-21) are at the center of a community economy that pushes against and is intrinsically tied to the capitalist system. In this community which is characterized by Latinos/as (65%) and African Americans (20%), urban farm workers engage in practices to protect their health and avoid harm. As they manage these hazards, workers grow, share and consume food, contributing to social change along community and ecological health lines. In the process, urban farm laborers achieve varying degrees of food sovereignty and gain varying degrees of autonomy from the dominant food system. On a deeper level, farm workers make visible the different forms of labor in urban sustainability initiatives and the work that plants and soil do to create environmentally considerate landscapes. Applying a critical digital ethnography approach, I present a photographic essay and scholarly video (6 minutes) with excerpts from video recorded interviews with urban farm workers and imagery of the cultivation process that show the opportunities and challenges urban farm workers face as transformative agents involved in feeding themselves and community members through autonomous food production. Images and stories were co-created with farm workers, illustrating the value of their labor, practices to stay safe, and relationships between humans and the environment.
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What Remains
Kassidy Thacker and Alaini Langston *Arts & Media*
Mentor: Thomas Kolicko

Abstract:
What Remains is a short documentary that follows the illegal firing of over 4,000 National Park Service members on February 14th, 2025, known as the Valentine's Day Massacre. Since then, park rangers and stewards have been silenced by the administration and fear for the security of their jobs and livelihoods daily. Despite their essential role in protecting public lands, stewards' voices and experiences are often overlooked, creating a gap in public awareness and understanding of both public lands and the work required to care for them. *What Remains* fills this gap by conveying the tragedy of these events through interviews with former park rangers, amplifying their voices, and sharing the true story of the Valentine's Day Massacre. This work is critical because if we don't advocate for the stewards who protect our lands, we will lose these places forever.

We fulfilled the goals of this project by interviewing Adam Auerbach, a former Rocky Mountain National Park ranger, as well as an anonymous park ranger who was fired during the Valentine's Day Massacre. Additionally, we partnered with Light Hawk Conservation to capture aerial footage that visually answers why the current administration is dismantling the park service, particularly through extractive industries.
The results of our project indicate that community is the answer to *What Remains*: coming together around this non-partisan issue to put up the fight. The results offer a perspective of one's responsibility in the ongoing fight for conservation, asking us to reckon with the gap between what we say we value and what we're willing to fight for. Ultimately, this film is critical today because it is not just a documentary about national parks, but about the bond between people, emphasizing that advocacy and awareness are essential to ensuring that these places, and the voices behind them, are not lost.
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When Buildings Learn to Breathe
Myles Rule, *Tech, Engineering, & Math*
Mentor: Julee Herdt

Abstract:
The building and construction sectors account for approximately 37% of global energy and process-related CO_2 emissions annually (UNEP, 2022). While buildings are among the largest contributors to environmental degradation, their surfaces remain largely inert and unable to improve the air around them. What if the walls around us could do more than enclose space? What if they could breathe? This project investigates how architecture can shift from being a primary source of environmental impact to becoming part of the solution, particularly through interventions applied to existing building stock.
This research proposes a new type of building surface composed of four widely accessible materials: clay, water, algae, and mycelium (fungal networks). By combining digital fabrication with living systems, the project explores how common materials can be transformed into active, responsive interfaces that engage with environmental conditions.
To test this approach, small-scale ceramic tiles are 3D printed using custom-coded toolpaths and geometries informed by environmental inputs such as water flow and solar exposure. Organic substrate is grown directly on to the clay body, allowing mycelium to grow within the printed structure and increase inter-layer durability and surface water retention. Rather than being fully fired, the material is maintained in a porous state to retain moisture and support biological activity. A layer of algae is then introduced using a bio-gel medium and exposed to light under controlled conditions. Carbon dioxide levels are monitored over time to evaluate system performance relative to non-living material assemblies.
Focusing on abundant, low-cost materials and adaptable fabrication methods, this research suggests a new direction for retrofitting existing buildings. Instead of acting as static barriers, building surfaces can become performative systems that support biological processes. By transforming conventional façades into sites of living activity, this project proposes a future in which architecture improves air quality and creates a more responsive relationship between the built environment and our climate.
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When Warnings Fail: A Systematic Analysis of Emergency Alert Breakdowns Using the Warning Failure Database
Siyang He, *Social Sciences & Humanities*
Mentor: Hamilton Bean

Abstract:
This study examines public warning failure through the development and application of the Warning Failure Database (WFD), a systematically coded dataset of emergency alert breakdowns in the United States. Public warning systems such as the Emergency Alert System (EAS) and Wireless Emergency Alerts (WEA) are designed to deliver timely and accurate information during crises; however, failures in these systems can result in significant social, organizational, and communicative consequences. This research aims to identify emerging patterns in warning failures and to explore how different types of breakdowns—technical, organizational, and message-related—affect public response and risk outcomes. Drawing on a structured codebook, the study analyzes systematically coded cases from the WFD, capturing variables such as alert timing, message clarity, dissemination channels, interagency coordination, and public feedback. Preliminary findings indicate that warning failures are often multi-causal, involving interactions between technological limitations, procedural gaps, and communication design issues. This study is ongoing, and future work will expand the dataset and refine analytical approaches. By conceptualizing warning failure as a systemic and multidimensional issue rather than a series of isolated incidents, this research contributes to a more comprehensive understanding of emergency communication breakdowns and offers practical implications for improving alert system design and policy frameworks.
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"Your Best Friend, Frog.": The Overlap of Friendship and Homoeroticism in Queer Companionships

Richie Joanis, *Social Sciences & Humanities*
Mentor: Gillian Silverman

Abstract:
This paper examines the intersection of friendship and homoeroticism found in queer companionships through the lens of *Frog and Toad Are Friends*, the first book in the long-beloved Frog and Toad series. Arnold Lobel's anthropomorphic amphibians, two night-and-day characters who, in spite of their differences, are the best of friends, have a companionship that represents the ways in which platonic and romantic affection overlap in strong, longstanding partnerships. As this overlap is represented by two male characters, the focus of these intersections is primarily the weaving together of homosocial and homoerotic intimacies in queer relationships, and this focus, though not overt, is intentional. As a closeted gay man in the 1970s, struggling to come out to his wife and family, Arnold Lobel used Frog and Toad's companionship to express, and normalize, both the importance of homosocial bonding and the muddy waters of queer affection and intimacy, and, thus, the ways in which these things overlap in queer partnerships. By detailing the lives of Frog and Toad, Lobel gives the reader a glimpse into the closeness and companionship shared between queer partners. This closeness, highlighted by the affection shared between these two male characters, is grounded in a combination of platonic and romantic love. The relationship between Frog and Toad offers a window into the overlap of friendship and homoeroticism in queer companionship, and it does this through the permissions afforded by the more surface-level, permitted aspects of homosocial friendship, particularly when considering the sharing of things like time, physical space, and possessions.
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