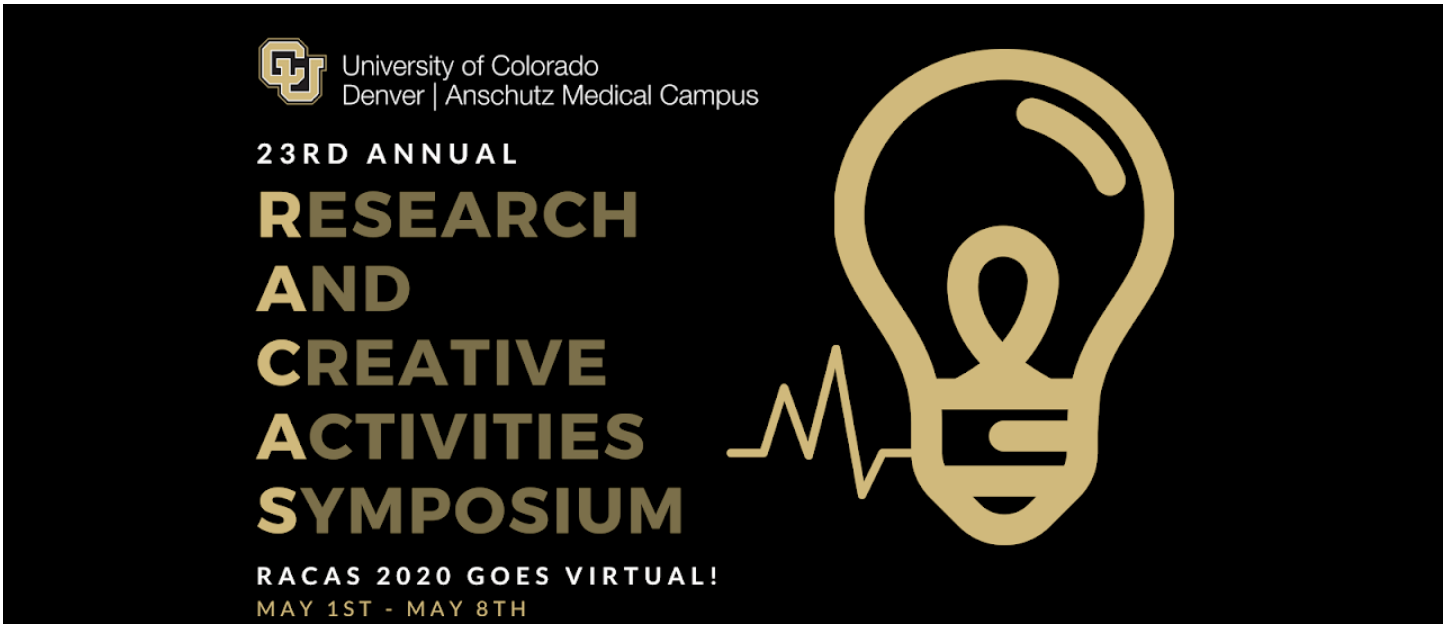

WELCOME TO RACAS 2020!

We hope that you enjoy the original student works featured in this virtual symposium. Although we can't be together in person, we are excited for this opportunity to celebrate CU Denver | Anschutz's talented young scholars and hope that you find this year's event both rewarding and inspiring! **View full details and presentations:** https://sites.google.com/view/racas2020/home

CATEGORY AWARDS

Arts & Humanities

- 1st Place: Melissa Jacobi (A5) - *Blurring the Lines of Anthropomorphism: Illustrated Stories of Animal Intellect, Ingenuity & Inspiration*
- 2nd Place: Gesina Null (A17) - *Colonization and Christian Art in Mesoamerica: The Mendicant Orders' Different Approaches to Conversion during Spanish Colonization*
- 3rd Place: Karima Osman (A18) - *Anecdotes of the Somali Diaspora Conveyed Through Poetry*
- Honorable Mention: Arturo Mireles, Todd Smith, Kevin Stanton, & Jocelyn Solis (A7) - *Green Revolution: The Emerging American Hemp Market*
- Honorable Mention: Harrison Sokol (A21) - *Trouble with the Trolleys: The Decline of Streetcar Use in Denver, 1919-1950*

Biomedical Sciences

- 1st Place (tie): Kristen Jackson (B21) - *Group B streptococcal surface adhesin protein promotes GBS interaction with cervicovaginal epithelium*
- 1st Place (tie): Alyssa Salazar (B35) - *iPSC-Derived Cardiomyocyte Model to Investigate Stretch-Responsive Signaling Pathways Involved in Hypoplastic Left Heart Syndrome*
- 2nd Place: Anna Meunier and Olivia Gibson (B14) - *Drosophila melanogaster as a model organism for early CDB research as indicated by anxious behavior*

- 3rd Place: Linh Nguyen (B29) - *Can personality explain individual differences in attentional capture?*
- Honorable Mention: Troy Hubert, Alyssa Hohorst, Margret Tanner, Kelsey Bonar, & Kelsey Abrams (B19) - *Neural mechanisms of exercise-induced stress resilience in females*
- Honorable Mention (tie): Hannah Abroe (B2) - *Inserting a FLAG-tag to the EcoRI Cloning Site on the Plasmid pCAGEN*.
- Honorable Mention (tie): Thomas Everett, Ryan Leman, & Hendrick Lopez-Beltran (B9) - *Chronic synthetic cannabinoid administration may produce tolerance to the dopamine releasing effects of heroin*

Natural & Physical Sciences

- 1st Place: Kathryn Harris, Raphael Hatami, & Judit Bergfalk (N15) - *Visualizing the Evidence for Dark Matter*
- 2nd Place: Tanja Kovacevic & Jillian Oviedo (N34) - *Computational Molecular Dynamics of a Small Protein (HP36)*
- 3rd Place: Annarose Phelps (N26) - *Impacts on gut microbial communities following exposure to Poly- and Perfluoroalkyl Substances (PFASs) from fire training area plumes in Cape Cod, Massachusetts*
- Honorable Mention: Emily Scott (N29) - *Effect of Serotonin on Mating Success in Male Teleopsis dalmanni*
- Honorable Mention: Dmitri LeeNatali (N35) - *A Time-Dependent Density Functional Theory study into the plasmonic resonance character of absorption spectra for small silver clusters (Ag_8, Ag_{18}, Ag_{20})*

Social Sciences

- 1st Place: Marcia Maxson (S19) - *Farm-to-Future*
- 2nd Place: Kate Fitch (S42) - *Disparities in dangerousness: Quantifying differences in threat across race and mental health status groups during police lethal force events*
- 3rd Place: Emily Barrington (S2) - *Avoidant Coping Mediates the Relationship Between Mindfulness and Performance-Based Anxiety & Test Anxiety*
- Honorable Mention: Victoria Beresford (S3) - *Does Prenatal Stress Affect Postpartum Depression of Mothers with a GG OTXR Genotype*
- Honorable Mention: Jada Lister (S16) - *Biological Motion Perception: A Predictor of Individual Differences Within the Autism Phenotype*
- Honorable Mention: Tianyue Sun (S35) - *A Biopsychosocial Overview of Autism Spectrum Disorder and Related Interventions*

Technology, Engineering, & Math

- 1st Place: Kevin Macfarlane, Tobby Lie, Devin Piner, Drake Young, & Jahoon Koo (T10) - *IAR: An Intelligent Augmented Reality Framework*
- 2nd Place: Matthew Anderson (T2) - *Real-time seizure forecasting for epileptics on a consumer product*

- 3rd Place (tie): Kenny Becerril, Zoe Kowalczyk, Jan Peciak, & Christopher Pennick (T4) - MycoBioSIP: *Bio-Renewable Building Panels for Sustainable Architecture*
- 3rd Place (tie): John Pace & Liang He (T11) - *Estimating Altitude of Drones Using Batteries*
- Honorable Mention: Jordan Hall (T7) - *Derivative-Free Optimization and Active Subspaces in Inverse Problem Theory*

PEOPLE'S CHOICE AWARDS

Arts & Humanities

- 1st Place: Tatum Meinert (A16) - *A Study of Dutch Still Life in the Golden Age*
- 2nd Place: Npaujnpaim (Diana) Lee (A6) - *A Closer Look at the Underground Music Showcase*
- 3rd Place: Joana Sanchez Gomez, Monique Salas, & Christopher Riggs (A8) - *The Impact Domestic Violence has on Children who are around it*

Biomedical Sciences

- 1st Place: Madeline Larson (B23) - *Immune Cell Homing to Pediatric Sarcomas: Changes in IL-8 Receptor Expression in T cells After Transduction with B7H3-CAR*
- 2nd Place: Gitanjali Rao (B31) - *A novel approach to early directional diagnosis of prescription opioid addiction*
- 3rd Place: Anna Meunier and Olivia Gibson (B14) - *Drosophila melanogaster as a model organism for early CDB research as indicated by anxious behavior*

Natural & Physical Sciences

- 1st Place: Derek Fearon, Sage Wheeler, Hope James (N12) - *Nitrogen Fixation Efficacy of Trifolium repens with Rhizobia Inoculant Treatments*
- 2nd Place: Riley England, Shelbie Johnson, Camryn Allen (N11) - *The effects of microplastic water contamination on the phagocytosis in Tetrahymena thermophila*
- 3rd Place: Matin Sanaei (N28) - *Neurogenesis Markers in Diapausing Rhagoletis pomonella*

Social Sciences

- 1st Place: Reese Titensor & Reagan Oates (S37) - *Identifying the most prevalent sources of stress in adolescent teens at Rock Canyon High School*
- 2nd Place: Marcia Maxson (S19) - *Farm-to-Future*
- 3rd Place: Lydia Rhino (S28) - *The Impact of Demographic Variables on Access to Eating Disorder Treatment*

Technology, Engineering, & Math

- 1st Place: Rebecca Dennis (T6) - *A Geospatial Analysis of the Urban Heat Island Effect in Denver, Colorado*
- 2nd Place: Khalid Adkins, Zaid Al Yasiri, Nicholas Stanford, & Marco Rojas (T1) - *Visually Rich Music Sequencing and Sound Generation*
- 3rd Place: Samuel Chen (T5) - *Bringing software engineering tools, mindsets, practices to mathematics research*

A Biopsychosocial Overview of Autism Spectrum Disorder and Related Interventions
Tianyue Sun, *Social Sciences*
Mentor: Bihun Joan

Abstract:
More attention is needed if we are to ever understand autism. Autism spectrum disorder (ASD), a neurodevelopmental disorder, affects around 1% of the worldwide population, with males being diagnosed 2-3 times more than females. The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) characterizes it with dyad: (1) ongoing difficulties in social communication and social interaction in different environments; and (2) restricted, repetitive patterns of behaviors, interests, or activities. Apart from that, there are some associated features, including atypical language development, cognitive dysfunctions, and regression. The objective of this paper is to equip the general public and health care professionals with more knowledge about ASD. The core and associated features of ASD, and differentiations between other neurodevelopmental disorders are systematically introduced. Information about ASD comorbidities and prognosis are presented with emphasis on significant but less researched topics. Researchers have identified several etiologies about ASD: Both biological (e.g., gene, brain and hormone) and environmental factors contribute to the development of ASD. Early screening is pivotal for early intervention, and this paper discusses a few ASD assessment tools applicable to various age groups. A series of recently published research offers more creative interventions for ASD, such as the use of wearable technology.

A Closer Look at the Underground Music Showcase.
Npaujnpaim D Lee, *Arts and Humanities*
Mentor: Storm Gloor

Abstract:
Music festivals all over the world have impacted cities' economies and communities. The Underground Music Showcase (UMS) has impacted Denver‚Äôs local economy for the past 19 years on South Broadway. This study explores the indirect, direct, and induced expenditures of the patrons through utilizing an economic model, IMPLAN. This research also compares and contrasts data with the ‚Americans for the Arts Annual Summary Report on: ARTS and Economic Prosperity‚. During the 19th annual three-day festival on July 26th-28th surveys, interviews, and a traffic study was conducted. A total of 680 surveys were collected throughout various stages, times, and participants for a random sample size. Through analyzing the data from patrons, community members, staff, and musicians on how they interact with surrounding businesses, the UMS supports economic growth.

A Critical Analysis of Media Influences and Fame-Seeking Motives in Mass Shootings
Honors Thesis Proposal
Madison Rose, *Biomedical/Health Sciences*
Mentor: Lindsey Hamilton

Abstract:
The United States has more mass shootings and other types of gun homicide than any other developed nation in the world (Henry, 2009). In the current academic literature available, the patterns and motives of mass shooters have yet to be discussed in a compressible and applicable way towards prevention. One of the behavioral patterns and motivating factors of mass shooting perpetrators is their preoccupation with fame and the depictions of other mass shooters in the media (Dietz, 1986 Knoll, 2010). American media has an prodigious influence on U.S. culture, if not the world (Frymer, 2009). With an exuberant amount of gun violence deaths each year in America, the media has made those types of crimes into easy targets for profit and exploitation. Through three mass shooting cases, Columbine High School, Virginia Tech University, and Jokela High School, this research will explore the consequences of the various media depictions of mass shooters. It will also discuss how those media depictions may influence the behavioral motives and patterns of mass shooters through a sociological, psychological and neurological lens.

A Geospatial Analysis of the Urban Heat Island Effect in Denver, Colorado
Rebecca Dennis, *Technology, Engineering, and Mathematics*
Mentor: Rafael Moreno- Sanchez

Abstract:
For the past decade Denver, Colorado has become one of the fastest-growing cities in the United States. The rapid population growth has increased the development of the inner city as well as the surrounding suburbs. Denver, Colorado is an excellent location to produce a good urban heat island case study. An urban heat island is in an area that is significantly warmer than its surrounding rural areas due to human activities. Also, an urban heat island is the product of the concrete environment. Buildings with dark roofs, city streets, and lack of vegetation are the causes of trapped heat energy. An impervious surface is artificial structures,ÄîsuchÄîas asphalt, concrete, brick, stone,ÄîandÄîrooftops. The correlation of fewer trees and a greater number of impervious surfaces can have a dramatic effect on the livelihood of residents living in an urban environment. Are the impervious services greater than the tree cover? And, what is the general infrastructure? By using remotely sensed thermal-infrared imagery which is collected by Landsat 8 Satellites, American Community Survey, and tree canopy data this will provide an analysis of the surface of Denver.

A Lady by Footlight
Edward Scott, *Arts and Humanities*
Mentor: Tom Noel

Abstract:
During the nineteenth century, the city of Denver hosted a number of professional female impersonators who were praised by theater audiences for their beauty, elegance, and charm. Simultaneously, men who were caught in the streets wearing female attire were promptly arrested for violating the city,Äôs lewdness and obscenity laws. This paper examines the double standard that allowed for nineteenth-century Denver to celebrate female impersonation within theaters while prosecuting the practice in all other public spaces. The competition between American theaters during the mid-nineteenth century to attract family audiences caused many companies to clean up their acts in an attempt to dissociate theater workers from disreputable populations such as vagrants and prostitutes. I argue that this (tentative) social elevation of actors allowed them to transgress boundaries of class, race, gender, and sexuality on theatrical stages, therefore permitting audiences to transgress such boundaries along with them, however within the safety and relative anonymity of the darkened theater. As long as a female impersonator belonged to a reputable theater company, their gender transgressions were forgiven and even

celebrated as an art form. As for their amateur counterparts, the societal restrictions of the nineteenth century required that they be singled out as different, and therefore dangerous, in order to strengthen the boundaries of what was considered normal. It is no surprise that stories of LGBTQ+ individuals often did not make it into the annals of Western History, but they still deserve recognition for their roles as laborers, entertainers, and pioneers of the West.

A METHOD TO REROUTE BLOOD DURING CPR FROM THE FEMORAL ARTERY TO THE BRAIN IN PEDIATRIC PATIENTS TO INCREASE BRAIN PERFUSION

Jimmy Tangchittsumran, Karl W., Danielle C. Larson, Leslie C. Piper, *Biomedical/Health Sciences*
Mentor: Mary MJ Bevilacqua

Abstract:
During CPR, pediatric patients in the ICU have excess blood flow to the lower extremities that could be used for the brain, increasing risk of brain damage. A cost-efficient, portable and size-adjustable device was developed to temporarily restrict blood flow to the legs, in order to force higher volumes to the brain. This device is made of a metal 3D printed buckle and polypropylene straps. The straps are long enough to allow for the device to be adjustable in size and fit a variety of patient bodies. The straps loop around both legs and thread through a specially designed buckle before being pulled tight and secured with Velcro. The straps are further tightened with a windlass device, which is secured by the buckle. Testing was completed on leg models made with two-inch multipurpose foam, which is comparable to the density of a leg. The device can be applied to the legs within 15 seconds and stay cinched for 30 minutes. Once applied, it decreases the diameter of each leg by 15% with an average of 1.67 twists of the windlass. When no longer needed, it can be removed with less than 6 lbs of force. Overall, this device has the possibility to lower rates of brain trauma due to lack of blood perfusion by adjusting blood volume locality from the lower extremities to the brain.

A Study of Dutch Still Life in the Golden Age

Tatum N Meinert, *Arts and Humanities*
Mentor: Maria Elena Buszek

Abstract:
During the Dutch Golden Age of the 17th century, the Dutch Republic had been through tumultuous years prior with the break from the Spanish Catholic dominated southern provinces of the Netherlands. The control that the Spanish Catholic had exercised over the Dutch had become more than the Northern Provinces could bare and as a result the 80-years,Äô war dating from 1568-1648. During this time, Still Life begins to make a comeback in the Netherlands, which becomes one of the most prolific for the genre, expanding its form into sub-genres of the like. The economic boom that takes place in the Dutch Republic is reflected in its art. This study reflects on the growth of the art in the Golden Age and questions the shift that takes place in the beginning of the 18th century.

A Time-Dependent Density Functional Theory study into the plasmonic resonance character of absorption spectra for small silver clusters

Dmitri D LeeNatali, *Natural Sciences*
Mentor: Emilie, B, Guidez

Abstract:
In the past decade, both empirical and computational studies have demonstrated unique resonances occurring in the Infrared to ultra-violet region of the electromagnetic spectrum of silver-clusters and silver-nanoparticles, as well its Group 1B, row 6 (periodic table) counterpart, gold, with the noted phenomenon termed Plasmonic Resonances and the discovery having potentially vast implications in industrial catalysis, superconductors, and medical radiation therapies to name a few. In an attempt to model and predict such plasmonic properties, various conformations of silver-8, silver-18, and silver-20 (Ag,Çà, Ag,ÇÅ,Çà, Ag,ÇÇ,ÇÄ) were generated or adapted from literature and geometrically optimized using Density Functional Theory (DFT) with a Rev-TPSS/Def2-TZVP level of theory/basis set. From the computed stable conformations, Plasmonic energies corresponding to the lowest 400 singlet-singlet electronic excitations were computed under the same level of theory/basis set, while the absorption spectra and electronic transition dipole moments were predicted and visualized with Time-Dependent Density Functional Theory (TDDFT) Relativistic Scalar Zora functionals using the lowest 200 singlet-singlet excitations. From the final data set of 17 potentially dependent variables, 136 squared-correlation coefficients (R¬≤-values) were computed by linear least squares fit in an attempt to find correlations amongst the data population. Amongst all 136 permutable sets of dependent variables, no linear relation was found, and research into the likely existence of non-linear dependence is ongoing.

Abuse of People with Mental Disabilities at Prayer Camps- Literature Review
Isaac J. Sargent, *Social Sciences*
Mentor: Dr. Karen U. Crawford

Abstract:
People in sub-Saharan Africa with mental disabilities are often forced into abusive or neglectful treatments. Such abusive and neglectful treatments include starvation, chaining by limbs or the neck, removal of self-agency, physical abuse, sexual abuse, and verbal abuse. Other studies have attempted to justify or complement sub-Saharan prayer camps, faith healing businesses that employ abusive and neglectful treatments of people with mental disabilities. However, little is known about how many of these prayer camps use abusive and neglectful treatments. Studying the frequency of prayer camps using abusive treatments will allow policy makers to identify appropriate changes and complementary treatments for people with mental disabilities.

An Analysis of the Relationship between Personality and Attention
Alexander S Morales, *Biomedical/Health Sciences*
Mentor: Carly J Leonard

Abstract:
People are constantly attending to, or selecting for, objects in their environment. People can attend narrowly or broadly to the contents of their field of view with an attentional window. People can guide their attention to objects via top-down, or goal-driven, processes. On the other hand, attention can be captured by a stimulus that differs from its surroundings (i.e. by having a different color from nearby objects) via bottom up salience. Previous research involving visual search tasks, in which participants used top-down resources to search for a target item with or without a salient feature in an array of distractor stimuli, has shown that salient targets usually capture attention in less time than non-salient targets. Moreover, salient items will most likely capture the attention of those with a broad attentional window. In research with atypical populations, it has been suggested that some individuals tend to hyperfocus, or narrow their attentional window, to find the target. Other work with general populations has suggested that neuroticism, a dimension of the Big Five personality model, can be linked to increased focus durations. The current study investigated the relationship between neuroticism level and response

times on a visual search task in a sample of college students. It was predicted that participants with high levels of neuroticism would narrow their attention, thus attending to less items in the task, and have less capture of the salient item than those with lower levels.

An Investigation of Extracellular Vesicles in Alcohol-Related Organ Diseases
Uyen Nguyen, *Biomedical/Health Sciences*
Mentor: Jared Brown

Abstract:
According to the National Survey conducted in 2015, 15.1 million adults reported having an alcohol use disorder. Alcohol misuse has been linked to a number of detrimental health effects. Liver is a primary target for the detrimental effects of alcohol; however, other organs and including adipocytes are also greatly affected by alcohol. While the stages of alcohol related disease on several target organs have been well characterized, targeted therapies to prevent or reverse this process are still needed. Previous work from our lab has shown that isolated adipocytes from ethanol-fed mice secrete EVs that contain more pro-inflammatory adipokine cargoes. However, it is unknown if adipocyte-derived EVs participate in organ-organ crosstalk and influence disease pathology in the liver. Therefore, we wanted to develop a more translationally relevant model to investigate adipose-liver crosstalk using fully differentiated adipocyte-derived mesenchymal stem cells in vitro. The goal of this project is to optimize EV isolations from cell culture supernatants to better evaluate mechanisms of organ-organ crosstalk on hepatic cell populations. Here, we wanted to address two specific questions:
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Can EVs be isolated successfully from the cell culture media of adipocyte-derived mesenchymal stem cells (Ad-MSCs)?
2. Does a cellular stressor, like ethanol or inflammatory mediator (LPS) increase the secretion of EVs from Ad-MSCs into the culture media?

Anecdotes of the Somali Diaspora Conveyed Through Poetry
Karima Osman, *Arts and Humanities*
Mentor: Jean Scandlyn
Abstract:
To know a person is to know their story, to understand a community, the narrative of the individual will not suffice. This distinction is important in that too often, when one seeks to understand a human experience other than their own, they may be comforted by a single narrative that is seemingly representative, but no single account can ever be representative, only reflective. In efforts to represent some of the experiences of Somali immigrants and refugees, I conducted 20 interviews with participants who reside around the globe. I have compiled and transcribed the findings from the interviews,ÄîidentifyingÄî both the trends and nuances,ÄîÄî to bring awareness to the varied challenges and insights of the Somali diaspora. The analyzed transcriptions inspired the final project, a poetry chapbook. I hope for the poems to have a breadth of impact, posing an influence at the political level as well as in daily rhetoric. As a storyteller, I prioritize amplifying the voices of communities that are disproportionately marginalized.

Assessing health disparities in American Indian communities in regards to mental health, environmental health, and elderly American Indian chronic health care needs
Najma A Abdi, *Social Sciences*
Mentor: Donna Martinez

Abstract:
Health disparities have been at the forefront of racial and ethnic minority communities, including American Indian Natives for quite some time. These health disparities have impacted the American Indian communities due to the lack of resources provided to them to tackle the adequate health care needs of the community. By focusing on identifying the issues regarding health disparities in the American Indian communities can potentially open doors to reduce and eliminate these certain health disparities in this underserved community. In secondary data analysis and archival study approach, I focused on the health disparities explicitly affecting the mental health and environmental health of American Indian communities as a whole as well as the chronic health needs of the elderly American Indians living on the reservations. By exploring the tribal environmental health risks through community-based research, the urban American Indian mental health issues, and the influence that health intervention programs placed in reservations have on reducing the healthcare disparities, I tackled the underlying issues of health disparities within the American Indian communities.

Ataxia telangiectasia and Rad3-related protein attenuates DNA damage and is a therapeutic target in Myc driven medulloblastoma

Ahmed H Abdel-Hafiz, *Biomedical/Health Sciences*
Mentor: Rajeev Vibhakar

Abstract:
Group 3 medulloblastoma tumors (Myc-MB), and particularly the 3g subtype, have the worst prognosis and show a 5-year overall survival of less than 40%. Group 3 tumors are often accompanied by MYC amplification and have a higher rate of metastatic disease and relapse. Unfortunately, therapeutic strategies to target MYC have remained elusive. The relapse of the MB has been linked to the DNA replication stress. Ataxia telangiectasia and Rad3-related protein (ATR) senses the persistent DNA damage arising due to the replication stress and activates the damage checkpoints, thereby leading to increased cell survival. ATR is highly expressed in MB, is also thought to contribute to undisturbed DNA replication to protect genomic integrity. Yet, the exact underlying mechanisms involving ATR are still unclear in MB. Inhibition of ATR (ATRi) using the ATR inhibitor, AZD6738, suppressed clonogenicity and cell self-renewal in MB. ATRi in MB cell lines downregulated Chk1 and upregulated P21. ATRi also induced cell cycle arrest and increased apoptosis in MB cell lines. Further, mice with orthotopic xenografts treated with ATR inhibitor survived significantly longer than control mice. High throughput drug screening showed that ATRi was synergistic with chemotherapeutic agents including gemcitabine, cisplatin and topotecan. The treatment of MB cells combination with the ATR inhibitor with gemcitabine and with radiation increased in expression of DNA damage markers. These findings highlight the role of ATR in alleviating DNA replication stress and that its inhibition is critical to the treatment of MB.

Avoidant Coping Mediates the Relationship Between Mindfulness and Performance-Based Anxiety & Test Anxiety

Emily D Barrington, *Social Sciences*
Mentor: Kevin Masters

Abstract:
The threat of negative social evaluation is a common stressor. In employment or academic settings these threats present during job performance reviews, presentations, and knowledge-based tests. Exposure to, or anticipation of, social evaluative threat can cause significant anxiety. Whereas anxiety can be created, maintained, or exacerbated by avoidance, there is evidence that mindfulness can undermine avoidance. Individuals who are

mindful, then, may be less likely to cope with anxiety by using avoidance. The present studies tested the hypothesis that avoidance-based coping would mediate the relationship between mindfulness and two forms of social evaluative anxiety: performance-based anxiety (Study 1) and test anxiety (Study 2). Study 1 included a nationwide sample of adults (N = 342), recruited via Amazon Mechanical Turk. Study 2 included a sample of undergraduate students (N = 120) from the University of Colorado Denver. Both studies utilized a cross-sectional design, identical statistical analytic strategies, and the following measures: three subscales of the Brief COPE questionnaire, the Mindful Attention and Awareness Scale, the Liebowitz Social Anxiety Scale (performance items only; Study 1), and the Test and Examination Anxiety Measure (Study 2). Consistent with hypotheses, avoidance-based coping mediated the relationship between trait mindfulness and performance-based anxiety (Study 1) and test anxiety (Study 2), such that individuals with higher trait mindfulness used less avoidance-based coping and experienced less anxiety. Due to the cross-sectional nature of these studies, future research should aim to verify the causal direction of these relationships.

Beyond the Lab: A Qualitative Overview of Research Across All Disciplines

SeKhai O Callier, *Social Sciences*
Mentor: Lindsey Hamilton

Abstract:
The purpose of this study seeks to understand how students of typically underrepresented majors engage in research.This study has two portions that will connect for the larger objective: qualitative research in the form of popular market research style interviewing with past and current students who participated in EUReCA programs; and a social media marketing campaign geared towards displaying these students and further encouraging research in all disciplines.
This study observes what engaged our current researchers and begins to solve how students at CU Denver perceive opportunities of undergraduate research through social media marketing. First, the interviews will take an audit of the experiences students would like to share from their semesters in research including images, videos, displays, or short video talk throughs of their current projects. Secondly, using these clips, we will introduce our researchers to our social media platforms of Instagram and Facebook.
Research is traditionally understood in the context of the Scientific Method; therefore, it can be rather difficult to consider oneself a researcher when their passions explore the shades of gray in the world, require abstract thought, seek to understand human nature, or express their inner world.

Biological Motion Perception: A Predictor of Individual Differences Within the Autism Phenotype?

Jada M. Lister, *Social Sciences*
Mentor: Carly J. Leonard

Abstract:
To date, there has been little conclusive research examining the relationship between biological motion and the presence of phenotypical traits associated with Autism Spectrum Disorder (ASD) within the general population. The perception of biological motion refers to the unique ability to recognize a moving, animate creature even with very little visual information. This can shed light on human,Äôs capacity and sensitivity towards communication and social interactions. This visual phenomenon holds relevance as there are currently no widely used biomarkers for ASD, a neurodevelopmental condition defined by marked impairments in social and communicative skills. Because of the paucity of current research, we propose a study of individual differences in a typical adult population examining the relationship between autistic-like traits and biological motion perception of subjunctive states such as happy or sad. This study will examine participants,Äô perceptual performance through a point-light display task measuring accuracy and reaction time in response to their ability to identify the biological motion or

emotional states presented. The results of this data will be correlated with various measures including the Autism-Spectrum Quotient (AQ22) and the Big 5 personality traits, namely focusing on extraversion, conscientiousness, and neuroticism, which have previously been correlated with higher AQ scores, an analogue to ASD in the general population.

Blurring the Lines of Anthropomorphism: Illustrated Stories of Animal Intellect, Ingenuity & Inspiration
Melissa A. Jacobi, *Arts and Humanities*
Mentor: Travis L. Vermilye

Abstract:
Animals have been underestimated for far too long, and some believe there is a hierarchy of intelligence with humans at the top. A shift in this hierarchy would allow a deeper understanding and empathy for the world around us. There are many examples of advanced cognitive thought in animals, observed by scientists in the field. However, these fascinating accounts are often buried in scientific journals or there is no vehicle to share the information. This study aims to present ethological data and observations with anthropomorphic visual narrative in order to provide accessibility to a broader audience. This unique original process is referred to as ,'responsible anthropomorphism,,' the art of combining the familiar tradition of anthropomorphism (the attribution of human traits, emotions or intentions) with advancements in ethology (the science of animal behavior observed under natural conditions). A different perspective of the animal kingdom is created by utilizing the familiar narrative tool of anthropomorphism to describe discoveries in animal behavior science. Anthropomorphism with its history of stereotyping animals is arguably the exact instrument that has caused animals to be underestimated, which makes it the most interesting tool to try and tell a new story for animal science. By using anthropomorphism, a concept aimed at trying to help humans understand animals since the beginning, we may be able to rethink preconceptions about the animal kingdom. In this study, stories of animal ecology and ethology are presented with a reinterpreted angle using imagery as an agent for social change. ,'Responsible anthropomorphism,' provides an understanding of the animal kingdom from their perspective, thus providing a motivation for conscientious human behavior to respect and protect biodiversity.

Bringing software engineering tools, mindsets, practices to mathematics research
Samuel S Chen, *Technology, Engineering, and Mathematics*
Mentor: Dr. Audrey Hendricks

Abstract:
Genetic datasets are often of considerable size (i.e.several gigabytes, comprising millions of records), which can be difficult to quickly and efficiently aggregate, merge, and deploy for analysis, especially in cross-disciplinary teams. Researchers have limited time to coordinate software resources while balancing ,'doing the science,'. Realizing and enhancing the implementation of such analyses for cross-disciplinary teams requires aligning efforts across data, the software, and the organizational structure for storing and accessing the software, data, and procedures. This includes protocols and implemented best practices to ensure effective use of computing resources.
To address these problems, I present the adoption and communication of software engineering concepts in a cross-disciplinary statistical genetics team. Providing software and documentation for the research team allows for reduced barrier to entry, and reduced friction for collaborative analysis of large data sets. While developing scripts for data aggregation and merging, I applied functional design, modularity with a focus on reusability, and best practices with R tidyverse packages. In one instance, the time-to-completion of an aggregated and merged dataset was reduced from person-weeks to compute-minutes. I developed a tutorial covering day-to-day usage of

Git and GitHub, communicating these concepts to a cross-disciplinary team with a diversity of skill sets, to improve overall organization and communication. The confluence of these efforts created the potential for better scaling of collaborative analyses, and improved access to organizational resources enabling researchers to more quickly and easily find the code and data they need to perform analyses.
The availability of reusable, efficient tools allows for more efficient and better organized current and future research. Enhanced usage of Git and GitHub enables organized code storage, access, and review; additionally supporting access to the code and data for the larger scientific community. When it comes to research, an ounce of planning and organization is worth a pound of cure, and all the small things count. For mathematics research, small adoptions in key pain points: writing software, coordinating data, documenting changes; can prevent that pain by using tools from the larger community.

Can personality explain individual differences in attentional capture?
Linh Nguyen, *Biomedical/Health Sciences*
Mentor: Carly J Leonard

Abstract:
Leonard & colleagues used a paradigm in which participants are instructed to identify a target with a specific color within an RSVP stream, but sometimes, distractors are present in the periphery with the same color feature as the target (Leonard, Balestreri, & Luck, 2015; Leonard, Robinson, Hahn, Luck, & Gold, 2017). Leonard et al (2017) found that people with schizophrenia, compared to matched controls, displayed greater capture cost from nearby distractors and less capture cost to more peripheral distractors. These results are consistent with previous work showing that people with schizophrenia are believed to hyperfocus in spatial attention.
However, it is not known if variation in spatial focus is evident within the typical population, and moreover, whether or not this also correlates with individual differences in personality. Therefore, using the capture cost paradigm described above, the present study looked at the typical college population and studied how capture cost as a function of distance maps onto personality traits of neuroticism and openness. Given the previous work in schizophrenia, neuroticism, which is high in this group, may be associated with hyperfocusing and local bias. Personality, then, may be found to mediate individual differences in spatial focus and influence performance in capture cost paradigm.

Cannabis-Induced Psychosis of Adults with Cannabis Exposure in Adolescnce
Lauren Moment, *Biomedical/Health Sciences*
Mentor: Jonathon Shaffer

Abstract:
Cannabis exposure has garnered increased attention, particularly with the decriminalization of exposure. The consequences, particularly among adolescents and young adults, is not clearly understood. Thus, the purpose of this literature review is to amalgamate the literature relating to the acute and persistent effects of cannabis use and synthesize its associations with psychotic disorders, particularly schizophrenia.
Over 20 million Americans are current users of cannabis. Approximately 8.6 million were 13 and 18 years of age. Cannabis is typically viewed as an innocuous drug with many high school seniors polled believing consistent exposure is harmless, compared to about 20% who held this view in 1990. This is concerning to biomedical professionals due to the neuromaturational aspects of the adolescent brain. The adolescent brain is believed to be particularly vulnerable to the adverse effects of exposure. In current literature, cannabis use has been concomitant with psychiatric illness including the psychotic symptoms of schizophrenia, particularly with early onset of cannabis exposure. This correlation between cannabis use and psychiatric illness is not, however, clearly

known, with unpredictable and even paradoxical findings. In this review, I will assess the acute effects of cannabis followed by a review of the fixed effects of cannabis in association with psychosis.

Childhood Trauma in Serial Killers: A Case Study Meta-Analysis

Brook T Langmaid, Christian J, Sybil A Towner, Lupita Y Kappert, *Social Sciences*
Mentor: Patricia Zornio

Abstract:
The purpose of this study is to contribute to current literature exploring the motivations, demographics, and patterns associated with serial homicide. The present study provides a focused meta-analysis, specifically assessing childhood trauma in individuals that were active in the United States within the previous century. Much has been theorized and observed, allowing researchers to distinguish certain typologies, experiences, and extended factors that contribute to an individual being capable of serial homicide (Miller, 2014). The current meta-analysis provided understanding between childhood trauma and the way it may present itself in serial homicide cases, revealing that over 85% of the sample had experienced some subtype of childhood trauma. The information gathered could potentially be applied to future investigations of serial murder, or may be utilized by various agencies to benefit public and domestic safety.

Chronic synthetic cannabinoid administration may produce tolerance to the dopamine releasing effects of heroin

Thomas J Everett, Ryan P Leman, Hendrick Lopez-Beltran, *Biomedical/Health Sciences*
Mentor: Dr. Erik B Oleson

Abstract:
Overdose deaths involving opiates have increased 4 fold over the last two decades (NIDA, 2020). Many have sought to elucidate the underlying neural mechanisms of opiate addiction and the factors which increase susceptibility to the addictive process. All drugs of abuse are thought to increase a neurotransmitter called dopamine. Our lab uses fast-scan cyclic voltammetry to measure subsecond dopamine release events in the nucleus accumbens shell of rats during intravenous (IV) heroin administration.These release events are necessary and sufficient for drug-induced neural plasticity (Oleson and Roberts, 2019). We recently found that repeated self-administration results in a blunted ability of heroin to evoke transient dopamine release events, accompanied by an increase in daily consumption. Our lab has also observed that the synthetic cannabinoid WIN 55,212-2 produces tolerance to its dopamine releasing effects (Gomez SFN, 2017). Reports show that the use of cannabinoids, and hospitalizations related to cannabinoid use, have been growing (Zhu, 2017). Additionally, cannabinoids and opiates are known to produce cross tolerance to some of their shared neurobehavioral effects, i.e. hypothermia, sedation, and antinociception (Manzanares, 1999). Based on this, we sought to investigate whether exposure to cannabinoids produces a cross tolerance to heroin,Äôs ability to increase dopamine. Following a period of chronic synthetic cannabinoid exposure we administered heroin and measured dopamine release. Preliminary data indicate that cannabinoid exposure may lead to lower initial dopaminergic activity, and a blunted response to heroin. These findings support that synthetic cannabinoid use may increase susceptibility to the development of heroin addiction.

Citric Acid Titration Experiments

Emily Mary Irlbeck, *Biomedical/Health Sciences*
Mentor: Ellen P Broering

Abstract:
As part of the Honors General Chemistry II lab, the most efficient source way to consume vitamin C was determined. The four sources examined were lemon juice, lime juice, EmergenC, and vitamin C tablets. The hypothesis was that the sources with less added ingredients would have higher concentrations of citric acid (vitamin C). A method of direct titration with sodium hydroxide was used to calculate the molarity of the acid. This process enabled the observation of the end point which is close to the equivalence point (when there are three moles of base to one moles of acid present). The indicator, phenolphthalein, was used to approximate the equivalence point with its color change at the end point from clear (occurs in acid) to pink (occurs in base). To determine the end point precisely, many trials were performed until they were within 0.01 M from the other trials for that source, which was calculated from their net sodium hydroxide volume used. When testing the EmergenC, it was boiled before it was titrated so the dissolved carbon dioxide precipitated out of solution. This allowed for a more accurate titration, because then the sodium hydroxide would only neutralize the citric acid present rather than also neutralizing the carbonic acid. The carbonic acid was formed from carbon dioxide and water reacting in solution. After testing the sources, lemon juice was determined to be the most effective source of vitamin C. Then the order followed with lime juice, vitamin C tablets, and EmergenC.

Cold tolerance of the apple maggot fly and its parasitoid wasps
Lalitya Andaloori, *Natural Sciences*
Mentor: Gregory J. Ragland

Abstract:
The constant conflict between hosts and their parasites, often resulting in evolutionary arms races, has generated much of the earth‚Äôs biodiversity. Thus, understanding how species co-evolve can provide insight into how biodiversity is generated. One model system for co-evolution is the fly Rhagoletis pomonella (an apple pest) and its endoparasitoid wasps, Utetes canaliculatus, Diachasmimorpha mellea, and Diachasma alloeum. However, we know little about how these organisms survive overwintering conditions, which might be crucial in understanding how they adapt to their environment. We therefore investigated the cold tolerance of the overwintering stage of these parasitoids (wasp larvae) and their host (fly pupae). Wasp larvae and fly pupae froze at a similar temperature (c. -19 ¬∞C), and did not survive freezing but did survive cooling for short time periods to temperatures above -19 ¬∞C. Many fly pupae and wasp larvae were able to complete development to the adult stage after prolonged periods (8 weeks) of mild chilling (4 ¬∞C). This suggests that R. pomonella and its endoparasitoids have similar cold tolerance. However, the current results do not distinguish between the three wasp species, largely because they look extremely similar at the larval stage. Future work needs to be done to distinguish these individuals genetically, by extracting their DNA and using PCR to amplify products unique to each species. This work will ultimately determine if cold tolerance varies among the three wasp species, providing insight into how this complex parasitoid system co-evolved, with potential implications for insect pest management.

Colorado CASAs Effect on Case Length and Parent Engagement for Abuse and Neglect- Preliminary Study and Literature Review
Isaac J. Sargent, Jessica, Luz Mills, Ashya Silva, *Social Sciences*
Mentor: Dr. Patricia Zornio

Abstract:
Children in dependency and neglect (D&N) cases often get resolutions from the court that do not address all their needs. In Colorado, the Office of the Child‚Äôs Representative (OCR) and the Colorado Supreme Court identify

increased length of cases when there is a lack of parent engagement as a significant barrier to children in D&N cases receiving the most beneficial outcome. Court Appointed Special Advocates (CASAs) have been used in the past to address complex issues that the formal court system does not have the resources or access to address. Past studies in other states have mixed results on whether CASAs are reducing the time a D&N case is open. Interviews of two Colorado Guardians ad Litem (GALs) and a Colorado parent attorney were collected to explore the idea of CASAs effect on case length and parent engagement. According to the interviews, Colorado GALs believe overall CASAs have the potential to influence such factors but like the reports, have mixed feelings about the efficacy of CASAs on these factors. Based on these results, Colorado CASAs could benefit from training to better address case length and parent engagement.

Communicating Social Sustainability with Creative Solutions on Auraria Campus

Jessica M. Diaz, Ashley (Ash) Ontiveros, Chelsea Minter-Brindley, Emily Weincek, *Arts and Humanities*
Mentor: Maria E. Buszek

Abstract:
Creativity has been a universal method of communicating ideas differently for centuries, and as a design student who is passionate about sustainable development, it is my responsibility to generate creative solutions to societal problems. Sustainability is generally understood and accepted as an environmental and ecological concept. From a more holistic lens, sustainability means an equal balance of environmental, economic, and social equity, with the most potential for growth lying within the social realm.
My project is comprised of two parts presented together in one digital presentation. The first involves the curation and design of an art exhibition titled The Future of Now: Contemporary Art in Our Unsustainable World, selected from an open call on campus and the city. The work highlights the intersections of sustainability with a diverse display of film, music, and visual arts. Artists responded to what sustainability looked like to them. They tied their work to an aspect of social sustainability, proving that any development can have social implications.
The second design solution will be presented at the 2020 Bachelor of Fine Arts Thesis Exhibition. It will answer the design research question: "How might the principles and techniques of branding be used to alleviate the stigma of shame in order to encourage food-insecure college students at CU Denver to increase their use of the university's food pantry?" The question investigates the problem of college food-insecurity, an issue of equity that disproportionately affects members of college communities who are people of color, international, first-generation, and single parents. Bringing awareness to, and presenting solutions for sustainable development can increase the number of people contributing towards long-term sustainable goals. It is time to prioritize people in our communities.

Communication Between Teachers and Students Analyzed Based on Age Cohorts Resulting in Modified Communication Patterns

Justin Shrader, *Social Sciences*
Mentor: Tamara Powell

Abstract:
Student success academically, socially, and psychologically is the concern of teachers around the country, but few studies investigate the changes in communication between teachers and students based on age cohorts. While research exists that demonstrates the impact of positive teacher-student relationships, on the three mentioned categories, communication scholars have yet to analyze age cohorts and the extent of their influence on these communication episodes. In an attempt to begin to fill in this gap, a conceptual literature review was conducted on Social Identity Theory and Communication Accommodation Theory literature relating to age. The

conclusion showed that generally people of different age cohorts use divergent and convergent language to distance themselves or draw closer depending on the extent of identification with their age cohort, and the positive or negative view they hold of the other age cohort. Further research should apply these findings to the high school setting to analyze how age effects teacher-student communication and how communication could be improved.

Competition for Neural Resources Between Perception and Memory May Depend on the Type of Working Memory Task Used

Mauricio Garcia, *Social Sciences*
Mentor: Carly J. Leonard

Abstract:
Previous cognitive studies have suggested the task of visual-spatial perception may pull from the same neural resources as that of working memory in humans. Visual-spatial perception refers to our ability to perceive objects in the world around us using our sense of vision, while working memory refers to our short-term memory and the mental work involved in its maintenance. We suggest there may be a natural competition that exists for the finite and shared resources between these two mental features. Our laboratory had formerly shown some evidence for the existence of this relationship as trials with more eye movements during memory maintenance had lower performance on the working memory task. However, a second experiment which was conceptually similar but used a different type of working memory task, was unable to securely replicate this competition. Better understanding this competition would help us define its boundaries and rules. Using data from two separate working memory tasks on the same subjects, we now seek to clarify whether or not the different types of visual working memory tasks used in these two experiments are actually measuring the same construct. With statistical modeling and analysis, we will be comparatively assessing the performance of each participant across both tasks. Our working hypothesis is that performance in one task does not correlate with performance in the other because they involve different forms of working memory and perception.

Credentials for Sale

Leah M Nordlund, *Social Sciences*
Mentor: Dr. Jennifer A. Reich

Abstract:
Emotional Support Animals (ESAs) have become more frequently used and thus have become controversial. Individuals‚Äô rights to have ESAs are protected under the Fair Housing Act as well as the Department of Transportation, which allow ESA owners to have these animals in their housing and on airplane flights. These animals do not need to be trained to provide specific skills; however, the owner must have a note from a therapist documenting the benefit to them from the use of the animal. However, many owners find that marking their animal offers legal protection. As a result, many websites claim that, for a fee, they can register and/or certify ESAs, despite that this is not legally required in order to have an emotional support animal. Some websites even sell therapist notes over the internet, which are required but are not legitimate without a psychological exam and diagnosis. Our research is centered around finding and analyzing common rhetoric used to promote ESA items sold on websites. We used keywords and phrases including ,'ESA,' and ,'Emotional Support Animal,' on search engines and cataloged the top twenty sites shown. This allowed us to see repeat websites under different search terms. After finding websites with consistent results in our search, we examined the content on the websites as well as the products they sold in order to understand the logic these sites use. We show how sellers promise legal legitimization that does not exist, how they commodity disability, and how vendors posit that individuals are entitled to bring animals with them even when said individual does not suffer from a disability.

CU Denver: A Multi-Criteria Assessment of Guided Energy Efficiency
Briley L. Manzanares, *Social Sciences*
Mentor: Rafael Moreno-Sanchez

Abstract:
University of Colorado at Denver is constructing a first-year student housing on campus; which in contrast, is subtracting from the urban areas,Äô green space and subjectivity may challenge sustainable performance. Denver,Äôs Auraria Campus has administered sustainability through natural and physical resource strategies to urge conservation of all the resources used on campus. Within this research, energy use intensity of all campus buildings will be related to each unit of floor area. The campus will be rated using the Sustainable Tracking, Assessment and Rating System (STARS) administered by the Association for the Advancement of Sustainability in Higher Education (AASHE). The hosts of this campus are CU Denver, MSU Denver and CCD. The efforts of energy efficiency in buildings across Auraria Campus have been gaining effort to become ,'net zero,' buildings. In the event of this construction on-campus, there is persistence to develop long term trends of sustainability based on mathematical methods and multi-criteria assessments such as STARS. The campus is restricted to its urban surroundings, growing in population and units of floor area, and requesting attention for sustainable action. STARS is used to evaluate the campus,Äô annual site energy consumption compared to the minimum performance threshold per gross square foot and per Fahrenheit degree day, as well as the reduction of total source energy consumption.

Deforestation and Global warming
Mahlet D Haileyesus, *Natural Sciences*
Mentor: Christy Briles

Abstract:
This research is a literature review and offers insight on how deforestation impacts global warming. Trees are a source of carbon storage and live hundreds to thousands of years and carbon is absorbed from the atmosphere using the process of photosynthesis.
Deforestation is the second leading cause of carbon dioxide release, accounting for ~24% of all greenhouse house gases released. The Amazon rainforest fires in South America is one recent example of deforestation.
Deforestation is happening around the world
by burning and cutting down trees which is one of main causes of the greenhouse gas effect. Further research serves to explore how to fight the future risk of global warming by establishing reforestation to rebuild degradation forests.

Deleting the CXCL10 gene in-vitro using CRISPR.
Nicholas N. Rotello Kuri, *Biomedical/Health Sciences*
Mentor: Jing H. Wang

Abstract:
Gene editing is the targeted modification of an organism¬¥s DNA. CRISPR-Cas9 technology utilizes the enzyme Cas9 to bind to gRNA in order to cut a specific region of DNA. This cutting allows for the deletion, or ,'knock out,', of a gene. The gRNA spacer is responsible for targeting the DNA sequence being edited, and the gRNA scaffold is

what will bind to the Cas9 enzyme. Once the gRNA spacer is attached to the targeted sequence, and the gRNA scaffold attaches to Cas9, only then will Cas9 proceed to cut the double-stranded DNA and delete the gene. CXCL10 is a gene responsible for making proteins (chemokines) that help immune cells (CD8 T-Cells) find tumors in our bodies. In order to test the functionality of the gene CXCL10, the gene was deleted in A20 B-cell lymphoma cells to see the difference in chemokine production and T-cell migration between wild type and knock out mice. Before proceeding to in-vivo experimentation, the gene was deleted in-vitro. First, a plasmid was created with both the target gRNA strands and the Cas9 protein. Then, E. coli was transformed for DNA cloning of the plasmid. Lastly, A20 cells were transfected with the plasmid DNA and tested for gene knock-out. The transfected cells were tested for deletion of CXCL10 by using PCR and DNA sequencing. The cells were found to be missing CXCL10, and further in-vivo experimentation will follow to observe the functionality of CXCL10.

Derivative-Free Optimization and Active Subspaces in Inverse Problem Theory

Jordan R. Hall, *Technology, Engineering, and Mathematics*
Mentor: Dr. Varis Carey

Abstract:
We present numerical results from solving a Stochastic Inverse Problem (SIP) in a data-consistent fashion using novel optimization approaches involving Derivative-Free Optimization (DFO) and Active Subspaces. Since the objective functions used to solve SIPs typically involve a noisy model with a high-dimensional input space, gradient approximation becomes expensive; hence, we consider DFO methods. The high-dimensional input space may be reduced to resolve the model more cheaply, allowing for more efficient computations, such as optimization problems involving the model. We use a novel method to perform the optimization needed to solve a SIP which is numerically more efficient in certain cases. We perform Data-Consistent Inversion (DCI), which ensures that the solution to our SIP will only be updated in the directions uniformed by data; in the directions informed by data, the updated density (i.e., the solution to the SIP) will be a push-forward measure, in the sense that one may evaluate the updated density through the model and recover the observed density in data space. We present numerical results for a SIP posed involving a linear model with Gaussian initial and observed densities tied to real-world applications.

Determining the effect of Polyfluorinated alkyl substances (PFAS) on hepatic and gonadal structures in exposed organisms

Hosbaldo Morales, *Natural Sciences*
Mentor: Alan Vajda

Abstract:
Paige Friedentag^1, Hosbaldo Morales-Murillo^1, Nour Awad^1, Larry Barber^2, David Bertolatus^1, Jeramy Jasmann^2, Denis Le Blanc^2, Andrea Tokranov^2, Elsie Sunderland^3, Heidi Pickard^3, and Alan Vajda^1
1: University of Colorado Denver, Department of Integrated Biology, 2: United States Geological Survey, 3: Harvard University
Polyfluorinated alkyl substances (PFAS), a group of anthropogenic chemicals, were created in the 1930s and are used in both commercial and industrial product production. They are known to bioaccumulate in the environment and, due to their structure, are not suitable for metabolism, thus making PFAS prevalent in exposed organisms. Fathead minnow were exposed to PFAS for 21 days and then dissected, tissue samples were collected and assessed for PFAS exposure damage. The goal of this experiment is to determine the effect PFAS has on hepatic and gonadal structures in exposed organisms. Fathead minnow tissues were collected in 2019. The gonads and livers were embedded in paraffin wax and sectioned on to histology slides in order to analyze the structures from

the exposed organisms. Currently, the stains that are being used are hematoxylin and eosin. Hematoxylin is a stain that attaches itself to nucleic acids, while eosin is a stain that attaches itself to the cytoplasm, by using these stains I am able to see the cellular structures of the exposed organism. The histology slides are then scored on the severity of cellular disruption observed in the sampled tissue. The results from this experiment will aid in the development in furthering our understanding of how PFAS exposure effects exposed organisms.

Discovering if the Physical Activity Level of Fathers Correlates with Relationship Quality During the Transition to Parenthood.

Grant R. Morales, Sydneyjane, Roberts, *Social Sciences*
Mentor: Dr. Krista W. Ranby

Abstract:
The importance of physical activity and positive health management is critical, especially during a major life change such as the Transition to Parenthood (TTP). Regular exercise has many benefits for both parents during the TTP, including the reduction of stress, increased cognitive functioning, emotion regulation, decreased risk of chronic health conditions, and the promotion of positive health behaviors. Additionally, within pregnant couples, the father may be a strong source of social support for their pregnant partners that provides a greater life adjustment for the couple. Importantly, there is a lack of research pertaining to the influences that fathers have in a heterosexual partnership regarding the overall relationship quality.Our objective is to discover whether or not the father can strongly increase the relationship quality during TTP while maintaining healthy levels of physical activity. The father,Äôs amount of exercise may be correlated with each partner,Äôs rating of the relationship, and due to the possibility of this association changing during this adjustment, we measured this correlation multiple times. In this study, 43 pregnant couples wore a Fitbit Flex 2 activity tracker and the participant,Äôs physical activity levels were monitored at the start of their first trimester until six months postpartum. Additionally, the participants completed consistent surveys with five different time points at 12 weeks, 24 weeks, and 36 weeks gestation, and 6-weeks and 6-months postpartum. The aim is to promote an understanding regarding the positive outcomes that a father can contribute to a couple,Äôs overall well-being by maintaining a healthy activity level.

Disparities in dangerousness: Quantifying differences in threat across race and mental health status groups during police lethal force events

Kate V Fitch, *Social Sciences*
Mentor: Audrey E. Hendricks

Abstract:
Research on police use of lethal force has shown that people with mental illness, particularly those of color, are more likely to be killed by police than people without mental illness and are less likely to be armed with a gun when killed. This research assesses whether situation-specific threats beyond weapon type help explain increased lethal force in these populations.
Subject names, incident dates, and locations were gathered for N = 1114 police lethal force events in the United States in 2018 from the Washington Post Police Shootings and Fatal Encounters databases. Area news reports were used to collect data on situation-specific threats like time, location type, and threats or violence. Data were scored based on association with police injury in previous research producing a threat score (6 to 54) for each event. Mean scores were compared for subjects with and without signs of mental illness (MI and NMI) across the entire sample and in subsamples of reported race using independent t-tests. Secondary analysis reclassified MI to include only events known to be mental health crisis before contact.

Preliminary results suggest that lethal force events involving mentally ill people and people in mental health crisis are less threatening to police even when considering a variety of factors beyond weapon type. Threat score disparities appear to be larger in people of color, especially Black subjects in crisis, suggesting that interventions addressing disparities in lethal force should be especially focused on this population.

Do Eye Movements Reinforce Memory Recall?
Jeremiah Hartzell, *Biomedical/Health Sciences*
Mentor: Carly Leonard

Abstract:
People often move their eyes when trying to access their long-term memory. This phenomenon has been researched before and is known as ,'looking at nothing.,' When faced with visual information (such as text or videos) in specific locations during a memory encoding phase, participants looked more at the quadrants where the items were initially associated when tested later. This research affects how we understand the mental processes of recall, as well as teaching and training pedagogy. By knowing other mechanisms that contribute to information recall, we can better improve academic testing. While looking-at-nothing occurs for memories encoded at a conscious level, we believe that it can also occur at a subconscious level. We will have participants perform a central task that occupies their attention, and surprise them with pictures unrelated to their task on either the left or right side of the monitor. After a filler task, we will test them on memory for these pictures. The goal is to test the looking-at-nothing phenomenon while the participant is distracted to see if this theory holds true. We predict that the placement of the objects in the testing phase will influence whether they report if they previously saw the picture. We also predict that they should be able to recognize it faster when it is in its original location. Finally, we predict that if the testing phase image is not in the same position as in the encoding phase, the participant will look at where they originally saw the image.

Does Prenatal Stress Affect Postpartum Depression of Mothers with a GG OTXR Genotype?
Victoria L Beresford, *Social Sciences*
Mentor: Dr. Lindsey Hamilton

Abstract:
Oxytocin is a neurotransmitter and a hormone that modulates social and emotional behaviors linked to bonding and empathy. Research in the field has indicated that individuals carrying a G allele on the rs53576 gene, which codes for the oxytocin receptor (OXTR) genotype, may be more adept at inferring the mental state of others and managing levels of stress. However, other sources have indicated that individuals carrying the G allele may be more susceptible to higher rates of depression and antisocial behavior. Unfortunately, these conflicting results could lead to further issues for mothers experiencing prenatal stress, as the interaction between the environment and the mother,Äôs OXTR genotype could influence the attachment between the mother and her new infant. In this study, I will address the conflicting research by conducting a literature review to determine if mothers carrying a G allele on the rs53576 gene will be more susceptible to prenatal stress in their environment, and if prenatal stress moderates the severity of the mothers,Äô postpartum depressive symptoms. For new mothers carrying a G allele on the rs53576 gene, it is important to determine the effects the OXTR genotype has on bonding between the mother and the infant in order to ensure the best outcomes for the mother and the child. In the future, these research findings should be referenced in order to identify the best supportive measures for mothers in stressful environments and for mothers experiencing postpartum depression.

Dynamics of the Villin Headpiece Protein,Äôs Subdomain HP-36 : Effects on Energy Barriers by Hydration Levels

Tanja Kovacevic, Jillian, Oviedo, *Natural Sciences*
Mentor: Hai Lin

Abstract:
Hydrophobic cores are sites of complex protein folding and misfolding patterns, and they often define protein stability and folding overall [1]. A protein subdomain of the protein villin, headpiece-36 (HP36) is a convenient model system to study the hydrophobic core interactions and dynamics due to its small size (36 residues) and cooperative folding. Here, we study the molecular dynamics of HP36 in the solid powder state, with the focus on the dynamics of three phenylalanine side-chains, F47, F51, and F58 belonging to the hydrophobic core under different (100%, 40%, and 10%) hydration levels. We attain the potential mean force (PMF) for the chi2 dihedral angle that is important to the side-chain rotations of these phenylalanine side-chain. The rotations are computed via umbrella sampling, a type of biased molecular sampling which provides implications on the plasticity and rigidity on hydrophobic core dynamics. From the PMF graphs, the free energy for ring flipping is determined for each phenylalanine side chain within the hydrophobic core. These results are compared to experimental, solid-state NMR data obtained by Dr. Vugmeyster,Äôs team [2].
[1] Vugmeyster, L.; Clark, M. A.; Falconer, I. B.; Ostrovsky, D.; Gantz, D.; Qiang, W.; Hoatson, G. L. Journal of Biological Chemistry 2016, 291 (35), 18484,Äì18495.
[2]Vugmeyster L.; Ostrovsky, D.; Villafranca, T.; Sharp J.; Xu, W.; Lipton, A.S.; Hoatson, G. L.; Vold, R. L. The Journal of Physical Chemistry B 2015, 119 (47), 14892-14904

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Jillian Oviedo, Tanja Kovacevic*Natural Sciences*
Mentor: Hai Lin

Abstract:
Hydrophobic cores are sites of complex protein folding and misfolding patterns, and they often define protein stability and folding overall. A protein subdomain of the protein villin, headpiece-36 (HP36) is a convenient model system to study the hydrophobic core interactions and dynamics due to its small size (36 residues) and cooperative folding. Here, we study the molecular dynamics of HP36 in the solid powder state, with the focus on the dynamics of three phenylalanine sidechains, F47, F51, and F58 belonging to the hydrophobic core under different (100%, 40%, and 10%) hydration levels. We attain the potential mean force (PMF) for the chi2 dihedral angle that is important to the sidechain rotations of these phenylalanine sidechain. These rotations are computed via umbrella sampling, a type of biased molecular sampling which provides implications on the plasticity and rigidity on hydrophobic core dynamics. These results are compared to experimental solid-state NMR results produced by Dr. Vugmeyster,Äôs team.

Educational Outcomes in Foster Children & Intervention Strategies

SM Meichtry, *Social Sciences*
Mentor: Joan T. Bihun

Abstract:
Foster children in today,Äôs society face many barriers to success with one of the most prevalent being a failure to thrive in academic settings. One of the original goals of the system was a focus on housing and

educational services but in the current system there seems to be a lack of support for educational achievement for children in the foster care system. In elementary school, children in the foster care system struggle to do as well on standardized tests and generally exhibit more problem behaviors than children in the general population. Later in life, studies have shown that foster children experience lower rates of high school and college graduation and in more severe cases lack of employment. This literature review aims to explore some reasons why foster children struggle with academic success and aims to present effective interventions for educational goals. The end of the paper will also include a professional development plan for primary grade teachers (K- 3) which will outline best classroom practices and strategies supporting children in foster care struggling with behavioral problems.

Effect of High-Altitude Residence on Placental Trophoblast Invasion of Maternal Spiral Arteries

Kori Baker, *Biomedical/Health Sciences*
Mentor: Lorna G Moore

Abstract:
Vascular disorders of pregnancy, including preeclampsia and intrauterine growth restriction (IUGR), are important public health issues due to their association with increased perinatal and later-in-life morbidity and mortality. Preeclampsia and IUGR are more common and uterine artery blood flow reduced at high altitude (HA, >2500m) compared to lower altitudes (LA) in Colorado. Extravillous trophoblast invasion is critical in the establishment of uteroplacental blood flow and is reduced in IUGR and preeclamptic pregnancies. We hypothesize that residence at HA also reduces extravillous trophoblast invasion. To test this hypothesis placental samples were collected at term delivery from healthy women residing at LA (<1700m) and HA in Colorado. Placental sections collected from 14 LA and 15 HA were selected for analysis based on the preservation of (maternal) decidual tissue and the presence of spiral arteries. Placental sections were cut, oriented on slides and triple stained using the antibodies for maternal vascular endothelium (CD31), maternal vascular smooth muscle cells (ÔÅ°-smooth muscle actin), and fetal trophoblast cells (cytokeratin 7). To quantify trophoblast invasion, our ongoing analysis evaluates the extent to which extravillous trophoblasts have replaced decidual endothelial and smooth muscle cells of the maternal spiral arteries. For these analyses, trophoblast invasion is quantified in three regions of the decidua: the most proximal 25% portion (closest to the placental villi,) the middle 50%, and the most distal 25% region. We expect that trophoblast signals will be reduced in HA women in the most distal region, and to a lesser extent in the middle and proximal regions.

Effect of Serotonin on Mating Success in Male Teleopsis dalmanni

Emily Scott, *Natural Sciences*
Mentor: John Swallow

Abstract:
Successful mating is one of the most important behaviors to a species survival. Neuronal components, such as monoamines, that mediate whether a pair successfully mates or not are often overlooked in invertebrates such as Teleopsis dalmanni. Some monoamines that already have been implicated in reproductive behavior are dopamine and octopamine, but serotonin (5-HT) has not been fully examined. We designed a study to explore the hypothesis that an increase in 5-HT in males would lead to an increase in successful mating attempts, as it increases aggressive behaviors between males. Female and male T. dalmanni were isolated for four days while being fed 5-HTP, a precursor to 5-HT, or control food. Flies were then randomly paired and allowed to interact for 20 minutes in an arena while their behaviors were recorded and scored. Males attempted to mate with females more when given 5-HTP (95% CI control 0.56-1.38, 5-HTP 2-3.75). Males also were more active when given 5-HTP and increased frequency of parallel (95% CI control 2.11-2.96, 5-HTP 3.19-4.61) and alternate arm waves (95% CI control 1.10-

1.51, 5-HTP 4.21-6.23) and chasing the female (95% CI control 0.25-0.71, 5-HTP 2.22-4.00), but did not alter abdomen bobs (95% CI control 2.71-4.54, 5-HTP 2.37-3.63). 5-HT plays a significant role in mating behaviors and alters behaviors that could lead to reproductive success.

Effects of Makeup on Perceived Personality Traits and Friendliness in College-Aged Women
Laura K Seaton, *Social Sciences*
Mentor: Peter Kaplan

Abstract:
Research has shown that visual aspects of a person,Äôs face are correlated to first impression judgments regarding personality characteristics. One visual aspect commonly studied has been makeup and its impact on perception of various traits in females including attractiveness, leadership ability, and warmth. It is also known that characteristics such as these are important in forming friendships. In progress is a literature review that seeks to determine if the amount and type of makeup a female wears affects judgments about whether she would be a good friend and why this might be. It seeks to evaluate not only how makeup affects judgement of personality traits, but how it moderates perceptions of threat and jealousy in other females.

Efficiency and Selectivity of RNAse A Cleaving RNA Containing 8-oxo-7, 8-dihydroguanosine.
Cheyenne Phillips, *Natural Sciences*
Mentor: Marino Resendiz

Abstract:
Oxidation of RNA has been linked to the development/progression of neurodegenerative diseases and other muscular atrophies. However their exact relationship in a biochemical context is not known, i.e., intracellular handling. Guanosine may lead to 8-oxo-7, 8-dihydroguanosine (8-oxo-G) under oxidative stress and this lesion is, arguably, one of the most abundant/important outcomes of such oxidation reactions. We are interested in studying the effect of ribonuclease activity on oxidized RNA in order to gain a better understanding on the impact that this lesion has on biological systems. Specifically, this research focuses on the activity of bovine pancreatic ribonuclease, RNase A, towards strands of RNA containing 8-oxo-G. Previous work from our lab has shown that RNase A recognizes and cleaves single strands containing 8-oxo-G, while it does not recognize guanosine. It was determined that RNase A cleaves with the following selectivity C > 8-oxo-G > U. This research will determine the efficiency to which RNase A cleaves at these positions. Dodecamers (AGA AGG XAG AAG; X=C, U, and 8-oxo-G) of RNA are being used as models to explore the reactivity in single stranded RNA. Steady-state kinetics were obtained by plotting Hanes-Woolf relationships carried out by measuring the cleavage efficiency as a function of RNase A concentration. The second stage focuses on RNAse A,Äôs efficiency toward C, U, and 8-oxo-G in other structural contexts, i.e., bulges, hairpin loops, and internal loops. The goal is to use RNAse A to probe for the structural impact that 8-oxo-G has on secondary and tertiary structures of RNA.

Efficient Estimation of Hidden Ancestry Substructure in Summary Genotype Frequency Data
Ian S. Arriaga MacKenzie, Gregory M. Matesi, Alexandria Ronco, *Technology, Engineering, and Mathematics*
Mentor: Audrey E. Hendricks

Abstract:
Modern genomic research has advanced at a rapid pace, resulting in ever-expanding online genetic databases. Some of the data has heterogeneous ancestry, such as the African/African-American group within the Genome Aggregate Database (gnomAD). Lack of precise ancestry information can lead to confounding in association studies and incorrect prioritization of putative causal variants. Ancestry differences between the database and a user,Äôs sample limits the utility of the database especially for heterogeneous or understudied ancestral groups such as Latinx populations.
We present a method to estimate the proportion of reference ancestry groups within these genetic databases. Our method uses sequential quadratic programming to estimate the mixture proportions in seconds and enables us to estimate error for the ancestry proportion estimates. We use the estimated ancestry proportions to update the database,Äôs expected allele frequency to match the ancestry of the user,Äôs sample, increasing the utility of these genetic databases.
We evaluate our method in thousands of simulation scenarios and in real data using a reference panel that includes 1000Genomes super-populations (non-Finnish European, South Asian, East Asian, and African) and Indigenous American ancestry. Across all simulation scenarios, we obtain ancestry proportion estimates with 0.05% accuracy and precision. Within the gnomAD African/African-American group we estimate 82.49% African, 15.66% European, 0.84% Indigenous American, 0.51% South Asian, 0.50% East Asian. We then use these ancestry estimates to provide updated allele frequency estimates for 100% African gnomAD ancestry to allow for better use of this genetic resource for African samples.

Estimating Altitude of Drones Using Batteries

John Pace, Liang, He, *Technology, Engineering, and Mathematics*
Mentor: Liang He

Abstract:
With the rise of drone technology, both new possibilities and new problems are presented in an expanding variety of applications. One such application is the use of drones to establish temporary mobile networks over a small area in the event of a catastrophe or environmental disaster, however this requires establishing the location of a drone without GPS data or other location sensors. In such cases, external battery readings may be used to characterize drone behavior and predict its location. The focus of this research study is to determine what classifications or predictions of drone flight behavior may be made using external battery readings alone, and to estimate the drone,Äôs location using these metrics.
In this study we analyze battery metrics collected from an external microcontroller attached to the drone,Äôs battery and compare this information against sensor data contained within the drone,Äôs internal flight logs. Using externally collected cumulative battery current data alone we were able to classify the flight state of the drone as being in takeoff, hovering, ascending, or descending. We have also developed programs that predict the altitude of the drone based off this data, using both a formulaic approach and with machine learning.

Estrous Cycle Modulation of Fear Extinction and Relapse

Aleezah Balolia, Kelsey Bonar, Alyssa Hohorst, Margaret K. Tanner, *Biomedical/Health Sciences*
Mentor: Benjamin N. Greenwood

Abstract:
Women are at a higher risk than men to develop common stress-related psychiatric disorders such as post-traumatic stress disorder (PTSD). Similarly, to humans, female rats experience a 4-day estrous cycle during which the fluctuation of ovarian hormones can impact stress-related behaviors. We have shown that increasing DA

signaling in the nigrostriatal dopamine pathway (dopamine neurons in the substantia nigra projecting to the dorsal striatum) during fear extinction can reduce fear relapse. Females in the proestrous phase (Pro) have increased dopamine release in the striatum. We hypothesized that estrous phase influences neural circuits recruited during fear extinction and renders fear extinction memories resistant to relapse in Pro females. 24 Long-Evans rats were used in this study (8 male, 16 female). Female cycle progression was monitored daily. All subjects underwent auditory fear conditioning. The following day, subjects were exposed to fear extinction training. 24 hours later rats were re-exposed to the conditioned tone in either the same or a different extinction context to test for renewal of previously extinguished fear. A week later, rats were placed in their original extinction context and tested for spontaneous recovery of fear. Preliminary results suggest that estrous phase of females during fear extinction can impact fear relapse. Females in pro-estrus during fear extinction had less renewal and spontaneous recovery compared to males rats and not Pro females. These data suggest that Pro females have increased protection of relapse following fear extinction, pointing to a possible mechanism of interest to support exposure therapy for PTSD.

Examining the linkage of science and adaptive management decision making: A Case Study of the Spruce Beetle Epidemic & Aspen Decline Management Response (SBEADMR) Program of the Grand Mesa, Uncompahgre, and Gunnison (GMUG) National Forest,Äô

Jordan M. Truitt, *Social Sciences*
Mentor: Rafael Moreno-Sanchez, Ph.D.

Abstract:
Within environmental management, many scientists claim that their input is ignored by decision-makers. Contrary, many decision-makers believe that the critical science for their decisions tends to not be readily or freely available to them or is not presented in a usable form (Liu, 2008). However, a strong link between the two is required for informed and adaptive resource management. Adaptive resource management is a structured and iterative process based on learning by doing to reduce uncertainty and better adapt to system changes. Within adaptive management, we learn through Monitoring Criteria and Indicators (MC&I) and engaging with stakeholders. Since 2012, Spruce Beetle outbreak and Sudden Aspen Decline (SAD) has affected the health of over half a million acres in the Grand Mesa, Uncompahgre, and Gunnison (GMUG) national forest in southwestern Colorado. To address the impacts, the U.S. Forest Service (USFS) established the Spruce Beetle Epidemic and Aspen Decline Response (SBEADMR) program to enhance the public safety, recovery, and resilience of the forest through an adaptive management framework. In order to answer the question, ‚ÄòHow is science linked to decisions in SBEADMR and what has been learned?‚Äô, I will be reviewing an abundance of documents and presentations from SBEADMR, attending a stakeholder meeting, and conducting interviews with USFS employees. This study will review how the science of stakeholder engagement and environmental and socio-economic monitoring in SBEADMR has been linked to management decisions, pre- and post-implementation. In addition, this paper will cover the main aspects of what has been learned through the SBEADMR process thus far. My research indicates that SBEADMR is an adequate example of linking science with decision-making as it focuses on promoting a clear and harmonious relationship between the two management components and will provide insight for other similar efforts.

Exploring a method to create a Master mix solution from its individual components to determine relative amplifications of genes

Jilla Chamanbahar, Harshith Alete, Nikhitha Kastury, *Biomedical/Health Sciences*
Mentor: Christopher Phiel

Abstract:
qPCR, or quantitative polymerase chain reaction is used to quantify RNA transcripts through the process of reverse transcribing them into cDNA. Throughout the process, gene expressions of a sample can be measured, as well as how much of a specific gene is present in your sample. In order to complete qPCR, a Master mix solution, probes, and cDNA is required. This Master mix solution is generally priced at around $300, dominating most of the budget for any lab that is dependent on the results of qPCR for their research. In order to decrease these costs, and streamline the activities of the lab, our research focused on creating a new solution that imitates the store bought Master mix solution by creating that solution by combining its individual components. By building off of previous research and data, we started with a template recipe for this Master mix and used the process of variable isolation to determine the optimal conditions and relative concentrations of each component. After determining the optimal concentrations of each component, the new homemade solution was tested against the original store bought Master mix to test accuracy and consistency of the homemade solution. Our solution would have been considered accurate and consistent if the homemade solution amplified and quantified gene expression at the same rates as the original store bought solution. We hope to continue our work in order to achieve this same rate that would qualify the homemade Master mix as accurate and consistent.

Farm-to-Future
Marcia M Maxson, *Social Sciences*
Mentor: Dr. Rene Galindo

Abstract:
This program evaluation study identified the dietary behaviors, agricultural knowledge, and job-readiness skills gained by all participants in JC's Journey Green Futures summer program for at-risk foster youth. This study followed a group of foster youth during their summer educational programming and evaluated the impact of the program on participants through qualitative data collection. Farm-to-Future evaluated the effectiveness of Green Futures educational programming for providing foster youth with job readiness training while at the same time promoting healthy eating and environmental/agricultural awareness. By performing an outcome evaluation, through pre-experience and post-experience surveys I was able to measure the impact of the program on the dietary behaviors, agricultural/environmental knowledge, and job-readiness skills of all participants. My presentation will highlight the key findings of my research and provide recommendations for further studies. Through a close examination of the "Green Futures" program other researchers will gain tangible steps for designing their program evaluation studies as well.

For All Races, Colors, Creeds, and Religions: Grace Lobach, Inclusive Spiritualism, 1920s-1930s
Elizabeth J Campbell, *Arts and Humanities*
Mentor: William Wagner

Abstract:
Madame Grace Lobach developed an interest in Spiritualism in the 1910s and 1920s, ultimately leading to her 1925 founding and leading of the Temple of Divine Brotherhood in Denver. Lobach,Äôs temple declared it ,'for all colors, races, creeds, and religions,' and its leadership and sermons were dominated by women from its founding to its decline and closing in 1934 during the Depression. At a time of prominence for the Ku Klux Klan in Colorado and the ascendancy of men in Christian religious leadership, Lobach,Äôs teachings were nothing short of radical and feminist. Through speaking with the dead, Lobach and her female followers gained power in their voices and challenged male establishments. Furthermore, Grace Lobach and her followers,Äô engaged with Eastern religion and spirituality,Äî including the pioneer of the popularization of yoga in America, Yogananda Paramahansa,Äî to

promote an inclusive and universal form of Christianity. This paper uses previously untapped primary sources from Lobach,Äôs family papers to add local nuance to the narrative of feminist Spiritualism and make connections to Eastern spirituality and religion.

Fostering Socio-Emotional Development in Early Childhood Education
Ellie McTigue, *Social Sciences*
Mentor: Cristina

Abstract:
Colorado Early Learning developmental guidelines have been created in order to foster a well-rounded positive experience of children in school. These guidelines outline the progression of the development and learning of children up to the age of eight. Within this path, there are many areas of development. The area that this paper focuses on is socio-emotional development. Socio-emotional development is important because it affects relationships and individual wellbeing, both of which have the power to affect other areas of life. For example, without a healthy socio-emotional development, educational development can also suffer. Development is continuous and constantly advancing, therefore, there are different guidelines for different age groups to ensure developmentally appropriate goals with positive outcomes are met. The age group of focus for this paper is three through five. The guidelines are stated to be researched-based, so the purpose of this review is to examine those guidelines and compare them to current research in order to assess if the most important findings have been embedded in the guidelines.

Galactic Rotation Curves: An Interactive Look at an Arfument for the Existence of Dark Matter
Kathryn Harris, Raphael Hatami, Judit Bergfalk, *Natural Sciences*
Mentor: Anthony Villano

Abstract:
,'The orbital velocities of matter in galaxies clearly signal the existence of dark matter.,' This is the stance of a large portion of the scientific community, but how can we really appreciate the reasons behind this statement and its implications? Our research focuses on understanding the mathematical modeling behind the orbital velocities of galactic matter. By comparing our models to real galactic data, we can visualize both how a model using only luminous matter falls short and how including dark matter might bring our estimations of the galactic orbital velocities into alignment with measured values. We make our results accessible through a computer application that allows people to observe this modeling first hand regardless of their own math or physics background. Tools like the one we present can help the general public understand and appreciate the concepts behind dark matter and reduce the barrier to entry for early-career scientists trying to learn more about dark matter.

Genes important for surviving low temperatures in Drosophila melanogaster: Validation of RNA interference
Joseph C Tucker, *Natural Sciences*
Mentor: Gregory J. Ragland

Abstract:
Low temperatures are challenging for many animals, especially insects, whose body temperature is similar to that of the environment. Many insects can survive low temperature exposures by modifying their physiology. However the genes that are important for surviving low temperatures are not well-characterized. The Ragland lab is testing

the function of genes in cold tolerance of Drosophila melanogaster fruit flies using RNA interference (RNAi) lines that knock down gene expression. The goal of my project was to validate this knock down for eight different genes, determining the relative abundance of RNA for each target gene in the RNAi lines. If RNAi is successful, RNA for a target gene should be absent or much less abundant compared to that target gene in a control line (without RNAi). For each D. melanogaster line, I extracted RNA from larvae (juveniles), adult males, and adult females. I treated these samples with DNase to remove contaminating genomic DNA, and then synthesized cDNA to use as a template in PCR. I tested primers that were designed to amplify the target genes using PCR. In future work, these primers and cDNA samples will be used in quantitative PCR, allowing us to determine relative RNA abundance for each target gene in RNAi and control lines. This project is important to ensure we can draw appropriate conclusions from experiments testing the effect of RNAi on D. melanogaster cold tolerance. Overall, this work contributes to our understanding of how genes contribute to the ability of insects to survive environmental stress.

Green Revolution: The Emerging American Hemp Market

Arturo Mireles, Todd Smith, Kevin Stanton, Jocelyn Solis, *Arts and Humanities*
Mentor: Marty Ota√±ez

Abstract:
Our documentary film is about how Hemp is a sustainable alternative for up to 50,000 products including; building products, fabrics and plastics, not just for CBD. Hemp has been used for a variety of products for thousands of years, yet there is still a stigma associated with it because of marijuana. European views toward hemp are much more progressive than that of the U.S. The hemp plant is beneficial for farmers, the environment and business. By focusing energy and resources towards research and developing products other than CBD, the U.S. can help build a more sustainable world.

Group B streptococcal surface adhesin protein promotes GBS interaction with cervicovaginal epithelium

Kristen J Jackson, *Biomedical/Health Sciences*
Mentor: Kelly S Doran

Abstract:
Streptococcus agalactiae, also known as Group B Streptococcus (GBS), is a Gram-positive bacterium that colonizes the reproductive tract of up to 30% of healthy women and can infect newborns. GBS is the main infectious agent of neonatal bacterial meningitis, resulting in 10-15% mortality. Bacterial meningitis is an infection of the central nervous system (CNS) that transpires following bacterial penetration of the blood-brain barrier (BBB). A surface protein on GBS, Group B Streptococcal surface protein (BspC) has been shown to facilitate adherence of GBS to the BBB, advancing meningitis progression.
Since it is known that GBS colonizes the female cervicovaginal tract, we explored the role of BspC in this environment. We infected human vaginal (VK2), ectocervical (ECT1), and endocervical (END1) cells with wildtype GBS and mutant strains lacking BspC and observed that ŒîbspC mutants exhibited a reduced ability to adhere to all three cell lines compared to the wildtype strain. This phenotype could be complemented by expressing the bspC gene on a plasmid in the ŒîbspC mutant strain. In silico sequence analysis of GBS clinical isolates showed that the presence of a complete bspC gene correlated with increased GBS adherence. Finally, using a murine model of GBS vaginal colonization, we observed that the ŒîbspC mutant strain was outcompeted by wildtype GBS and exhibited a decreased ability to cause ascending infection through the cervix and into the uterus. These results demonstrate the importance of BspC to GBS vaginal colonization and infection, and further suggest that BspC may represent an appealing therapeutic target.

Historical occurrence of intersex in Largemouth and Smallmouth Bass
Angela Geiger, *Natural Sciences*
Mentor: Alan M. Vajda

Abstract:
The widespread occurrence of gonadal intersex (presence of testicular oocytes) has been recently reported in populations of Largemouth Bass (Micropterus salmoides) and Smallmouth Bass (Micropterus dolomieu) from populations across North America. To evaluate the historical occurrence of intersex in bass species, gonads were examined visually and histologically from museum specimens of the bass collected from 16 States. These fishes were collected between 1823-1965, before the widespread discharge of estrogenic chemicals to surface waters via wastewater effluents. All females examined had normal ovaries. Intersex gonads were identified in 17.8 % of male Largemouth Bass, and in 14.2% of male Smallmouth Bass. The intensity of testicular oocytes in some males was as great as observed since 2000. These results indicate that the occurrence of this form of intersex in these bass species is not a recent phenomenon.

Hookup Culture and its Effects on College Student Self-Esteem
Lillian Taylor, Kasandra, Erin Orta, Kendall Tully, *Social Sciences*
Mentor: Patricia A. Zornio

Abstract:
Hookup behaviors are a relatively recent social phenomena unique to college age emerging adults. Hookups refer to a variety of casual sexual activities that may range from kissing to intercourse, and are distinguished by a lack of any conception of a commitment or emotional intimacy between the parties involved. The present study was conceived to examine the perspectives and attitudes of college students on hookups related to issues of self-esteem. Students of the tri-institutional Auraria campus were chosen to participate in a survey that addresses hookups and self-esteem outcomes. The survey was created using existing evidence about hookup behaviors and related psychosocial outcomes, and utilized an existing scale to measure self-esteem. Random sampling was used to invite 130 students on campus to take an anonymous 15 question online survey from different classes from the school. Women (68.7%) outnumbered men (27.5%) in responding to the survey with the majority within the 18-21 year old age range (72.5%) and with 22-25 year range following second (22.9%). Answers to the questions were coded and analyzed quantitatively using a Chi-square analysis using SPSS. Results indicate no significant relationship between frequency of hookup behaviors and self-esteem according to the determined p-value of 0.265. This research adds some insight into how hookups in general may not be as detrimental to the mental health of individuals, or is in any way an indicator of low self-esteem of college students who participate in these behaviors.

HOSPITAL BED
WALAA Albu Eisa, *Technology, Engineering, and Mathematics*
Mentor: CRAIG LANNING

Abstract:
A METHOD TO ADJUST A HOSPITAL BED FOR INDIVIDUALS WITH SEVERE MOTOR IMPAIRMENTS TO REDUCE THE RISK OF DECUBITUS ULCERS.

Hospital-based adolescent drug use interventions: A missed opportunity
Kristen Ghiazza, *Social Sciences*
Mentor: Sneha

Abstract:
Drug abuse among adolescents remains a major public health concern. Drugs abuse is one of the leading causes of morality, morbidity, and social concerns among youth in the United States. Significant progress has been made in the understanding and development of treatments to address adolescent drug abuse. Although most youth are state mandated to receive a complete physical exam from a healthcare provider (e.g., well-child visit) before each academic year; hospital-based interventions (i.e., screening, prevention, and/or interventions) appear to be lacking. After reviewing the prevalence of drug use among adolescents and the health and psychosocial impact of use, research documenting the frequency and benefits of medical visits for youth will be considered. Research on existing drug abuse hospital-based interventions for adolescents will then be described. The review will conclude with consideration towards gaps in hospital-based adolescent drug use interventions and future directions that should be explored.

How Analog Photography is More than Just a Camera and Film: Manipulating Prints with Light and Chemistry
Alexandra L Foster, *Arts and Humanities*
Mentor: Carol Golemboski

Abstract:
The first surviving photograph was captured in 1826 and took over eight hours to create. Since then, technological advancements have allowed for the rise of digital cameras and pixelated images. Analog photography, however, has not yet become obsolete. One of the main attractions of analog photography to contemporary artists is the physicality of film and darkroom prints. This project explores the process of chemical reactions of the materials used, along with the dynamics of light in order to create vibrant, multicolored prints using monochromatic papers. The goal of this study is to explore the different types of processes that allow for colored prints to be created in the darkroom and to compare the outcomes in terms of a vibrant range in color. Two of the experiments conducted consisted of using several different types of black and white silver gelatin paper, along with different solutions of chemicals, which created varying results in the hue, saturation, and even texture of the paper. We found that varying solutions, along with modifying print exposure times, created vastly different outcomes in the visual effect of the prints. The Edmund Teske process, a method for experimental solarization which reverses highlights and shadows in prints, resulted in a fire-like appearance in terms of color and movement. The other technique, which can be titled as the Chromoskedasic process, allowed the silver particles in the paper to scatter light in a way that altered the prints to appear metallic and rather muted in tonality.

How Does Temperature Affect Eczema?
Kathy H. Le, *Natural Sciences*
Mentor: Katharine Kelsey

Abstract:
Inflammation of the skin can result in red, dry, scaly patches. Depending on the environment, there can be everyday triggers that can result in these types of inflammation. This is a disease known as Eczema. For this

disease, there is research showing different temperature thresholds and lengths of exposure to the natural heat. There is no true definition on how this is caused on skin, however researchers have shown that temperature can be a potential environmental factor. Sunlight plays a role in the potential environmental factor as humans living on Earth. To add on, seasonal factors correlate to climate change as well. Summer is naturally hot. Studies have shown, the higher the temperature, the more likely eczema shows up. Through this literature review it has been known that eczema is seasonal. However diving deeper into the research, it shows that eczema is tied into certain thresholds or lengths or exposure outdoors. Once people are exposed to direct sunlight there are frequencies and intensities that can be measured. This meta analysis research provides a starting point to further explore how temperature affects eczema in different aspects of climate change.

IAR: An Intelligent Augmented Reality Framework

Kevin R Macfarlane, Tobby E Lie, Devin W Piner, Drake R Young, *Technology, Engineering, and Mathematics*
Mentor: Farnoush Banaei-Kashani

Abstract:
The field of Artificial Intelligence (AI) studies approaches to utilize computers to perform human tasks. On the other hand, Augmented Reality (AR) is a technology field where computer graphics is harnessed in a user‚Äôs view of the real world. On their own, each individual computer science field mentioned above provides powerful aid and utility in improving everyday life. In this project, our ultimate goal is to seek out a framework (i.e., a general-purpose software that can be customized to implement different applications) that would yield the optimal marriage of these two aforementioned fields. Our framework, dubbed IAR (Intelligent Augmented Reality), consists of modules for data preprocessing, data management and organization, data modeling (with machine learning and deep learning models), and data visualization.
There are a plethora of applications that would see great benefit from the integration of AI and AR using IAR. For demonstration purposes, we have implemented three specific applications from diverse areas based on the IAR framework: 1) a tool that serves as therapeutic aid for patients with strabismus, 2) a tool that enables intelligent lane detection on road networks under adverse weather conditions and/or for visually impaired, and 3) a tool that allows for automated classification of garbage to educate the user on the differences between recyclable and non-recyclable trash. We have implemented these applications using both a mobile device (i.e., iPhone) and a Fove headset with a Zed mini camera as augmented reality devices.

Immune Cell Homing to Pediatric Sarcomas:
Changes in IL-8 Receptor Expression in T cells After Transduction with B7H3-CAR

Madeline J Larson, *Biomedical/Health Sciences*
Mentor: Molly Nepokroeff

Abstract:
Background: While CAR T therapy has been an effective form of treatment for many hematological malignancies, solid tumors are more challenging for the CAR T cells to find and kill. The IL-8 receptor is naturally expressed on T cells. Prior research has found that the IL-8 receptor expression increases after radiation and that this increased expression enhances T cell trafficking to the tumor. We have also found an increase in IL-8 receptor expression on T cells after radiation. Therefore, we are hoping to utilize the IL-8 receptor as a homing device.
Methods: T cells from five donors were isolated via magnetic selection and analyzed every two days up to days ten post-transduction. Cells were analyzed via flow cytometry for various surface markers including CXCR1 and CXCR2, CD3, CD4, CD8, CD56, and B7H3 CAR via L-protein. L protein staining of the T Car ScFv region was used to quantify expression of B7H3 CAR post transduction.
Hypothesis: An increase in IL-8 receptor expression will enhance T car homing to pediatric sarcomas.

Immune Response of Type 1 Diabetes
Cristian Sarabia, *Biomedical/Health Sciences*
Mentor: Jessica Luna

Abstract:
This comprehensive literature review included twelve scholarly and peer-reviewed articles that serve to provide information on Type 1 diabetes (T1D). This T1D autoimmune disease typically occurs in young children and lasts a lifetime. The autoimmune disease is diagnosed by the presence of autoantibodies and results in the lack of insulin. My project serves to expose the pathophysiology of Type 1 diabetes and my long-term research serves to determine if geographical location influences risks of development of T1D.

Immunogenic Potential of Porcine Aortic Valves
Kyra Flores, *Biomedical/Health Sciences*
Mentor: Jeffrey G. Jacot

Abstract:
The goal of this research is to prevent graft rejection of heart values for congenital and age-related valvular heart defects (VHD) through reducing the immunogenic potential. The process of decellularization, the removal of cellular components, has the potential to minimize the immunogenicity of porcine heart valves. The cryopreserved allograft is the current standard of care for VHDs, but they have limited availability. Tissue engineered xenograft tissue is, therefore, a preferable alternative valve replacement. One limitation of the tissue-engineered grafts is the remaining presence of xenoantigens, foreign proteins that stimulate an immune response. Decellularization can be utilized to remove xenoantigens from porcine heart valves. The immunogenic potential of the valves can be quantified through in vitro assays that determine the presence of antigens and the production of cytokines by cultured human macrophages. The purpose of this project is to evaluate the immunogenic potential of porcine heart valves before and after decellularization using in vitro assays.

Impacts on gut microbial communities following exposure to Poly- and Perfluoroalkyl Substances (PFASs) from fire training area plumes in Cape Cod, Massachusetts
Annarose E Phelps, *Natural Sciences*
Mentor: Chris S. Miller

Abstract:
The composition of gut microbial communities can have far-reaching effects on host physiology; however, little is known about the relationships between toxicant exposure, gut microbial communities, and host health. Per- and polyfluorinated alkyl substances (PFAS) are a class of persistent organic pollutants used in many applications. The objective of this study is to examine the effects of exposure to PFAS on the gut microbiome of fathead minnows (Pimephales promelas). Adult fathead minnows were exposed to mixtures of PFAS from a contaminated groundwater plume on Cape Cod, MA, USA. Fish gastrointestinal tracts from exposed and control fish were dissected and DNA was extracted. Relative abundances of different Operational Taxonomic Units (OTUs, or different types of bacteria) will be identified by 16S ribosomal gene sequencing. The relative abundance of each OTU between the control and PFAS exposed treatment groups will be compared. This study will measure changes in the composition of gut microbial communities due to different doses of PFAS mixtures. We hypothesize that the

relative abundance of certain OTUs compared to the reference fish will change as the concentration of PFAS increases in each treatment group. Changes in gut microbial communities may have important direct and indirect effects on host health. Examining the specific OTUs that are affected by exposure may provide testable functional hypotheses about the consequences of PFAS exposure.

In the Basement: The Denver Art Museum,Äôs Native Arts Collection, 1922-1949
Raphael M Angoulvant, *Arts and Humanities*
Mentor: William Wagner

Abstract:
The Denver Art Museum (DAM) found its first home in the Chappell House, a mansion-turned-museum, in 1922. Only three decades after its establishment, the DAM accrued a world-renowned collection of native arts, largely thanks to the work of curator Frederic Douglas,Äô Indian Department. In 1949, The DAM succeeded in its multi-year battle for a new museum and built a new location. While the brand-new DAM enjoyed the spotlight, the allegedly world-class native arts collection faded within the Chappell House, multiple blocks away from the new nucleus of the Denver art world. The native arts collection remained excluded until the late 1960s, when a newer, larger museum allowed for the consolidation of the entire DAM assemblage. No longer needed for space, the Chappell House was sold and torn down in 1970. This paper seeks to investigate, through the story of the Chappell House and its native arts collection, American attitudes towards native arts and culture. Eric Douglas,Äô fascination with native arts built a formidable collection, but practical concerns and prejudice led museum authorities to sideline the collection. The construction of a larger museum allowed for the inclusion of the native arts collection, not due to a new-found respect for native art and culture, but rather for convenience,Äôs sake. By studying the DAM,Äôs native arts collection and its turbulent story, I hope to contribute a different approach to the study of American attitudes towards American Indians: one that focuses on the intersection between art and public life.

Inferiority: A Mental Illness?
Carlos Joel Guillen, *Social Sciences*
Mentor: Candan Duran-Aydintug

Abstract:
The perception of being lower in status than others is a sensation can lead to feelings of inferiority. Inferiority is a daunting emotion coupled with other cofactors that arise primarily from negative social comparisons that are products of realistic or imaginary sources. This literature review surveyed both males and females in all demographics and their sensation of feeling inferior. This comprehensive literature review demonstrates that experienced inferiority is a direct causation to negative self-imagery, low self-esteem, social isolation and can undoubtedly lead to acts of discrimination towards others if the feelings of inferiority are considered as abnormal. Acts of discrimination can arise when the feelings of inferiority are brought forth to the conscious mind and paired with the particular social negative comparison, causes the individual to place fault with the subject of the negative comparison and thus demonstrating acts of discrimination towards that subject. Though these emotions are likely subconscious, it often causes individuals suffering from it to overcompensate. Thus, the drive to overcompensate is to extinguish the inferior perception. Further research shows that the feeling of inferiority can be a diagnosis for mental illness.

Inserting a FLAG-tag to the EcoRI Cloning Site on the Plasmid pCAGEN.

Hannah Abroe, *Biomedical/Health Sciences*
Mentor: Christopher Phiel

Abstract:
Plasmids are small, circular extrachromosomal DNA structures that can replicate independently of the chromosomes. Originally found in bacteria, plasmids are useful tools in eukaryotic organisms as well. We use plasmids for experiments in our lab for cloning genes and expressing those genes in mouse embryonic stem cells. To assess the expression of a gene as a protein product, it is useful to include an epitope tag fused to the gene of interest. In this project, I designed a DNA oligonucleotide (a short DNA molecule), that included the sequence for the FLAG epitope tag (amino acids; DYKDDDDK) and a sequence for a HindIII restriction site, to be inserted into the mammalian expression plasmid called pCAGEN by using a technique known as Gibson Assembly Cloning. Competent E. coli cells were transformed after the Gibson Assembly cloning reaction and grown on selection plates. Individual colonies were picked and grown further in LB broth, then the plasmid DNA was purified. Finally, the plasmid DNA was cut using the restriction enzyme HindIII, to determine if the oligonucleotide containing the FLAG tag was successfully inserted.

Investigating a Role for Glucose-6-Phosphate Isomerase (GPI) in Regulating Embryonic Stem Cell Pluripotency

Chang Huang, Amy Hernandez*Biomedical/Health Sciences*
Mentor: Christopher J. Phiel

Abstract:
Embryonic stem cells (ESCs) are a unique cell type due to their ability to differentiate into any type of cell; we call this pluripotency. While ESCs hold great promise for future use in regenerative medicine, we are still trying to understand the fundamentals of how pluripotency is regulated. ESCs are typically cultured in a media containing 4.5 g/L glucose. Our lab recently began investigating whether ESC pluripotency was enhanced by using different sugars at different concentrations. We found that culturing ESCs in high concentrations of fructose (9 g/L) strongly enhanced ESC pluripotency, while high concentrations of glucose had no effect. We sought to understand the molecular basis of this effect. Glucose is universally used by eukaryotic cells as a source of energy; glucose is eventually converted to pyruvate, which then enters the Krebs cycle to generate ATP. Glucose is first converted to fructose, and this is mediated by the enzyme glucose-6-phosphate isomerase (GPI). Because ESCs did not have enhanced pluripotency in high glucose conditions, we hypothesized that this was due to GPI being a rate-limiting enzyme. We therefore speculated that if we overexpressed GPI levels in ESCs, they may now be responsive to high glucose. To address this, we set out to clone the GPI gene and express it in ESCs. Results from this experiment will be presented.

Investigating a Role for Glucose-6-Phosphate Isomerase (GPI) in Regulating Embryonic Stem Cell Pluripotency

Amy Hernandez, Chang, Huang, *Biomedical/Health Sciences*
Mentor: Christopher Phiel

Abstract:
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4.5 g/L glucose. Our lab recently began investigating whether ESC pluripotency was enhanced by using different sugars at different concentrations. We found that culturing ESCs in high concentrations of fructose (9 g/L) strongly enhanced ESC pluripotency, while high concentrations of glucose had no effect. We sought to understand the molecular basis of this effect. Glucose is universally used by eukaryotic cells as a source of energy; glucose is eventually converted to pyruvate, which then enters the Krebs cycle to generate ATP. Glucose is first converted to fructose, and this is mediated by the enzyme glucose-6-phosphate isomerase (GPI). Because ESCs did not have enhanced pluripotency in high glucose conditions, we hypothesized that this was due to GPI being a rate-limiting enzyme. We therefore speculated that if we overexpressed GPI levels in ESCs, they may now be responsive to high glucose. To address this, we set out to clone the GPI gene and express it in ESCs. Results from this experiment will be presented.

Investigating effects of methoxy groups on salicyl alcohol derived photolabile protecting groups
Hoai Tieu Bao Pham, *Natural Sciences*
Mentor: Scott Reed

Abstract:
Protecting groups are useful tools in the synthesis of organic compounds. Photolabile protecting groups (PPGs) can be removed via photo irradiation under neutral conditions. This research presents a new pathway for synthesis of salicyl alcohol derived PPGs with two different functional groups on benzylic positions of the PPGs for carbonyl compounds. The 6-step transformation using inexpensive starting materials has been developed successfully with the yield for each step higher than 78%. This method allowed us to pursue precise structural modification on the PPGs to test the effects of functional groups. By selectively positioning electron-donating methoxy groups in different benzylic positions on PPGs in acetal 1-3, the meta and ortho/para effects were investigated. A phenyl group with a methoxy substituent in meta position in acetal 1 showed the best deprotection yield. In contrast, the introduction of a methoxy group in para benzylic position in acetal 2 showed the lowest deprotection yield. Compared to acetal 1, additional introduction of a methoxy group in para benzylic position in acetal 3 lowered the deprotection yield. By comparing experimental deprotection yield with computational results, effects of methoxy groups and deprotection mechanism can be understood deeply.

Investigating Phosphorylated CREB and ERK Protein Expressions Within the Prefrontal Cortex of Rats Previously Exposed to Social Buffering of Conditioned Social Fear
Alina Nohr, *Biomedical/Health Sciences*
Mentor: Sondra Bland

Abstract:
When animals of the same species are together during a stressful experience, they exhibit a reduction in fear responses, referred to as social buffering (Kikusui et al., 2006). The social fear response is linked to increased activation of the prefrontal cortex (PFC) (Xu et al., 2019) and may involve neuroplasticity in this brain region. Phosphorylated cyclic AMP response element-binding protein (pCREB) is considered a good marker for neural plasticity (Li et al., 2014). The neural pathways of CREB and extracellular regulated kinase (ERK) have been involved in the formation of fear memories (Glueck et al., 2015; Brewer et al., 2010). In this experiment, immunohistochemistry was performed to assess pCREB and pERK expressions within the PFC of 24 male and 24 female rats previously exposed to social buffering of conditioned social fear. The conditioned social fear paradigm consisted of an experimental rat learning to associate an unconditioned stimulus with a conspecific (same-species) rat, leading to a fear response when presented with the conspecific alone (Reichenberger et al., 2017). Male and female rats exposed to a social stimulus during conditioning showed decreased freezing. Social buffering

was seen to have occurred during conditioning and re-exposure to the context (Dawud et al., 2019). Cells positive for pCREB and pERK were counted in subregions of the PFC. A sex difference was observed in pCREB and pERK cell counts, showing a higher number of pCREB and pERK positive cells in female rats. Differences in pERK and pCREB expression were observed in subregions of the PFC .

Investigating the Effects of Zar2 on Early Development by Using Engineered Mutants

Cameron Cornn, *Biomedical/Health Sciences*
Mentor: Amanda Charlesworth

Abstract:
Although a great deal is known about early development in general, there is still so much that is not understood about early development,Äîwhich includes meiosis, fertilization, and embryogenesis,Äîat the cellular level, such as the mechanisms that regulate the formation of viable eggs, or meiosis, and the development of the embryo, or embryogenesis. The purpose of this investigation was to understand the effects that zygotic arrest 2 (Zar2) protein has on the formation of viable eggs. Zar2 is made up of two functional regions: one region is the translational control domain (TCD), which contains a region conserved across vertebrate species, and the second region is the RNA binding domain, which is where Zar2 binds to RNA. Zar2 has been shown to bind to maternal mRNAs, such as Wee1, and regulate translation. To investigate normal Zar2,Äôs function, an engineered mutant that has the TCD deleted but has the RNA binding domain still intact was used. This mutant Zar2 will still bind to RNA, however, won,Äôt be able to regulate translation. This mutant was injected into Xenopus laevis oocytes, at concentrations I optimized so that it would outcompete endogenous Zar2, and then amounts of Zar2 and MS2 were measured via western blot to assess the extent to which the Zar2 mutant outcompete wildtype Zar2. When the oocytes injected with the Zar2 mutant were matured, an inhibition of meiosis was observed, indicating that Zar2 plays a crucial role in the formation of viable eggs.

Investigation the influence of Monoamine neurotransmitters on the price that rats are willing to pay for avoidance or reward and their role in determining predictive value

Oniza M. Chaman, Nate, Ryan Smith, Jonte Leman, *Biomedical/Health Sciences*
Mentor: Erik B. Oleson

Abstract:
Optimal behavior and overall survival require obtaining highly-valued outcomes from our environment. These action-outcome situations are often driven by either the pursuit of reward or the avoidance of harm. The three primary monoamine neurotransmitter systems that modulate such motivated behaviors are dopamine (DA), serotonin (5-HT), and noradrenaline (NA). We are using selective uptake inhibitors GBR-12909, fluoxetine, and desipramine, to block the uptake of DA, 5-HT, and NA respectively. To investigate how these uptake inhibitors influence the value of avoidance vs. reward, we combined operant behavior with behavioral economic theory. In our avoidance task, rats were trained to respond to avoid electrical foot-shock across a range of prices (response requirement/mA shock avoided); in our reward-seeking task, rats were trained to respond for sugar across a range of prices (response requirement/mg sugar received). We then fit data with demand curves and solved for alpha. Preliminary data suggest that GBR-12909 increased avoidance value; whereas desipramine decreased avoidance value. Investigating whether these pathways produce distinct effects on reward vs. avoidance valuation will provide novel insight into how the brain controls these fundamental aspects of behavior. The implications of this work may also advance our understanding of major psychiatric conditions such as depression and drug addiction. After completing the reward valuation component of this study, we attempt to replicate our findings using chemogenetics to add anatomical specificity to our exploration of this research question.

iPSC-Derived Cardiomyocyte Model to Investigate Stretch-Responsive Signaling Pathways Involved in Hypoplastic Left Heart Syndrome

Alyssa K. Salazar, *Biomedical/Health Sciences*
Mentor: Jeffrey G. Jacot

Abstract:
Hypoplastic left heart syndrome (HLHS) is a congenital heart defect that results in the underdevelopment of the left ventricle, mitral valve, aortic valve and ascending portion of the aorta. This reduces the heart,Äôs ability to pump oxygenated blood through the body and is fatal without immediate intervention. For the majority of cases, the causes of HLHS is unknown. However, at a phenotypic level, cardiomyocyte (CM) deficiencies, such as proliferation rate and cell structure, have been observed in HLHS. Given that CM must respond to biomechanical stretch for proper heart development, we hypothesize that disruption of mechanical signaling pathways in CM are responsible for the defects observed in HLHS. In order to test this hypothesis, we compared the stretch-induced proliferative and morphologic response of human iPSC-derived immature cardiomyocytes from infants with HLHS and controls with typical heart structure. CMs were differentiated using small molecular inhibitors impacting Wnt signaling and purified by glucose starvation with insulin. CM were stretched for 48 hours at 10% strain at 1 Hz. Total cell area and proliferation rates were analyzed using ImageJ (NIH). We predict that the proliferation rate and cell area will be abnormally reduced in HLHS patients as compared to healthy controls. Future planned experiments of specific mechanosensitive pathways will provide insight into how HLHS develops and could lead to new therapies for the treatment or prevention of HLHS.

Korean Natural Farming: Processes and Applications

Nicole Boudreaux, *Natural Sciences*
Mentor: Rafael Moreno- Sanchez
Abstract:
Author: Nicole Boudreaux
Co-Authors: Rafael Moreno-Sanchez, Kirsten Christensen, Amanda Weaver
The health of a plant below ground indicates the health of the plant above ground. IMO farming is building block for building healthy farmland and crops because of the interconnected relationship between micro and macro organisms below ground. Korean Natural Farming is a farming method which uses indigenous microorganisms to fertilize the soil encouraging increased soil health, higher yielding crops, and invites earthworms to the region. During a two-week period on the Big Island of Hawaii in August 2019, practices of Korean Natural Farming were observed. The trip ended before the microorganism trap was opened and before the remaining steps of Indigenous Microorganism (IMO) farming was able to be carried out. This research carries out the investigation of processes observed and those that were unable to be observed.

Korean Natural Farming is a closed, multi-step, farming system which uses inputs directly from the land minus a few items such as rice, which is food to catch indigenous microorganisms in untouched environments for the most beneficial results. A few of the multiple steps involved with Korean Natural Farming include making ‚ÄòFermented Plant Juice‚Äô (FPJ), and the five-step process of ‚ÄòIndigenous Microorganisms‚Äô (IMO). There are five different stages in which the IMO‚Äôs experience; this is because microbiology does different things in different stages. The multi-step farming methods will highlight the excretion of Fermented Plant Juice (FPJ) and the five-step evaluation of Indigenous Microorganisms (IMO); collection, resting, tilling, blending, and brewing. The research will tell a story of the living organisms beneath our feet and the benefits that they can bring to society.

Lasting Effects of Childhood Abuse and Trauma in Adulthood
Charlotte A Garrison, Isabelle M LeVeau, Jessica Alvarado, Gilberto Casillas-Flores, *Social Sciences*
Mentor: Patricia Zornio

Abstract:
Child sexual abuse is a widely considered risk factor for mental disorders later in life. Despite this, the long-term consequences of other forms of child maltreatment have not yet been systematically examined. The aim of this study was to summarise the data and evidence relating to the potential correlation between child physical abuse, emotional abuse, neglect, and subsequent mental and physical health outcomes. The ACE quiz specifically focuses on abuse, neglect, and household dysfunction. The adult mental health illnesses investigated include: depression, anxiety, and addictive behaviors. Data were collected from external sources, including the CU Denver counseling center and Anschutz Medical Campus. The results of the study contribute new knowledge on how mental illness can arise in adults, and what kind of mental illness is expected to arise after a child experiences abuse. This information can provide counselors, therapists, and family clinicians with insight on how to treat both abused children and formerly-abused adults.

Legal Drug use or Temptation as correlated with Workplace-Related Stress
Brandon L Mercer, Citali, Adam Barcenas, Julia Copeland, *Social Sciences*
Mentor: Trish Zornio
Abstract:
Can the workplace influence drug and alcohol use? Work-related stress has been known to cause health issues and, in some cases, increased alcohol use. This study aims to establish whether there is a link between work-related stress and legal substance use in the workplace in Colorado. Because recreational marijuana is legal in Colorado, both alcohol and recreational marajuana are considered. Many past studies have drawn a connection or attempted to draw a connection between specific occupations (especially high-stress careers, such as paramedics and law enforcement) and substance use, but this study will not focus on any one specific career, attempting to discover whether this trend is generalizable to the public as a whole. A brief survey gauging stress levels at work, substance use or desire to use substances was distributed to (around) 30 participants with various jobs in the state of Colorado. We expect to find a direct correlation between work-related stress and substance use or desire to use substances. If there is a significant link between these variables, future research may focus on specific workplace stressors that increase substance use or methods to cut down on stress in the workplace in order to improve the health and habits of employees at work and at home.

Material Processing Using Electromagnetic Fields
Quang Vu Le, *Technology, Engineering, and Mathematics*
Mentor: Randall Tagg

Abstract:
The goal of this project is to design and optimize a cavity resonator cavity resonator with the purpose of using electromagnetic fields contained within the cavity for material processing. Primarily the material being processed are carbon nanotubes, but the design will be versatile enough to process other materials as well.

The main requirements for the cavity resonator is to reach electric field strength near 3000kV/m with capability for self-tuning (a closed-loop control system) to deal with changes (such as heat, material properties, etc) which could lead to disturbance and weakening of the electric field.

Measuring Elemental Heavy Metals in the Environment Using Bees and Their Products

Desiree Paz, *Natural Sciences*
Mentor: Dr. Christy Briles

Abstract:
The importance of bees and their role in the environment is very clear and well understood. All species of bees are necessary for the diversity of life on our planet. Bees are pollinators, and in this role, support the complex, interconnected ecosystems that support a vast number of different species to coexist, including humans. What is less clear is how the human impact, or more specifically the way in which our daily activities are creating heavy metal pollution affecting the lives of bees and consumers of their products. Agrochemicals, resource extraction and the burning of fossil fuels both impact bee health and populations and the food they bring back to their colonies. Trace amounts of toxic heavy metals are deposited into the atmosphere through industrial processes, agriculture, energy production and transportation. Heavy metal particulates float through the air, in some cases several miles, and land on surfaces and attach to plants, pollen, insects and animals. The most common environmental heavy metals are cadmium, lead, mercury and arsenic. These metals can be toxic and are difficult for organisms to manage due to a lack of homeostasis mechanisms. Can this harmfully affect bees at a cellular level? In this research I examine the scientific literature to determine the gaps in knowledge around environmental heavy metals and bee survival.

Mesoamerican Religious Art in the Sixteenth Century; Mendicant Approach to Conversion

gesina null, *Arts and Humanities*
Mentor: Maria Elena Buszek

Abstract:
Following the Spanish conquest of Mexico, the indigenous inhabitants were quickly baptized and instructed on the ways of the Catholic Church,Äôs cultural customs, and religious beliefs. Franciscans, Dominicans, and Augustinians were the Catholic religious groups who took over the task of religious practices, along with the development of new churches and monasteries. Between the three mendicant orders, different actions were taken to convert the native inhabitants to Catholicism during the sixteenth century in Mesoamerica. The Franciscan order relied heavily on the didactic image, by producing large theater productions, murals, confessionals, and theatrical sermons. The Augustinians also used murals within their churches as a form of conversion, but chose instead to depict morbid scenes such as hell, taking a fear-based route to conversion. The Dominicans,Äô mission into the undeveloped area of Oaxaca was confronted with difficult circumstances. The friars were few in number and located in an area with sixteen different languages. And so, instead of abolishing the ways of pre-Columbian culture, the order chose to incorporate new Catholic values with existing social traditions. By integrating aspects of pre-Hispanic culture into the architecture, murals, and paintings, the Dominicans made conversion more relevant for to local community. In this presentation, I will show that, from a distance, the different mendicant orders,Äô attempts to conversion in Mesoamerica may appear to be similar, but closer investigation of their religious art demonstrates that different forms of conversion were used.

Migraines: Relationships Between Age of Onset, Onset of Event, and Frequency of Migraines Per Month
Amanda B Hong, Ryan, Radosevich, *Social Sciences*
Mentor: Dustin Goerlitz

Abstract:
INTRODUCTION: Migraines have been found to be associated with a variety of onset events alongside specific triggers. While numerous studies have examined specific etiologies of migraines, relatively few have examined what the most common etiologies are within relatively large samples. We aimed to examine relationships between the age of onset of migraines, reported onset event for migraines, and frequency of migraines per month, in a national migraine population. METHOD: Data was collected from 758 respondents in the 2015 MigraineinAmerica.com survey. Relationships between variables were analyzed with chi-square tests of independence. Likelihood ratios are reported in place of chi square values, as assumptions for percent of expected counts less than 5 exceeded 20% with both analyses. RESULTS: Results from the chi-square tests showed a significant relationship between age of onset and event (LR60,757=550.075, p<0.001). The effect size for this relationship, Cramer's V, was moderate, 0.353. A significant relationship was also found between onset event and frequency of migraines per month [LR48,757=65.554, p=0.047]. The effect size for this relationship was small, 0.174. The most common onset factors regardless of frequency of migraines per month were head injury or trauma (25.3%), period/menstruation/monthly cycle (22%), puberty (13.9%), and childbirth (12.3%). DISCUSSION: The results of this study add to the literature on the etiology of chronic migraines and helps elucidate common etiologies by age, in addition to their association with frequency of migraines per month. With this information, the conceptualization of migraine management may be furthered by emphasizing the need for tailored treatment and prevention.

Mode of Delivery, Breastfeeding Patterns, and Postpartum Depression
Susan L Kim, *Social Sciences*
Mentor: Peter Kaplan PhD

Abstract:
Background: Due to the surgical nature of cesarean sections, the early relationship between mother and infant is affected by mode of delivery and associated with a lower probability of breastfeeding, which in turn may affect maternal mood. Postpartum depression (PPD) has been linked to delays in infant cognitive development. We examined relations between mode of delivery, breastfeeding, PPD, and infant cognitive development in mothers and 4- to 14-month-old infants.
Methods: Participants (mother and baby) were recruited through Facebook and completed anonymous surveys assessing their depression levels, breastfeeding patterns, and mode of delivery (vaginal vs. cesarean section). We measured child cognitive performance using the Bayley Scales of Infant and Toddler Development, 3rd Edition (BSID-III), which assesses cognitive and communicative development in relation to age-based norms.
Results: Results from 270 mothers showed that mothers who had a caesarian delivery were less likely to breastfeed than mothers who had a vaginal delivery (48.0% vs. 32.4%, X2 = 5.58, p = .06). However, PDSS scores were nearly identical for mothers who had vaginal versus caesarian deliveries (Ms = 74.5, SD = 27.6, and 74.2, SD = 28.5). In contrast, breastfeeding mode was significantly correlated with maternal PDSS scores, r(270) = -.17, p = .01. Neither mode of delivery nor breastfeeding was related to the infant,Äôs performance on the BSID-III scales.
Conclusions: Although caesarian delivery was marginally associated with lower likelihood of breastfeeding, mode of delivery was unrelated to self-reported symptoms of depression. However, mode of feeding was significantly related to self-reported symptoms of depression, with fewest symptoms reported by exclusively breastfeeding mothers.

Moose and Hare Herbivory in Reburned Stands in Boreal Interior Alaska
Katherine Hayes, *Natural Sciences*
Mentor: Brian Buma

Abstract:
Increases in fire frequency and intensity in Boreal Interior Alaska have led to shifts in successional trajectories in black spruce (Picea mariana) dominated communities. Short-interval fires (< 15 years) specifically disfavor local black spruce populations immediately post-fire but the longevity of resulting emergent deciduous communities remains to be seen. Herbivory is one of several factors that can influence long-term post-fire successional trajectories of black spruce stands in Interior Alaska after the initial disturbance: browsing by moose or snowshoe hare can suppress regeneration of black spruce, particularly in stands dominated by a deciduous overstory. What remains unclear however, is the role of moose and hare browsing on emerging deciduous communities specifically in reburned stands (whether conifer or deciduous). Understanding and predicting future successional trends in the boreal requires a functional understanding of the effect of moose and hare herbivory on both black spruce and deciduous recruitment, growth rates and survival. To investigate the interaction of herbivory pressure and short-interval reburning, we evaluated browse intensity, herbivore presence and browsing preference in (originally) black spruce stands that have burned in one, two or three short intervals in two locations of Interior Alaska. We compared the effect of herbivore pressure of both moose and hare on tree, sapling and seedling species presence, density and abundance in reburned stands. We present initial results of browse intensity, herbivore presence and browsing preference and the results of the modeled effect of herbivore pressure on regenerating reburn communities. This work will help inform landscape-scale predictions of future successional trajectories within reburned Boreal Interior Alaska and add to our understanding of the interaction between disturbances and herbivore pressure in forested ecosystems.

Morphometric Analyses of the Elbow In Apes and Humans with Application to Fossil Human Ancestors
Gabrielle M Jones, *Natural Sciences*
Mentor: Caley M Orr

Abstract:
In the human lineage, the upper limb evolved considerably as our ancestors gave up arboreality (life in the trees). In this project we analyzed one component of the elbow (the proximal ulna) from gorillas, chimpanzees, and modern humans along with fossil hominins (human ancestors) to test the hypothesis that hominoid species can be differentiated based on elbow morphology.
First, we collected 3D digital models of ulnae using an Artec Space Spider scanner. Then we measured the surface areas of three articular surfaces on the proximal ulna and statistically compared the relative sizes of these facets among species. The surface area data show that humans align with gorillas more than chimpanzees (our closer relatives), but there is extensive overlap among groups using these data limiting utilities. To improve upon the basic surface-area approach, we created a novel protocol for landmarking 3D models of the ulna and applying multivariate geometric morphometric techniques to conduct a quantitative analysis of overall shape differences among species.
The geometric morphometrics results show that this method is highly repeatable and clearly distinguishes among the extant groups (humans, chimpanzees, and gorillas) based on quantification of the overall shape of the proximal ulna. Most hominin fossils align with humans with some outliers that exhibit weathering that might affect their results. Thus, the classification of fossils is improved by using the geometric morphometrics approach. Ultimately, this will help us to infer climbing ability or the manipulation of objects (e.g., tools) in fossil specimens important for understanding human evolution.

MycoBioSIP: Bio-Renewable Building Panels for Sustainable Architecture
Kenny A. Becerril, Zoe, Jan S. Kowalczyk, Christopher Peciak, *Technology, Engineering, and Mathematics*
Mentor: Julee Herdt

Abstract:
Standard structural insulated panels, or ,'SIPs,' for building construction, consist of polystyrene or polyurethane foam insulation held between two layers of surfacing skins such as oriented strandboard (OSB) or plywood. These petroleum-based components contain toxic chemicals having adverse effects on nature and living beings. Their biodegradability timeframe is 100-200 years.
The MycoBioSIP team is developing a strong, non-toxic, bio-renewable, and biodegradable, low carbon, proof-of-concept SIP alternative to those containing harmful petro-chemicals. Called ,'MycoBioSIP,', the team,Äôs concept is devoid of petro-chemicals. MycoBioSIPs possess compostability features for return to the earth at end-of-building-use without harm to soil micro-environments, earth, water, or air. MycoBioSIPs are non-off-gassing and safe for humans and animals. A few potential architectural applications include: Relief shelters, temporary buildings, and military huts that can be left behind after use to biodegrade and nourish the host location.
MycoBioSIPs are made from 100% recycled wastepaper, eco-fiberboard skins containing natural water-resistance additives. The skins enclose MycoBioSIP,Äôs patented 3D structural core, which also performs as a ,'bio growth mold,' for cultivation of regenerative mycelium --or mushroom spore -- insulation. The mushroom insulation, in wet-form, is inserted into MycoBioSIP,Äôs 3D-cores where it expands and bonds to core and skins to form an integrated building panel system. Natural growth inhibitors are being tested to deter the mushroom spores,Äô growth resumption once bonded within a MycoBioSIP panel.
MycoBioSIPs are developing with ultimate goal of product commercialization. Project technological framework is Professor Julee Herdt,Äôs patented and pioneering biobased materials and bio-architecture at CU and in professional practice.

Needs Assessment of Comprehensive Sex Education for Physically Disabled Community
Samantha R Slawson, *Social Sciences*
Mentor: Lindsey Hamilton

Abstract:
Although society has made great strides in shifting its views and supporting sexual identities and expressions, there is still a stigma against disabled people and sexuality. Topics of disability are excluded from comprehensive sex education programs. I will identify the barriers within comprehensive sex education programs for the physically disabled community. I will cover why disabled people are excluded from these conversations and propose a solution on how we get improve current comprehensive sex education to better support this community. I will utilize journal articles focused on sexual health, intimacy, and disability, as well as, conduct interviews with sexuality experts. This topic is important because the disabled community is a marginalized population and there is an ethical obligation to educate and normalize healthy sexual relationships to ensure disabled people will have a safe but pleasurable sexual trajectory.

Neural mechanisms of exercise-induced stress resilience in females
Troy J Hubert, Alyssa, Margret Hohorst, Kelsey Tanner, *Biomedical/Health Sciences*
Mentor: Benjamin N Greenwood

Abstract:
Inescapable stressors are associated with the onsets of major depression, anxiety, and stress disorders. Despite the fact that females are known to suffer from stress-related disorders more commonly than men, there has been less research on the neural mechanisms of stress disorders and their treatments in females. One sex difference in treatment of stress-related disorders comes from observation of the stress-protective effects of exercise in rats. Specifically, while six weeks of voluntary exercise can protect male rats from the anxiety- and depression-like behavioral effects of inescapable stress, only 3 weeks of exercise is required to enable similar stress resilience in females. In males, excessive activation of serotonergic (5-HT) neurons within the dorsal raphe nucleus (DRN) is largely responsible for the adverse effects of inescapable stress. Exercise has been shown to facilitate inhibition of these same neurons. This suggests that long-term exercise enables stress resilience in males by constraining activation of DRN 5-HT neurons. However, whether a similar mechanism underlies the rapid stress resilience produced by 3 weeks of exercise in females is unknown. The goal of the present study is to determine if both 3 and 6 weeks of voluntary exercise constrains activation of DRN 5-HT neurons during exposure to inescapable stress in females. Double immunohistochemistry is being used to label DRN 5-HT neurons and mark their activity with the neural activation marker, cFos. Data collection is ongoing. Results of this study have to potential to reveal novel, fast-acting, and potentially sex-specific targets of stress resilience.

Neurogenesis Markers in Diapausing Rhagoletis pomonella

Matin Sanaei, *Natural Sciences*
Mentor: GregoryRagland

Abstract:
In response to unfavorable conditions, many organisms enter a state of dormancy in which development is suppressed for extended periods. We use the apple maggot fly, Rhagoletis pomonella, as a model to understand the regulation of this suppression, termed diapause in insects. Work from the Ragland lab has shown that gene expression changes over time in the brains of diapausing R. pomonella. We therefore hypothesize that diapause is a dynamic process, during which development does not stop, but occurs at a very slow rate. To test this hypothesis, I developed methods to track developmental processes in fly brains, such as neuron (brain cell) fate specification, growth, and activity. Specifically, I used immunohistochemistry (IHC) and confocal microscopy to detect biological markers of these processes in fly brains, including the proteins Numb and Prospero (neuron fate), CNS axons (neuron axon growth), and Synapsin (synapse activity). I detected Numb in the subesophageal ganglion, and both Numb and Prospero in the medial regions of the optic lobe of fly brains. CNS axon staining in the ventral nerve cord showed a distinct segmented pattern. Finally, I detected Synapsin in the subesophageal ganglion. Ongoing research will use these methods in R. pomonella to determine the location and abundance of each marker at several time points during diapause, measuring changes in the developmental processes over time. Documenting these changes at the cellular level of proteins will bring understanding to the dynamism of diapause and its importance to developmental biology, with potential implications for insect pest management.

New Ways of Teaching y=mx+b, Youth Education =Methods (Xplanation) + Behavior

Daniela Villalobos, *Social Sciences*
Mentor: Junior Reina

Abstract:
In the state of Colorado, math requirements for high school students,Äô range from Algebra 1, Geometry, and Algebra 2. Mathematics can be incredibly difficult for students with a variety of barriers including communication,

comprehension, and testing. There are many different methods evaluated nationally that try to address these barriers ranging from game type activities, using different programs, and increasing communication between teachers. There are articles that look into what age substantial STEM can be taught to students. There are also barriers that do not have to do with the education system like parents anxiety in Math that has been passed down to their children and math-gendered stereotypes.

Optimizing Uptake of a Designer phage-Like Particle in Bladder Cancer Cells

Meaza Abebe Feyso, *Biomedical/Health Sciences*
Mentor: Jared Brown

Abstract:
Bladder cancer is one of the most common forms of cancer in the United States. Approximately 80,000 new cases and 17,000 deaths are expected in 2019. Additionally, bladder cancer treatment advancements have been stagnant in the recent past. We propose using a nanomedicine approach. Nanomedicine is the science of building small particles (1-100 nm) which are small enough to get into the cancer cells. In our case the small particles are called Phage-like particles (PLPs). By developing PLPs based on bacteriophage Lambda, which allows for chemical modification and surface display of multiple ligands. We hope to improve the treatment and detection of bladder cancer utilizing these modified PLPs. These PLPs can be modified in order to obtain the best uptake by bladder cancer cells. In order to optimize therapeutic, diagnostic and physicochemical properties, the PLP can be decorated by fluorescein to track the particle for diagnostic purposes. Additionally, they can be decorated with, Cetuximab (Ctx), a monoclonal antibody that binds to epidermal growth factor receptor (EGFR) which is a target that over expressed in bladder cancer. Upon binding to EGFR, the Ctx is internalized and hence internalization of a connected particle should be observed. In doing this, we hope to develop a potential platform to efficiently track and deliver a drug load to bladder cancer tumor cells specifically for potential immunotherapuetic purposes.

Optogenetic Stimulation of Substantia Nigra Terminals in the Dorsal Lateral Striatum During Fear Extinction Prevents Fear Renewal

John Wiseman, Kimberly, Alyssa Campos, Troy Hohorst, *Biomedical/Health Sciences*
Mentor: Benjamin, Greenwood

Abstract:
One clinical limitation of exposure therapy is that fear tends to return in contexts different from which exposure therapy is conducted, a phenomenon called fear renewal. Exposure therapy relies on fear extinction, which represents new learning that the previous fear-conditioned stimulus no longer predicts danger. Identification of novel strategies to prevent fear renewal could improve the success of exposure therapy. Previous work demonstrated that activation of substantia nigra (SN) dopamine (DA) neurons during fear extinction enhances fear extinction recall and blocks fear renewal; however, the specific targets in which SN DA acts to enhance fear extinction remain unknown. SN DA neurons projecting to the dorsal lateral striatum (DLS) support the formation of habitual behaviors, which can be resistant to contextual modulation. The goal of this study was to test the hypothesis that optogenetic activation of SN terminals in the DLS during fear extinction learning will reduce fear renewal. Adult, male Long-Evans rats received bilateral intra-SN microinjections of control virus or AAV-Chr2-hSyn-mChery and optic ferrule cannulas in the DLS. SN terminals in the DLS were then optogenetically stimulated during auditory fear extinction learning. Fear extinction memory and relapse were subsequently assessed in the absence of stimulation. Results indicate that optogenetic stimulation of DLS-projecting SN neuron terminals during fear extinction reduces fear relapse in a novel context while having no effect on extinction memory or

spontaneous renewal. These data suggest that novel therapeutic strategies aimed at the SN-DLS circuit could be effective adjuncts to exposure therapy.

Organic Synthesis: Functionalization of Benzothiophene Methanol
Isabelle Castro, *Natural Sciences*
Mentor: Marino Resendiz

Abstract:
Benzothiohphene methanol can be used as a base compound that leads to useful synthetic intermediates and the eventual production of potential drugs. Benzothiophene methanol was functionalized with allyl bromide, propargyl bromide, and methyl acrylate. The addition of an alkene to benzothiophene methanol via SN2 with allyl bromide was successful with no less than 70% recovery. The resultant compound1,Äêmethylidene,Äê2,Äê[(prop,Äê2,Äên,Äê1,Äêyloxy)methyl],Äê1lambda6,Äêbenzothiophen,Äê1,Äêone, underwent controlled oxidation, leaving the alkene unaffected. The reaction was relatively successful with a low percent recovered, less than 60%. The resultant oil underwent radiation at 300 nm in solution and solid phase, an intramolecular reaction that resulted in a structure with a tetrasubstituted cyclobutene ring. This tetrasubstituted cyclobutene ring within the structure was desired and will be used for future synthetic intermediates. The other intermediates will be further functionalized.

Ornament Size Effect on Escape Ability of Stalk-Eyed Flies
Dilan S Aziz, *Natural Sciences*
Mentor: John Swallow

Abstract:
Elaborate ornaments often pose performance, energetic, and/or predation costs to organisms. This is observed in stalk-eyed flies where flies with longer eyestalks exhibit reduced flight maneuvering and performance abilities (Swallow et al 2000). However, female preference exerts selection for longer eyestalks, and since selection acts on integrated phenotypes rather than isolated ornaments, this suggests that compensatory traits may have evolved to offset these costs. Twelve stalk-eyed flies with varying combinations of morphological traits (i.e eyestalk length, wing area, wing size) will be placed into a mesocosm with a predator (jumping spider) to test the relationship between survival and compensatory ability in this species. The order in which the flies are eaten by the spider will be recorded over 24 hours along with morphological measurements of both surviving and dead flies. Flies that undercompensate for ornament size are expected be the first individuals to be eaten by the predator while flies that overcompensate are expected to be consumed last and/or survive. These results would suggest that stalk-eyed flies have evolved mechanisms to compensate for the costs imposed by their eyestalks when faced with a predator.

Parental Perceptions of a Diverse, Suburban High-School School Based Health Center
Lisette Martinez, Safa Mecherguli*Social Sciences*
Mentor: Sara Yeatman

Abstract:
School-based health centers (SBHCs) are comprehensive health clinics located within school settings that provide services to students regardless of their ability to pay. Community support is critical to the successful funding and

operation of SBHCs, and parents of students with access are key stakeholders in this arena. For high-school aged adolescents, the parent-child relationship within the healthcare context becomes more complicated with issues of confidentiality and trust between provider and child. Understanding how parents perceive and think about confidentiality for their children receiving care in a SBHC is important to how the center creates and maintains ties with the community. In Colorado, the first SBHC opened in 1989, and the last decade has been marked by a sizeable expansion of SBHCs within high schools across the state. In this study, we examine parental perceptions of a high school SBHC within a diverse suburban setting of Colorado. This evidence will better the understanding of community perceptions of SBHCs and inform future interventions to improve dissemination of SBHC information, community planning, and community support.

PeaceXchange: Act Local, Impact Global

Olivia L Fambrini, John, Sera Mazzetta, Jones, *Arts and Humanities*
Mentor: Martin Widzer

Abstract:
PeaceXchange is a student-led research initiative designed to educate CU Denver students in peaceful dialogue, negotiation, and conflict resolution. We provide a range of online and in-person resources, aiding in the education of the next generation of peace-builders. By making these resources accessible to students, they are enabled to act as change agents in their communities and actively work towards a more peaceful world. Our website utilizes online resources to provide a platform for students to learn about conflict and to connect with like-minded peers interested in conflict resolution. Among these online resources are carefully written reports detailing on-going conflicts worldwide and a collection of external website links, which provides students the opportunity to become active in the field of peace-building both in their communities and abroad. The reports are written by student researchers from the University of Colorado Denver and are composed with the intention of being accessible to students with different levels of education and varying levels of exposure to the sphere of international relations. In addition to a collection of written reports, the online component of PeaceXchange hosts a database of hand-picked professional and academic opportunities, including fellowships and academic summer programs, focused on conflict resolution, peace-building, and negotiation. Peacexchange gives students the background knowledge of international conflicts through concise, accessible written reports and then connects students to opportunities to engage in the field of peace-building both in their communities and abroad, thus helping generate the next generation of peace-builders and working towards a more peaceful world.

Pedagogy, Technology, and Multi-Modal Learning: A Better Method for Student Success

Sophie Kolstad, *Social Sciences*
Mentor: Dr. Jamie M Hodgkins

Abstract:
In 2020, technology and pedagogy collided to protect society from a pandemic. When teaching with technology, different learning styles must be accommodated. This research seeks to demonstrate the effectiveness of three different styles of teaching (auditory, written, and visual) when assigned the same task: completing Zooarchaeology analyses. In ANTH 4121/5121, students are expected to complete four analytical figures. We acknowledge that an individual,Äôs success in creating these figures is dependent on the learning style that best suits them. We designed three ways to teach the same four figures to address a spectrum of learning needs; 1) by employing online how-to videos using Camtasia; 2) by creating an online-accessible instruction manual; 3) by providing explanatory PowerPoint lectures either in the classroom or over Zoom. We anticipate that students will successfully create these figures if their preferred learning style is matched. We will test this assumption by asking 10 volunteers to complete the figures using a test data set. Prior to beginning, volunteers will be asked how they

learn best and matched with the appropriate materials (video tutorials or manual), next volunteers will be given a 20-minute Zoom lecture using PowerPoint to explain the task and significance of their analysis. Each volunteer will have one-and-a-half hours to complete as many figures as they can. Their progress and accuracy of their figures will be accessed. Finally, a survey will be given to the volunteers to track personal impressions of the learning method they used; allowing us to assess the effectiveness of this pedagogy.

Poporodn√≠ Deprese- A Visual Exploration of Postpartum Depression
Kaitlin C Woodward, *Arts and Humanities*
Mentor: Carol Golemboski

Abstract:
Poporodn√≠ Deprese: A Visual Study of Postpartum Depression
Kaitlin Woodward
Faculty Mentor: Carol Golemboski
Becoming a mother is a momentous moment in a woman‚Äôs life, but many soon experience a dark reality called postpartum depression. Postpartum depression (or 'Poporodn√≠ Deprese,' in Czech) is labeled as depression and anxiety that happens after the birth of a child. Kaitlin Woodward, a photographer of Czech descent, uses digital photography to show the complex emotions and symptoms of this illness, which she personally experienced after the birth of both of her children. The surreal fantasy style of her photographs shows how postpartum depression often feels like a disconnection from reality. This work is intended to encourage awareness and support for mothers who experience postpartum depression by creating a visual representation for how the illness manifests. By drawing attention to the symptoms of postpartum depression, people can create a positive environment for mothers suffering from this common but often invisible illness. Fostering that awareness will create happier and healthier mothers and children by reducing or eliminating fear, doubt, lack of support, and lack of resources. Others will be able to viscerally experience feelings that are not so easy to express through verbal and written narrative. While there is no way to prevent postpartum depression yet, more can be done to help those who do and will suffer from it. Poporodn√≠ Deprese is an essential key to helping unlock more help for new mothers suffering from this usually silent illness.

Preventative Measure for Delirium in ICU Units
Huda N Farooqi, Samantha M Yakimow, Wendy E Schadler, Holden E Beckett, *Biomedical/Health Sciences*
Mentor: Mary Bevilaqua

Abstract:
A means to control the amount of light a patient is exposed to in the ICU to reflect natural light cycles
Patients in the ICU are at a high risk of developing delirium due to various stressful environmental factors that interrupt their normal schedules. One of the major contributors to the development of delirium is the abnormal sleep schedule that patients are subject to in the ICU. A potential preventative measure that can be taken is the development and implementation of a device that would return a patient to a normal sleep schedule, establishing some order to the chaos that comes with being in the ICU. The device would be a light panel that is programmed to reflect natural daylight cycles in order to ensure that a patient is awake when they are supposed to be. The light panel would be easily attachable/removable to/from a hospital bed. This would be tested by performing several timed experiments in which the device is attached to various surfaces and removed to examine its effectiveness in all potential situations. The device would also come with an override remote that could be used by doctors or nurses to turn off the device for light sensitive procedures, but then turn the device back on to resume the regular schedule. A third feature of the device would be a built-in lumen sensor that could read the ambient light levels in

the room and respond accordingly (i.e. if the room is bright enough at a certain time, the panel would dim). This feature would be tested by placing the panel in various light levels at the same time of day to ensure that it adjusts as it should. The device, once implemented, would return patients to a normal circadian rhythm, restoring some level of chemical balance and reducing their risk of developing delirium.

Protein Isoforms in the Aged Heart
Julianna M Wright, *Biomedical/Health Sciences*
Mentor: Dr. Maggie PY Lam, Ph.D.

Abstract:
Aging is a high-risk factor for the onset of heart failure (HF) which affects over five million individuals in the United States with a dire ~50% five-year survival rate. Symptoms associated with aging-related HF include exercise intolerance, frequent hospitalizations, and higher mortality rates, with no long-term treatment beyond a heart transplant. Among many cellular pathways, aging-regulated changes in alternative splicing (AS) have been proposed as one of the primary means that deteriorates the function of the heart. AS is a mechanism which causes more than one expression of RNA and protein molecules (i.e. protein isoforms) to result from one parent gene. Aging-related changes in AS at the RNA level has been shown in the aged heart; however, how AS changes regulate the expression of downstream protein isoforms remains incompletely examined to-date. In this study, we utilized liquid chromatography-mass spectrometry (LC-MS) to systematically examine the expression profiles of protein isoforms in the young (12 weeks) and old (78 weeks) mouse heart. Heart proteins were extracted, digested, tagged, and analyzed with LC-MS, and searched against a custom age-specific database to determine differences in AS protein expression in aged mice. 65 protein isoforms were found to be differentially expressed between young and old mouse hearts. Among these age-associated isoforms, we found several cardiac proteins that have been known to play vital structural or functional roles and are implicated in cardiac dysfunction of the aged heart.

Proton Transport through E. Coli CLC Chloride/Hydrogen Antiporter in the Presence of Bound Fluoride
Baris Aydintug, *Natural Sciences*
Mentor: Hai Lin

Abstract:
The CLC transmembrane proteins are Cl,àí channels and Cl,àí/H+ antiporters. Highly conserved in all domains of life, CLCs serve a variety of functions, including high-acid response, controls of cell volume and neural resting potential, and lysosome acidification. It has been established that a prototypical E. coli CLC (EcCLC) transports Cl,àí and H+ stoichiometrically 2.2:1, but many details are not completely clear for the actual H+ translocation process. In our past work we have shown that the chloride anion actively facilitates the proton transfer process, as the H+ was shown to hop to the bound Cl,àí. Notably, this antiporter is weakly selective to a wide variety of anions including, Br,àí, I,àí, SCN,àí, NO3,àí, and as stated Cl,àí. However, the protein is strongly selective towards F,àí, failing to transport the ion, and leading to a ,'lockdown,' on H+ transport if it is bound in the central binding site. Via molecular dynamics (MD) simulation using combined quantum-mechanics and molecular-mechanics (QM/MM) we aim to understand why the transport process is halted in the presence of F,àí in the central binding site, an anion halogen that is very similar to Cl,àí. Through these molecular dynamics simulations the transport pathway will be revealed and compared to a CLC like protein that transfers F,àí and H+ naturally.

Psychedelic Safety and Therapeutic Potential

Julian Crouch, Cleto, Sean. M Madrid, McKinney, *Biomedical/Health Sciences*
Mentor: Patricia Zornio

Abstract:
Psychedelic substances have been in use for thousands of years throughout human history and likely most of human existence. Despite this omnipresence, Psychedelics have been something of a mystery. Psychedelics have been met with a variety of perceptions throughout time. Attitudes towards psychedelic use have varied greatly depending on time and place with an extreme of dogmatic stigmas often resulting in legal consequences (as is prevalent in modern America, circa 2020) to a greatly revered religious ritual and social rite of passage in various indigenous cultures. Psychedelics are often used in a recreational way in order to escape reality. In many cultural traditions psychedelics hold perception of a path towards a spiritual journey that,Äôs supposed to facilitate moving toward a state of self-reflection and becoming more in touch with reality, according to religious practitioners in various cultures. We wanted to limit the speculation and utilize meta-analysis of peer reviewed papers and articles as the primary method. Given the vague conceptualization of psychedelic Drugs and their dangers, this would be an important step to guiding public policy in making a rational informed decision about the way psychedelics are seen by our society at large and the subsequent policies thereby derived. For the purposes of this paper serotonin hallucinogens will be included, specifically psychedelics that work as an agonist and or partial agonist on the serotonin 5-hydroxytryptamine (5-Ht 2A) receptors in the peripheral and central nervous system and in fact have a similar chemical structure to serotonin, lysergic acid-N,N-diethylamide (LSD), dimethyltryptamine (DMT), and psilocybin mushrooms; along with mescaline, peyote and Methylenedioxymethamphetamine (MDMA) The overall evidence from the meta-analysis thus far seems to indicate a relative level of safety uncommon to the pharmaceutical industry and substances classified as drugs in general. This level of safety reduces, though doesn,Äôt eliminate, ethical concerns with studies of this nature because of the extremely low risk of long term issues. This allows researchers to focus on deliberating on proper methodologies. This is important to properly frame ongoing debates about dealing with mental health and considering every tool in modern medicine through the use of sound science. The data gathered thus far certainly leads to the objective consideration of utilizing psychedelic research to treat a variety of mental ailments from mild to severe depression to Post Traumatic Stress Disorder (PTSD) and other emotional issues like anxiety and with various issues involving addiction

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Public Opinion of Bail Reform: A Study of Post-Bail-Reform Views

Jessica Valdez, *Social Sciences*
Mentor: Melissa Tackett-Gibson

Abstract:
The criminal justice system is going through a period of reform. One of the areas that is undergoing a lot of changes is bail. Bail is traditionally an amount of money set by a judge that someone recently arrested must pay in order to be released from jail before their first court date. As part of bail reform, efforts have been made to reduce the use of monetary bond. The research in the current project aims to understand how aware the public is of the nationwide bail reform movement and what public opinion of bail reform is. The method of data collection is a survey that asks questions designed to determine the respondent,Äôs personal views on bail, factors that may bias those views such as work experience and personal experience, and how much prior knowledge they had of bail reform from the media. The survey was distributed to people of a variety of backgrounds beginning in March 2020. Understanding public opinion is essential in understanding the extent to which bail reform will be put in place, as the public has the power to vote on such reform and to influence their state legislators. While research is still ongoing, this presentation will give an overview of the trends that the data collection has revealed to date.

Religiosity & The Gender Wage Gap
Dallas Leitz, Llam, Moore, *Social Sciences*
Mentor: Dr. Traci Sitzmann

Abstract:
Religion is a preeminent social institution that meaningfully shapes cultures. Prevailing theoretical perspectives suggest that it is primarily a benevolent force in business and idiosyncrasies across world religions preclude examining effects that thread across religions. Guided by a qualitative review of the religiosity literature, we develop a theoretical account that fundamentally challenges these assumptions by explaining how and why religious cultures,Äîregardless of which religion is prominent,Äîdifferentiate based on gender, widening the gender wage gap. Three mechanisms are proposed to explain this relationship, including prescribing gender-based social domain differentiation, that women,Äôs sexuality is subject to external regulation, and agency is men,Äôs purview. We use a multi-method approach to test our theoretical model. First, a series of experiments establish the causal order of effects. Second, field studies showcase the predictive power that religiosity has on the gender wage gap across 140 countries worldwide and the 50 United States. In both field studies, the effect of religiosity on the gender wage gap is explained by differentiated social domains, sexuality, and agency. Finally, U.S. longitudinal data reveal that the gender wage gap is narrowing significantly faster in states with less religious cultures.

Representations of Post-Prison Life on Reality Television and Their Effects On Viewers
Maria Diaz Mize, N/A *Social Sciences*
Mentor: Melissa Tackett-Gibson

Abstract:
U.S. Department of Justice statistics paint a grim view of the outlook for released inmates. Per a 2018 report on prison recidivism, 68% of state prisoners released in 2005 returned to prison in three years and 83% returned within 9 years. The challenges prisoners face when they are released are numerous: from difficulty finding work to lack of social support and treatment, the deck is stacked against them. Exacerbating this issue is the fact that many Americans do not realize the difficulty in post-prison life. Media can close the information gap, but rarely does as most media focuses on life while inside correctional facilities.
One exception is Love After Lockup, a reality show on the WE TV network, which focuses on couples who met while one of the members was incarcerated. In many ways, the show is a typical reality program, displaying many of the tropes common to the genre. However, it also plainly portrays the challenges faced by offenders after they are released, including recidivism, drug use, and the challenges of remaining on parole or probation.
This paper analyzes the effects of representations of post-prisoner life. In a survey of fans of the show, the results are decidedly mixed with some viewers feeling more sympathetic to former offenders while others simply have their existing prejudices reinforced. I argue that television shows can still serve as educational tools in the fight for criminal justice reform efforts due to their immense popularity, despite their many limitations.

Resilience: a potential protective factor for acute pain and pain catastrophizing
Madisen Q. Frederick, *Biomedical/Health Sciences*
Mentor: Amy Wachholtz

Abstract:
Current research investigating resilience and its effect on chronic pain suggests that it may serve as a protective factor by decreasing several pain-related factors such as pain tolerance, pain sensitivity, and total pain. Although the role that resilience plays in the experience of chronic pain has been widely researched, there remains a lack of research exploring the relationship between resilience and both pain catastrophizing (how one subjectively quantifies pain) and acute pain experiences. This study aims to: (1) understand how resilience relates to acute pain experiences and pain catastrophizing and (2) explore potential of resilience serving as a protective factor for acute pain experiences to better adapt pain-related interventions that may protect against future chronic pain. The current study utilized a cold-water task to test the relationship between resilience and acute pain experience, pain-related factors, and pain catastrophizing (PC) in a sample of college students. We found several significant correlations including total resilience scores & total PC scores, pain sensitivity & total pain, pain tolerance & total pain, and sensitivity & pain tolerance. Exploratory analysis revealed the relationship between total resilience scores and total PC scores was mediated by age. What we observed suggest that both resilience and increased age can be a potent predictor of how one catastrophizes their pain. Additionally, we found that several pain-related factors are reliant on one another in many aspects, however resilience could not reliably predict any pain-related factor. Future direction regarding pain-related intervention suggests manipulating resilience to be a mechanism to reduce PC.

Scattering Poverty: Emigration Schemes and London's Unemployed, 1880-1914

Matthew Fulford, *Arts and Humanities*
Mentor: Professor William Wagner

Abstract:
Scattering Poverty examines the role of British emigration societies in tackling unemployment between 1880 and 1914. These societies were tasked with the contradictory goals of exporting unwanted crowds of casual workers from Britain,Äôs urban areas while also convincing their host communities that they were only sending abroad their ,'best,' laborers. In Canada, where most workers were sent during this time, the process appeared to create significant tension. This was due in part to the early development of Canada,Äôs own fledgling national identity and nativism. By sending workers to labor on colonial farms in regions such as Manitoba, British reformers believed that they were rescuing the honest poor from moral degradation in the city. However, this process helped to teach reformers about the complex, global nature of unemployment. The ineffectiveness of exporting surplus labor taught them that unemployment was not a one-sided local issue that could be cured by dealing with the character flaws of workers, but required more comprehensive policies.

Scoping Review on the Effect of gentrification on Chronic Conditions in Late Adulthood

Chase Hills, *Social Sciences*
Mentor: Ronica Rooks

Abstract:
This scoping review is aimed to answer questions surrounding research focused on the effect of gentrification on chronic conditions in late adulthood. These questions include What is known from existing literature about the negative and positive impacts of gentrification on seniors,Äô health? What social determinants of health services are needed to support seniors in gentrifying neighborhoods? What disciplines are contributing to the research? How overall research could benefit from interdisciplinary contributions? A scoping review is a literature review that evaluates gaps in the literature about a topic. Our methods consisted of using databases such as Web of Science. We combined these key concepts: gentrification, health, vulnerable, older adults, and services; along with

synonymous terms, and filtering articles by language (English) to find n=1172 articles. From here all the articles are screened first by abstract and title, then by the content of the text. Once the articles fitting the criteria are found, they will be evaluated to address the research questions. Aging in place means residing within a community that keeps older adults included and socially engaged, promotes access to resources and needed goods, and overall positive health outcomes for older adults. Gentrification threatens to disrupt aging in place by means of social isolation, food insecurity, limiting mobility and access, and diminishing mental health; this ultimately impacts chronic conditions. While there is ample literature covering aspects of the impact of gentrification in late adulthood, there remains scarce literature that covers the effect of gentrification on chronic conditions in late adulthood.

Sequencing and Comparative Analysis of Limb Genes in the Leopard Gecko Eublepharis macularius

Alyssa M. Brostowitz, Madison Leeper, Roxanne Van Hove, Alison Ashby, *Natural Sciences*
Mentor: Carlos Infante

Abstract:
Using sequences from several organisms we were able to narrow down several genes responsible for regulating limb development and develop primers for PCR. These primers were then used for PCR with Eublepharis macularius embryonic samples and sent for Sanger sequencing. I will be presenting our current findings for the number of genes we have sequenced and showing why these genes were chosen.

Service Member/Veteran PTSD Symptoms, the Impact on Military Family Functioning, and Current Interventions

Jennifer Rasmussen, *Social Sciences*
Mentor: Dr. Elizabeth S. Allen, Ph.D.

Abstract:
Clinicians and researchers have recognized the significant toll that military life, in general, can have on military families. In the post-9/11 era, many military families have been left to navigate a path through this stress and dysfunction in the presence of mental health disorders related to their service, such as Post Traumatic Stress Disorder (PTSD). Understanding how critical family systems can be disrupted in their daily lives during and after deployments, especially when mental illness is present, is key to providing adequate treatment that addresses the unique needs of military families. Current treatment plans for PTSD do not regularly, if at all, include family-centered care that focuses on parenting behaviors as a means to lessen the interaction between PTSD symptom expression and poor family functioning. This literature review takes a more in-depth look at the impact that military service member PTSD symptoms have on the military family system, especially their parenting behaviors, family systems response to symptoms and behaviors, and the psychosocial functioning of children living in the home. Implications for interventions are also considered, particularly to what extent recent studies have shown positive outcomes for family functioning when a more family-centered intervention is included in the treatment plan when a parent has PTSD. This project aims to highlight the positive impact that family-centered care has on child behavior outcomes, PTSD symptom expression, and family functioning in an effort to emphasize the merit of including family-centered care as a standard practice, where applicable, in PTSD treatment interventions.

Severe Traumatic Brain Injury in Pediatrics: Prevalent causes, symptoms, brain dysfunction by location, diagnosis, rehabilitation treatment and management, and prevention

Kailyn M Deavens, *Social Sciences*
Mentor: Jason Watson

Abstract:
TBI is a form of an acquired brain injury that occurs when a sudden trauma causes damage to the brain. TBI can result when the head suddenly and violently hits an object, or when an object pierces the skull and enters the brain tissue.TBI is categorized for levels of severity. Mild, moderate, and severe are the types of TBI sustained and assessed. TBI will be assessed through loss of consciousness among other aspects. Mild is < 30 minutes, moderate is 30 minutes to 6 hours, and severe is > 6 hours. The Glasgow Coma Scale (GOS) is also used for a degree of recovery. Within these categories there are specific symptoms displayed and certain head injuries. Concussion (a mild TBI), penetrated head injury, and closed head injury are just a few. The head injury is what one acquires and the type of TBI is due to that impact. Symptoms will vary depending on its severity. Mild displays fatigue, visual disturbances, and dizziness. Moderate displays nausea, mood changes, and loss of smell. Severe displays a lot more brain dysfunctions. Causes of TBIs will vary from falls to motor vehicle accidents. Many populations can acquire a TBI however, within children, this is the leading cause of death and disability and is seen as a public health concern and burden. Within my research I will focus on severe TBI within pediatrics. Uncovering prevalent causes, brain dysfunction, diagnosis, rehabilitation treatment and management, and prevention is crucial to understand since this population is at such risk.

Sex differences in the neural circuits underlying voluntary exercise

Nashra Jamil, Kelsey, Margaret Abrams, Aleezah Tanner, *Biomedical/Health Sciences*
Mentor: Benjamin Greenwood

Abstract:
Sex differences in the neural circuits underlying voluntary exercise
Nashra Jamil, Kelsey Abrams, Margaret Tanner, Aleezah Balolia, Kelsey Bonar, Alyssa Hohorst, Esteban Loetz, Benjamin Greenwood
Exposure to stress can lead to stress-related psychiatric disorders, such as depression and anxiety. Females are more susceptible to depressive and anxiety disorders than males; however, the majority of mechanistic studies have focused on males. Understanding the mechanisms underlying this sex difference could lead to novel strategies for treatment of stress-related disorders. Our lab has observed that exercise enables stress resilience faster in females rats than in males. In male rats, 6 weeks of exercise is required to enable stress resilience, but in females, only 3 weeks is needed. Female rats also develop a running ,'habit,' faster than males. This could be important, because a region of the brain that controls habit behavior, the dorsal lateral striatum, has recently been implicated in stress resilience. The purpose of our experiments is to test the hypothesis that females recruit the DLS to control voluntary exercise faster than males. We observed that exercise activated the DLS in females, but not males, with a history of only 4 days of wheel running. We then pharmacologically inactivated the DLS during exercise to determine if this activity was required to maintain normal exercise behavior. Inactivation of the DLS after 4 days of exercise reduced typical exercise behavior in females, but not males. Inactivation of the DLS after 4 weeks of exercise, when both sexes have developed a running habit, reduced exercise in both sexes. These data suggest that exercise relies on habit, DLS, circuits in females faster than in males, and could explain the rapid development of exercise-induced stress resilience in females.

Sex differences in voluntary exercise behavior

Alyssa A Hohorst, River Wood, Jazmyne KP Davis, *Biomedical/Health Sciences*
Mentor: Benjamin N Greenwood

Abstract:
While various physical and mental health benefits of exercise are well known, this knowledge has not yet translated into increased exercise behavior among humans. In fact, participation in physical activity is decreasing. Rats provide a useful translational model as they, like humans, engage in voluntary exercise behaviors. Additionally, the positive physiological impacts of wheel running on rats resemble many of the health benefits of exercise in humans. However, very little of this research has been conducted with female rats due to additional work and difficulty in controlling for the estrous cycle, which has a pronounced impact on physical activity. Our research aims to begin to address this deficit by characterizing sex differences in voluntary exercise behavior. Adult male and cycling female Long-Evans rats were singly housed with in-cage running wheels for 4 weeks. Females were lavaged daily to track estrous phase and running distance was collected nightly. Initial results suggest that female rats run greater distances than males starting from the first night of wheel access. This sex difference is most pronounced when females are in the proestrus phase of the estrous cycle, when estrogen levels are highest. Nightly running distance escalates more quickly in females than it does in males, reaching a plateau after only 1 week. The circadian pattern of wheel running behavior is similar between sexes, wherein the majority of running occurs in the active cycle. During proestrus, however, females engage in wheel running behavior prior to the start of the active cycle. Most interestingly, the estrous phase females are in during the start of wheel running has a dramatic effect on later exercise behavior. Females which start wheel running during proestrus display greater running distances during subsequent days, compared to females which started running during any other estrous phase. This difference is most pronounced during later proestrus, suggesting that starting wheel running behavior in proestrus produces a state-dependent priming of exercise behavior. Further analyses of running speed and circadian rhythms of exercise behavior are ongoing. Our data reveal novel sex differences in voluntary exercise behavior, and suggest that ovarian hormones have a profound influence on voluntary exercise. Further, these data suggest that hormones present specifically at the onset of an exercise regime may prime the neural circuits controlling later exercise behavior in a state-dependent manner.

Status of soil microbial communities after a severe forest fire

Michael Kain, Andres, Andrade, *Natural Sciences*
Mentor: Dr. Annika Mosier

Abstract:
Fires impart both structural and functional changes to below ground forest ecosystems. Fire exerts direct pressures through combustion and thermal stress and indirect pressures through changes in pools of organic/inorganic resources as well as in alterations to the soil microbiome. Both direct and indirect pressures drive changes in recovery trajectories and long-term function. The effects of these processes may also differ under different moisture regimes. Here, we investigate the recovery state of the soil microbial community in a former subalpine forest 30 years after severe forest fire at two study sites in the Greater Yellowstone Ecosystem (Mount Washburn and Henderson Mountain). We are evaluating microbial community structure in burned and unburned soils under mesic and xeric conditions and will predict whether differences in soil chemistry influence microbial community membership. Soil inorganic nitrogen (mg/g of soil) varied minimally across sample sites, whereas other primary drivers of microbial community assembly such as soil moisture were significantly higher in mesic sites. Overall microbial community structure (based on 16S rRNA gene sequence analysis) was similar across plot condition. Microorganisms involved in nitrification, which plays an important role in controlling nitrogen availability in forest soils, showed greater abundance in burned soils. For instance, Nitrospira and Nitrobacter sequence types

were approximately 5X more abundant in burned soils compared to unburned soils at both Washburn and Henderson mountains. This systematic study of the conditions in the soil 30 years after a significant disturbance will inform future studies on the long-term consequences of wildfires in similar ecosystems.

Targeted homologous recombination directed by ROSA26 zinc finger nucleases
Elizabeth R Korthals, *Natural Sciences*
Mentor: Christopher J. Phiel

Abstract:
Targeted gene addition to the ROSA26 locus in a mouse genome can be used to obtain ubiquitous gene expression in embryonic stem cells. Previously, the most readily available technique for this process was through CRISPR-Cas9 technology,Äîa system in which a Cas9 enzyme, trans-activating crRNA, and a single guide RNA bind at a specific target sequence of DNA in a genome. However, new zinc finger nuclease technology has been reported to accomplish high levels of expression with on-target gene specificity, producing an outcome to rival that of CRISPR. In this experiment, the ROSA26 locus is used as the target locus. The mouse ROSA26 locus is particularly useful for genetic modification as it can be targeted with high efficiency and provides ubiquitous transgene expression. This experiment seeks to insert the FTO gene at the ROSA26 locus in hopes that by adding FTO at the targeted site, the affected cells will maintain a state of pluripotency more so than those without the addition. High levels of FTO expression have been previously linked to increased levels of pluripotency in mouse embryonic stem cells, however, the mechanisms by which this is accomplished remain unclear, thus prompting further research.

Tattooing Culture and Identity in Scotland
Hanah N De Laurell, *Arts and Humanities*
Mentor: Jeffrey Schrader

Abstract:
Tattoos and various types of body art, popular worldwide in recent decades, have become a method by which to express Scottish nationalism. By focusing on a European tradition, this paper expands the scholarly coverage of these arts as expressions of collective identity, which historians have otherwise prioritized in studies of, for example, the Pacific Rim and the Americas. Modern body art among Scots rests on a range of foundations. This inquiry covers historical documentation of the Picts, Pictish standing stones, the early development of 20th-century practices, interviews with current tattoo artists, and visual representations of their works. These 21st-century emblems cover Scottish brands, such as Irn Bru (a carbonated soft drink) and Tunnocks tea cakes, as well as clan representation and ties to ancestral Scotland. These connections consist of designs featured on standing stones as well as the usage of blue ink reminiscent of the woad-dyeing practice of the Picts, without the dangers the procedure involved. This research shows how tattooing and body arts have developed as a way of expressing identity and how this manifestation connects with the nationalism held dear to many Scots.

Temporal Analysis of Ecological Responses to Climate Variability in a Subalpine Environment
Matthew T Davis, James Rivers*Natural Sciences*
Mentor: Christy Briles

Abstract:
This study provides a reconstruction of past changes in forest composition and fire in response to past shifts in climate during the last 6,000 years. The climate events of interest are the Medieval Climate Anomaly (MCA: 850 - 1250 cal yr BP), the Little Ice Age (LIA: 200 - 600 cal yr BP), and a regional precipitation shift ~3,000 cal yr BP. This was accomplished by retrieving environmental proxy data from an 11 meter sediment core from Beaver Lake in Southern Colorado.
Beaver lake is at a ecotone between steppe and forest. In the past climate change has significantly influenced the the vegetation around the lake and the fire activity. Summer moisture is a significant driver of fire at the site. When summers are cool and wet, forests expand to lower elevations and fire activity increases. However, warm and dry periods cause steppe to expand and fire activity declines.
As the climate continues to change, it is important for us to understand how ecosystems and our climate have changed in the past if we are to understand how they will change in the near future.

The Affect of Socioeconomic Status on Cardiovascular Risk
Hirah Sheikh, *Biomedical/Health Sciences*
Mentor: Jennifer M Boylan

Abstract:
Socioeconomic status (SES) is an established risk factor for cardiovascular disease. Low SES has been linked to higher risk for cardiovascular disease. However, the mechanisms by which this occurs are unclear. Having an exaggerated blood pressure and heart rate response to short-term stressors within the lab have been linked to greater risk for cardiovascular heart disease. A prior meta-analysis suggests there is a relationship between SES and cardiovascular recovery but not reactivity. The main research question was: Is socioeconomic status predictive of cardiovascular reactivity and physiological recovery? Data was provided by 148 healthy adults from the Denver metro area. During the lab session, physiological and psychological measures were collected from participants at rest, during, and after stressor tasks. SES was measured with education and reported difficulty paying for basic necessities. Results showed that participants who completed at least some college education had lower heart rate reactivity compared to participants with a high school education or less. No other significant associations between SES and physiological reactivity and recovery emerged. SES may not have predicted cardiovascular recovery and reactivity due to acute stressor tasks not being perceived as equally stressful across levels of SES or because participants exhibited incomplete physiological recovery. Future work will examine whether SES was associated with different psychological responses to the stress tasks (e.g., task engagement, anxiety during tasks), as these psychological results may inform the lack of physiological differences in reactivity and recovery across SES.

The Association of Trait Mindfulness with Meaning Salience: An Exploration of the Mindfulness-to-Meaning Theory
Mackenzie M. Peckham, *Social Sciences*
Mentor: Kevin S. Masters

Abstract:
Background. Research on the mindfulness-to-meaning theory proposes that those with higher degrees of mindfulness will find greater meaning in life. Multiple studies have shown a correlation between learned mindfulness and meaning; however, trait mindfulness has not been tested in the context of the theory. Purpose. The purpose of this study was to test the mindfulness-to-meaning theory using a quasi-experimental design investigating whether trait mindfulness predicted meaning salience after a meaning induction task. Methods.

Participants (M = 37 yrs.) completed demographics, trait mindfulness, and meaning presence measures. They attended a laboratory session and were randomized into one of two groups; meaning induction (MG) or control. The MG completed two tasks designed to evoke a sense of meaning. The control tasks were similar but did not include meaning induction. Meaning salience was measured before and after the tasks. Results. Regression analyses showed that both trait mindfulness and group designation predicted increases in meaning salience (ps = 0.001) and these findings remained significant when controlling for age, gender, and education level. However, when meaning salience was regressed on the group by trait mindfulness interaction, it was found to be non-significant (p = 0.808). Conclusions. These findings demonstrate a relationship between trait mindfulness and meaning salience but the anticipated augmented effect in the presence of the meaning manipulation was not found. Thus the results only partially support the mindfulness to meaning theory. The meaning manipulation, used here for the first time, may not have been potent enough to produce anticipated results.

The Colonized Subject as Fetish Object: Hannah H√∂ch,Äôs From an Ethnographic Museum
Margot Silverstein, *Arts and Humanities*
Mentor: Maria Buszek

Abstract:
In the spring of 2019, I was selected to present my essay ,'The Colonized Subject as Fetish Object: Hannah H√∂ch,Äôs From an Ethnographic Museum,' at Chapman University,Äôs 9th annual undergraduate Art History symposium. With the help of the Office of Undergraduate Experience I received full funding for my trip to Los Angeles, sourced from extraneous funds from the 2018 UROP Grant. In my essay, I study a series of photomontages by the Dada-era artist Hannah H√∂ch, in which the artist critiques her peers,Äô and contemporaries,Äô interests in non-Western art and cultures. Presenting at the Chapman symposium proved an invaluable experience, allowing me to transform a simple term paper into my first conference presentation. Conferences and symposia are one of the major ways that art historians present their research to one another, and this experience gave me insight into the process of preparing for a conference presentation. In February of 2019 my essay was selected by a jury of Chapman,Äôs Art History faculty and students. With the aid of my own department,Äôs faculty, prior to departing for Los Angeles I put the essay and its accompanying slideshow through an intensive additional round of edits, so as to elevate the presentation to a professional caliber. This conference gave me the incentive to refine my writing to a professional and presentable quality, and to continue to do so in my work that has followed.

The Development of Children,Äôs Resilience: Relations Between Parent and Child Response Styles
Samaria Stovall, *Social Sciences*
Mentor: Katherine L. Casillas

Abstract:
According to the National Scientific Council on the Developing Child, resilience is defined as positive, adaptive responses in the face of significant adversity. While not all children face significant adversity, all children do face at least intermittent stressors and challenges to which they must respond. Learning positive, adaptive responses to such events is one necessary factor in the development of resilience, yet how are such response styles attained? One of the most important factors that influences children,Äôs emotional and behavioral responses,Äîespecially for young children,Äîis the parenting to which they are exposed. While the centrality of the parent here is not surprising, the specific mechanisms by which a parent influences children,Äôs response styles is less clear. Social learning theory would say that parents shape their children,Äôs behavior through modeling. Yet, a review of the literature provides mixed results on the direct relation between parent and child response styles, at least when

focused on direct dyadic interactions between parent and child. Perhaps the field has focused too narrowly on situations directly tied to parent-child dyadic interactions? Instead, our current work takes a more holistic view of the role of the parent. We argue that the influence of the parent is more cross-contextual,Äîacross the many settings from which the child is watching and learning, parenting and otherwise. We propose that adult response styles,Äîavoidant and overreactive,Äîare key in the development of child response styles,Äîinternalizing and externalizing. We expect that parents holistically impact the development of their children,Äôs resilience.

The Effect of Stress on High Blood Glucose and Diabetes Mellitus
Judy P Tran, *Social Sciences*
Mentor: Candan D Ayintug

Abstract:
Stress is one of the most common psychological stressors toward first-generation students. The correlation between stress and student's health issues is common in academics, work, caregiving, and many more responsibilities. Students having severe headaches, sleep deprivation, high blood glucose, diabetes, obesity, hypertension, and many other issues that could make an impact on student's physical and mental functionality. First-generation students encountered this from previous family health backgrounds passed on to this generation. There are biological processes towards the effect of health issues from stress. Diabetes is one of the most commons health issues that students and anyone in the world can pertain to stress. The qualitative method of open-ended questions will be documented from different first-general students. According to the affection of health issues from stress, understanding the psychological and biological process of how students get that disease from stress and how students are getting treated for their health.

The Emergency Medicine Specimen Bank: Consenting A Diverse Population in an Acute Care Setting
Alexis V Veste, *Biomedical/Health Sciences*
Mentor: Andrew A. Monte

Abstract:
The Emergency Medicine Specimen Bank (EMSB) was created in 2018 to generate a biorepository that can be utilized by investigators interested in improving health care in acute care environments. The EMSB recruits patients from the UCHealth Emergency Department (UCHED).
Eligible patients are given a consent form at registration and student interns complete the consent process. Consent lasts for 1 year, facilitating sample collection during the index visit and return visits. Waiver of consent allows collection of blood samples at IV placement and disposition. Samples are matched to consented patients and stored for future research. Presented is information of consented patients during February 2018-December 2019.
There were more than 180,000 visits to the UCHED; over 20,000 of these visits resulted in a consented patient, while about people 12,000 declines. Most consented participants are ages 18-39 (n=4116, 51.2%). 51.02% (n=3973) of consented participants are white, 21.43% (n=1669) are Black, and 26.45% (n=2060) are of Hispanic ethnicity. 130 participants are of Asian race, 43 are Native Americans, and 27 are Native Hawaiian. 57.2% (n=4458) of the consented cohort are female gender. The most common chief complaints of consented patients with samples are: abdominal pain (n=718, 17.7%) chest pain (n=445, 11.0%), and shortness of breath (n=262, 6.5%). Many acute care patients are consentable in the ED and are willing to participate in biobanking research. We have consented a diverse subject group, which has not been reflected in other biobanks. Since many biobanks aim to personalize medicine, diversity in the enrolled population is essential.

The Impact Domestic Violence has on Children who are around it
Joana Sanchez Gomez, Monique, Christopher Salas, Riggs, *Arts and Humanities*
Mentor: Jessica McGaugh

Abstract:
The film, Thicker than Water, focuses on Dahlia, an eight-year-old who tries to cope with the abusive relationship her mother is in with her boyfriend DJ. The film focuses on the point of view of Dahlia and the relationship between her and her mother. As the toxicity of the setting worsens, this pushes Dahlia and her mother to make a decision that will impact their lives for good or bad.
Students of the Film and Television program made this film and our projected outcome of this film is to screen it at film festivals internationally with the hope that it will create awareness of the impact that domestic violence has on children. In the US alone, domestic violence harms more than 15 million children according to the Womenshealth.gov. The research projects that an average of 582,000 unreported cases exist in the US. We are wanting to partner with a couple of domestic violence organizations to create a screening series online and at events to showcase the film and its message.

The Impact of Demographic Variables on Access to Eating Disorder Treatment
Lydia Rhino, *Social Sciences*
Mentor: Jenn Greiving

Abstract:
The purpose of this project is to explore research regarding the impact of demographic variables such as race, ethnicity, and socioeconomic status in access to eating disorder treatment in the United States. Prior studies reveal that underserved populations are the most at risk for developing an eating disorder due to systemic oppression and other underlying variables. A review of the literature will be conducted with the goal of informing future research.

The isosteric matrices of the Non-Watson-Crick base pair
Kazuki Hincks, *Biomedical/Health Sciences*
Mentor: Marino Resendiz

Abstract:
For many years people were able to exhibit and observe the RNA structure at an atomic level to the point where we are able to distinguish the four base pairs: Guanine, Adenine, Cytosine, and Uracil. Of course with this there is still unknowns to this structure. One of those unknowns is the edge-to-edge hydrogen bonding between the isosteric matrices of the non-Watson-Crick base pairing in the cis direction. By observing the base pairs and hydrogen bonding, we could uncover more about gene mutation within the RNA. My work involves creating and observing those base pairs and their hydrogen bonding through program called chemcraft. Methods used for the program involved finding the stability of the Hydrogen bonding through syn and anti-formation along with observing the canonical. We also used both 8-oxo and Bromo on Guanine and Adenine to indicate that gene mutation.

The Patagonia Research Experience
Sarah L Zimmer, *Technology, Engineering, and Mathematics*
Mentor: Rafael Moreno-Sanchez

Abstract:
Three flights, one boat, a horse, and a lot of patience. These are the elements that made one woman,Äôs most recent research trip to the northern ice fields of Chile possible. The video "The Patagonia Research Experience", documents a young scientist,Äôs journey into one of the most beautiful and pristine, yet harsh regions of the Earth. As an environmental scientist and a GIS analyst, Sarah Zimmer wanted to challenge herself by pushing beyond the normal realms of a research trip. Using various methods such as drones, GPS, and dendrochronological dating, a team of researchers consisting of students and faculty from the University of Colorado Denver embarked on a 2-week adventure into the Patagonia wilderness to gain a better understanding of the state of the Nef Glalcier on the Aysen Glacier Trail. Of special interest were the long-term effects of a glacial ice dam bursting in the Soler Valley in 1989. By studying how the glaciers have historically responded to the effects of climate variability, scientists can begin to create and improve current prediction models for what the future may bring. Using daily logs and video footage from each day in the field, Sarah gives her audience an inside look at the overall data collection process. It is her intention to relay the importance of first-hand data collection and research in the field to other analysts and scientists.

The Relationship between Mindfulness, Pro-Social Behavior, and Emotional Response
Emerald G Saldyt, Esmeralda, Lopez, *Biomedical/Health Sciences*
Mentor: David S Albeck

Abstract:
Substantial evidence indicates that the brain recruits more neurons and attention to negatively valenced visual stimuli and that this ,'negativity bias,' can be modulated by both bottom-up and top-down processing as well as individual differences. The variables, altruism, empathy, and trait mindfulness and meditation are positively correlated with each other, yet they tend to cause opposite effects in the brain in response to negative emotional stimuli. High altruism and empathy correlate with increased arousal while high mindfulness correlates with decreased arousal, both to negative stimuli. This experiment uses the self-reported subjective ratings of valence and arousal, using the Self-Assessment Manikins Survey (SAMs), to determine the variability of a person,Äôs response to emotional images when these traits co-occur. Subjective ratings will be examined in relation to self-reported trait empathy and mindfulness, behaviors such as altruism and meditation, and the image valence (positive, negative, or neutral). The aim is to explore relationships between the independent variables of image valence and scores from the Five Facet Mindfulness Questionnaire (FFMQ), the Toronto Empathy Questionnaire (TEQ), the Altruistic Personality Scale, and the Meditation Experience Questionnaire on the dependent variable of subjective arousal. Images are selected from the International Affective Picture System (IAPS). Data will be analyzed using multiple regression. We will examine whether an interaction exists between these individual traits on subjective arousal and we operate with the goal of understanding emotional regulation and processing in the brain. Findings will guide clinical research to promote emotional intelligence and regulation.

The Restorative Impact of Fascination at Different Viewing Durations
Thomas K. Poehlman, *Social Sciences*
Mentor: Jason, M, Watson

Abstract:
Attention is a resource that is constantly being taxed. Due to its importance in cognition, a clear understanding of how to renew attention is paramount. Natural settings, notably those that have been deemed to elicit fascination, may replenish this vital resource. Mystery in nature also seems to have an effect on its restorative potential. Yet, the mechanisms of how mystery/fascination in nature promote cognitive recovery are still unclear. The current study used a quasi-intervention approach, presenting images of mysterious/fascinating nature and then testing for any recovery effect on attention. In Experiment 1, participants were primed with two images of nature for a total of 20 seconds (10 seconds/image), where the two images were either high or low mystery based on normative data. Following the primes, participants were asked to complete a question from a Remote Associates Test (RAT) test (e.g. cottage, swiss, cake = cheese), a creative problem solving task requiring attentional resources. Experiment 2 used the same procedure, however, the images were shown for a total of 2 seconds (1 second/image), permitting a strong theoretical test of how much engagement with the images might be necessary to produce cognitive benefits. In both experiments, when primed with high versus low mystery images, participants showed greater accuracy and faster reaction time when solving RAT problems. Taken together, these results suggest both 20 and 2 seconds are sufficient for mysterious-fascinating aspects of nature to both engage and restore attention. Implications of our findings for attention restoration theory will be discussed.

The State of State Parks: An Analysis on the Achievements and Shortfalls of Colorado,Äôs Park System to Identify Political, Social, and Economic Barriers to Sustainable Development Practices
Samantha S Rovno, Alexander J, Gomez, *Social Sciences*
Mentor: Larry A Erbert

Abstract:
Colorado,Äôs newest and second largest state park, Fisher,Äôs Peak, is expected to open in 2021, a mere 4 years after the project was initiated. The speed and efficiency with which the new park is developing has received much attention and praise, taking an entire 23 years less to open than Colorado,Äôs previous state park. Intrigued by the stark difference, our capstone thesis project aims to untangle the complex support structure of Colorado,Äôs park system in order to identify major roadblocks in the establishment and maintenance of state parks. Semi-structured interviews were conducted using a consistent set of questions with members of CPW, DNR, GOCO, and other park related organizations. Qualitative analysis of their participant perspectives revealed a range of political, social, and economic barriers to sustainable development practices. It is clear that park management are struggling to maintain critical conservation projects while adjusting to increasing visitation rates, climate change, public misconceptions, and inconsistent funding sources. Our research provides insight into establishing and maintaining new parks, compares different strategies for managing park visitation, analyzes how parks are coping with climate change and other ecological disasters, illuminates how political systems can support or hinder state and national parks, and identifies opportunities for citizens to support park efforts.

The Synesthetic Mindscape
Jack Lewis, *Technology, Engineering, and Mathematics*
Mentor: Cecilia Wu

Abstract:
The focus of ,'The Synesthetic Mindscape,' is to imagine what it,Äôs like to see sound. Synesthesia is a condition where one sense is perceived by another. Virtual Reality environments are the perfect medium to simulate a synesthetic experience. Using the video game development tool Unity, it,Äôs possible to build an interactive and immersive world where users have the opportunity to see sound. The nature of the VR environment allows for

shapes and colors corresponding to frequencies (related to the synesthetic experience) to be added, removed or relocated. In addition, sound can be experienced spatially so that a user can easily locate a sound within the VR environment similar to the way we locate sounds in real life. Coding languages like ChucK provide functionality for spatial audio. I have been researching how to implement ,'The Synesthetic Mindscape,' through software like Unity, ChucK and Chunity. I want to explore the reciprocation between sound and visuals. The experience begins with gesture-based music composition but continues indefinitely toward far-reaching implications in big data analysis, psychoacoustics, music theory and medical research.

The Use of Digital Pedagogical Tools to Scaffold Key Chemical Concepts

Kathleen M Le, *Social Sciences*
Mentor: Dr. Priscilla Burrow

Abstract:
DFW (drop, fail, withdrawal) rates in STEM courses are traditionally higher than in other disciplines. The purpose of this project is to evaluate student knowledge of five core chemistry concepts in General Chemistry I, General Chemistry II, Organic Chemistry I, and Organic Chemistry II. These five core concepts are: 1) physical and chemical properties, 2) stoichiometry and equations, 3) acid-base chemistry, 4) glassware and equipment and 5) written communication in chemistry. The concepts were chosen because they are central to General and Organic Chemistry courses. The basis of this project is to determine if the core concepts are retained from introduction to use in subsequent courses. In addition, videos were created that cover some of the concepts which were included in the curriculum for the General Chemistry courses. After the piloting segment of the project, more videos are envisioned to cover the other concepts. The original intention of the videos is that repetitive viewing would reinforce concepts necessary for success in this four course sequence and subsequent chemistry courses. Initial data has shown that there is a great deal of variability in successful mastery of the concepts, based on data gathered from questions given to students in these courses. Therefore, it will be necessary to reanalyze how mastery of these core concepts is measured. Questions designed to measure mastery of the concepts will be evaluated. This will be accomplished through a faculty survey, interviews with students enrolled in the four course sequence, and development of a concept inventory test.

Tipping Our Hats to Truth: The Role of Research in Creative Writing

Holly C McCloskey, LeShaye A Hernandez, *Arts and Humanities*
Mentor: Nicole Beer

Abstract:
A common image: a writer sits down at their desk, hit by an invisible bolt of inspiration, and effortlessly cranks out a masterpiece of prose or poetry. This is a myth we,Äôre here to dispel. The reality is that inspiration is often a moment of curiosity that leads writers along an extensive journey of investigation. A writing project is the result of distilling this research into a compelling creative work. In an effort to explore the dynamic relationship between research and creative writing, we will be sharing excerpts of our stories and poetry, and discussing questions about the creative research process. What qualifies as ,'research,'? How do writers balance being accountable to the truth and taking creative liberties? What does it look like to make something creative out of a collection of facts? How can research-driven fiction and poetry be used to complicate our view of history and the world?

Tracking the Excess Proton in Proton Transfer between Water and Titratable Amino Acid Side Chains
Sahitya Talachutla, Shamik Bhat*Natural Sciences*
Mentor: Dr. Hai Lin

Abstract:
Proton solvation and transfer is ubiquitous in chemistry and biology. Unlike ordinary ions such as sodium or chloride, a hydrated proton is delocalized, existing in the form of a hydronium in water, a protonated ion, or a protonated functional group. One pressing issue in molecular modeling, e.g. when analyzing the saved trajectory from dynamics simulations, is to track the delocalized proton during the proton relay process that is typically dominated by bond-breaking and bond-forming steps. In this work, we develop a computer program that can track the approximate location of an excess proton in aqueous solution. Extension to proton transfer between titratable amino acids was also attempted.

Transgressive Politics: Child Welfare Institutions, Politics, and Gender in Progressive Era Denver, 1898-1914
Matthew Taylor, *Social Sciences*
Mentor: Bill Wagner

Abstract:
This paper examines the emergence of the child welfare movement in Denver during the early twentieth century in which Colorado developed two important child welfare institutions: the juvenile court, championed by Judge Benjamin Barr Lindsey, and the State Bureau for Child and Animal Protection. Lindsey and the heads of the State Bureau for Child and Animal Protection, E.K. Whitehead and Dr. Mary Elizabeth Bates, were all motivated by progressive ideology, but they developed a political rivalry that centered on sentencing practices in the juvenile Court. Lindsey,Äôs critics asserted that the court shielded men who sexually abused children from just punishments; however, Lindsey countered by attacking the legitimacy of the State Bureau for Child and Animal Protection. The conflict between Lindsey and his critics reveal that the child welfare movement in Denver was fractured, and provides an example of how political rivalries and disparate political philosophies shaped the progressive era child welfare movement in Denver. Exploring the political rivalry, and competing philosophies, that divided Whitehead and Bates from Lindsey provides insight into how the Juvenile Court in Denver promoted a vision of child welfare that increased state scrutiny of adolescent girls and promoted traditional gender norms. Understanding Denver,Äôs Juvenile Court, its sentencing practices, and the public feud between Lindsey and his critics demonstrates that progressive activists in the early twentieth century were far from unified about exactly what progress meant.

Trouble with the Trolleys: The Decline of Streetcar Use in Denver, 1919-1950
Harrison J Sokol, *Arts and Humanities*
Mentor: William Wagner

Abstract:
Streetcars helped shape America. For cities across the country, including Denver, they were once the primary mode of public transportation for millions of Americans. Yet nowadays only a handful of cities still have operational trolley systems. My paper sought to discover why streetcars disappeared from Denver by examining events between 1919 and 1950. Through thorough investigation into the Denver Tramway Company's internal records, some pieces came to light. As one might expect, there is no single answer to such a monumental overhaul. Labor unrest, increasing car ownership, declining ridership, a combative city government, and the tumultuous Great Depression all played their role in the demise of the streetcar. All in all however, the advent of

buses over trolleys came about for financial reasons. Public transportation in Denver at that time was controlled by a private company that was ran for profit. Lowering costs was paramount to the Tramway Company, and replacing trams with buses seemed like the best way to achieve that goal. This is a story that spans over three decades, and Denver is still impacted by the decisions made over a hundred years ago. Relevantly little has been written on the topic, and there is a particularly large gap in the World War II era scholarship. My paper aimed to correct that mistake.

Tuning halogen bonds and chalcogen bonds for drug capsule functionalization
Anh L Tran, *Natural Sciences*
Mentor: Emilie, B, Guidez

Abstract:
Chalcogen (Ch)/halogen (X) bonds, which are non-covalent bonds formed between group 16/group 17 elements and nucleophiles (N), are categorized as a type of intermolecular force known as sigma hole interactions. Sigma hole interactions have an emerging role in rational drug design as they can be used as a potential glue to hold drug capsules together, depending on their binding affinities. In this study, we seek to characterize the strength of sigma hole interactions by optimizing chalcogen and halogen bonded molecular complexes using MP2 and the Effective Fragment Potential (EFP) method, a first-principles derived force field. The results indicate that chalcogen bonded dimers are lower in energy than halogen bonded dimers, mostly due to stronger electrostatic interactions. Results also show that both inductive and steric effects need to be considered in order to tune the geometry of the complexes and the strength of the sigma hole interactions.

Understanding the Association Among Environment, Microbiome, and Golden Retriever Health
Kayla A. Medina, *Biomedical/Health Sciences*
Mentor: Christopher S. Miller

Abstract:
Golden Retrievers across the United States suffer from increased adverse health outcomes due to obesity. However, there has not been a further study of the link between environmental factors such as diet and microbiome, and how that might affect dogs who suffer from an adverse health outcome. Given the fact that there is a strong association between microbiome and body condition in humans and mice, we hypothesized that there is a relationship among diet, microbiome, and adverse health outcomes in dogs. To begin to explore this hypothesis, we utilized 16S rRNA sequencing method. Our initial work highlights that environmental factors.

Understanding the Association Among Environment, Microbiome, and Golden Retriever Health
Kayla Medina, Alex, Romero, *Biomedical/Health Sciences*
Mentor: Christopher S. Miller

Abstract:
Golden Retrievers across the United States suffer from increased adverse health outcomes due to obesity. However, there has been limited study of the link between environmental factors such as diet and microbiome, and how that might affect dogs who suffer from an adverse health outcome. Given the fact that there is a strong association between microbiome composition and body condition in humans and mouse models, we hypothesized that there is a relationship among diet, microbiome, and adverse health outcomes in dogs. To begin

to explore this hypothesis, we utilized high throughput 16S rRNA gene sequencing methods. Using a Course Based Undergraduate Research Experience in General Biology labs, we have characterized the microbiome composition of 400 Golden Retriever fecal samples with replication. Our work is one of the largest samplings to date to characterize the common microbes found in a single dog breed, and lays the groundwork for understanding associations among variation in microbiome composition and environmental factors.

Understanding the Role of the Unfolded Protein Response on Innate Immune Sensing by RIGI

Haven Himmighoefer, *Biomedical/Health Sciences*
Mentor: Jay Heesselberth

Abstract:
The unfolded protein response (UPR) is a highly conserved reaction to endoplasmic reticulum (ER) stress caused by an accumulation of unfolded or misfolded proteins. Activation of the UPR resolves cell stress by proteostasis or apoptosis. Inositol requiring enzyme 1 (IRE1) is an essential ER transmembrane protein that activates the UPR through its RNase activity, which produces anomalous splicing of X-box protein 1 (XBP1) messenger ribonucleic acid (mRNA). IRE1 also functions in IRE1- dependent-decay (RIDD), where ER-associated mRNAs are cleaved to maintain proteostasis. RIDD produced RNA fragments are suggested to cause inappropriate activation of retinoic acid-inducible gene 1 (RIG-I), a pattern recognition receptor (PRR), initiating a type I interferon response. We propose to identify RIDD produced RNA fragments that may activate RIG-I by identifying IRE1 downregulated mRNAs in XBP1-null cells and determine how mutations in RIG-I affect binding and activation with these RNAs. We are generating XBP1 knock-out cells using homology-directed CRISPR-Cas9 editing and have validated ribonucleoprotein complexes in vitro. To identify specific RIDD cleaved RNAs, we will compare IRE1 activated cells with IRE1 inhibitor, 4Œº8C, treated cells using mRNA sequencing to identify downregulated RNAs. Concurrently, we are generating plasmids expressing WT or mutant RIG-I through site-directed mutagenesis. We will express these plasmids in cells and activate IRE-1 to determine how RIG-I mutations affect RIG-I activation by RNAs cleaved during RIDD. These experiments will enable us to identify RNAs cleaved during RIDD and determine how endogenous RNAs bind and activate RIG-I.

Urban and suburban food availability for native in a semi-arid environment, Denver Colorado

Melissa Allen, *Natural Sciences*
Mentor: Christy Briles

Abstract:
Native bees serve an important ecological role in pollination. Pollen is an extremely important food source for bees and especially bee larvae. There has been a documented decrease in native bee species throughout the world and Colorado is no exception.
This study aims to review the available literature on resource availability for native bees in suburban and urban environments as well as semi-arid environments. Many native bees are specialists and have evolved to pollinate only certain species of plants, unlike generalists such as honeybees (Apis mellifera).Most studies on resource availability and pollen nutrition for bees have focused on honeybees, a managed and polylectic species (collects pollen from a variety of plants). Therefore literature focuses primarily on the Halictus and Melissodes bees found in Colorado with consideration of other bees such as the bumblebee (Bombus). Further research will be needed to fully understand how native bees are affected by resource availability in urban and suburban environments, in order to provide more targeted conservation efforts of native bees.

Variance Reduction Methods Based on Multilevel Monte Carlo
Lu Vy, *Technology, Engineering, and Mathematics*
Mentor: Yaning Liu

Abstract:
If we could see into the future, then finance would be a lot easier. Unfortunately, we can,Äôt, so stock traders work with mathematicians. When a time machine isn,Äôt available, the next best option is a good mathematical model. While many excellent models exist to predict stock prices, their complexity often evades an analytic solution. When this is the case, simulation becomes the best alternative. What began in the Los Alamos Laboratories as Monte Carlo estimation evolved over the next 80 years to become something ubiquitous in financial mathematics. Today, Monte Carlo computational methods are so heavily used that pseudo-random numbers alone hardly suffice. Predicting the modern market requires efficiency, and to this end, a number of variance reduction techniques emerged. Monte Carlo algorithms naturally require averaging many estimates, but due to computational expenses, one must choose between averaging many poor estimates and averaging a few good estimates. In 2008, Mike B. Giles published a paper that introduced the Multilevel Monte Carlo algorithm. He found a way to incorporate both poor and good estimates, thus producing an even better estimate. In our research, we seek to improve on Multilevel Monte Carlo. Methods we consider include control variates, antithetic variables, the Milstein discretization, and quasi-random numbers.

Venner: An American Perspective on Danish Culture
David A Younglove, *Arts and Humanities*
Mentor: Melissa Furness

Abstract:
While Americans often reference Denmark in political discussions, Danish culture is little understood in the US. In order to foster better understanding and explore international perspective, I undertook an artistic research trip to Denmark. This trip focused on museum and gallery exhibitions as a means of gaining insight into both contemporary and historic elements of Danish culture. It also included interviews with experts in Danish fashion and participation in cultural events. In addition to the trip scholarly research was conducted with Marie Riegels Melchoir and Toke Lykkeberg as primary sources. Ultimately, these experiences formed the backdrop for a series of artworks communicating my findings. Inspiration from Danish artist Dea Trier M√∏rch was foundational in my aesthetic approach, and Jens Haaning,Äôs work helped to guide me conceptually. What I found were the calm, cozy, and communal traditions of a historically pastoral culture melding with contemporary issues such as the integration of refugees. Presiding over everything were the notion of sustainability, and humanity,Äôs relation to nature. My intention is that by communicating these Danish elements through my own perspective as an American an insight into both cultures is gained.

Visually Rich Music Sequencing and Sound Generation
Khalid H Adkins, Zaid Al Yasiri, Nicholas A Stanford, Marco C Rojas, *Technology, Engineering, and Mathematics*
Mentor: Ellen Gether

Abstract:
The digital synthesis of sound is a mathematically and computationally challenging endeavor that is limited by the fact that natural sound waves produced by instruments are the result of nearly infinite harmonic frequencies. Computer Scientists have grappled with the challenge of modeling the physics of natural sound for decades. The

goal of our team has been to make an engaging, interactive tool by which participants with little formal knowledge of music theory can synthesize new sounds, and then play these instruments using an interface that facilitates the learning of fundamental musical concepts. Users will also be able to develop a more profound appreciation of the link between mathematics and music. In addition, we have striven to create a tool that is not only educational, but fun and intuitive to use, incorporating interesting visual elements as a core element of the user interface.

What do bees eat in resource-limited environments?

Hillary Hillam, *Natural Sciences*
Mentor: Christy Briles

Abstract:
Bees are keystone species that pollinate many of our food crops. Urban and agricultural landscapes are considered to have limited resources for pollinators. There is increasing and needed demand for local food production; however, it is unclear if there is both a diversity and abundance of food resources for bees to sustain healthy populations. The CU Denver Bee Project has been collecting and measuring pollen and nectar resources for honey bees from 30 colonies placed in downtown Denver, suburban Littleton, and a rural and intensely cultivated site in western Colorado. In comparison to suburbia, nectar production was low in downtown and cultivated landscapes, while pollen production was highest in those locations and low in suburbia. While honey bees are generalists, they prefer insect-pollinated plants that produce nutritious pollen and often have a nectar reward for visitors. In suburbia, the bees were sourcing mainly these nutrient-rich pollen types; however, in downtown and agricultural locals, they were bringing in wind-blown pollen which is produced in abundance by many forbs and urban trees in the semi-arid West. Wind pollen is low in nutrients and cannot sustain healthy bees. The results suggest that urban and agricultural regions of Colorado supply bees with copious amounts of low-quality food to sustain their colonies. In suburbia, more open space and gardens supply better quality resources for bees. The study highlights the importance of planting pollinator-friendly resources, but also the use of honey bees, pollen and nectar in determining habitat quality in resource-limited environments.
