GRADSHOW

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Presented by

Graduate School | Vice President for Research

COLORADO STATE UNIVERSITY

2020

Performing Arts

Short Fiction: An Apparent Opening

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An Apparent Opening is a short story about a young woman named Caroline who visits her father at his mountain cabin in the Sierra Nevada and is forced to confront his coming decline and death. Not long before the events of the story her mother died, and she continues to learn about what it means to grieve as she looks to her fathers future. It is a story about family, about loss, and about the lessons that nature might teach us about life cycles and the grieving over our loved ones.

I plan on incorporating this piece into a larger collection of short fiction that explores the connection between family, loss, and nature. I'm broadly interested in the ways that close observation of nature and its patterns can bring us existential comfort and philosophical insight.

Visual Arts

2   The Piano Showroom Reimagined: Virtual Museums of Art

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I propose producing unique classical music videos that utilise piano showrooms as museums and consequently attract and inspire our next generation of young musicians. These videos will showcase the piano as a historical artefact.

The modern piano is encapsulated in museums across the world. Last year, I was stolen away to another era upon viewing the history of the piano in The MET Museum's (NYC) musical instrument exhibit. Golden harpsichords and fortepianos fit for royalty littered the exhibit. For somebody who has played piano her entire life, I felt fonder of my instrument than ever before.

COVID-19 stole the chance for this kind of inspiration to occur to the wider world. The advent of social media is the most effective way to communicate with global audiences. Classical music's popularity is ebbing and is unbeknownst to children who lack access to it. We could lose the next generations musicians with COVID-19 as another inhibitor to accessing classical music.

The advertisement opportunities within piano showrooms are seldom used to our advantage. This summer - the 250th anniversary of Beethoven - I teamed up with Sherwood Phoenix in England, to shoot an eye-catching video of Beethoven's Piano Sonata No. 18 in E Flat Major, The Hunt.

Piano showrooms should be accessible as a local museum of discovery for all. To inspire curiosity in these videos with exciting, quirky visuals is to inspire the start of a learning process.

Thank you for your consideration.

3   Experimental Video and Painting: A Disobedient Mediation

ANDREA BAGDON

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Within the canon of art history, the female form and ultimately female identity was conveyed as a commoditized trope of the feminine. As a female artist, I have searched for a solution to escape the patriarchal ideology that the medium of paint is chained to. There was a disruption to the historical, and patriarchal artistic canon in 1968 with the invention of the handheld Sony Portapak camcorder. Due to its accessibility many female artists gravitated towards this technology as a new way of art making. As a result, video became and inherently feminist medium which offers an alternative form of mediation to subvert patriarchal artistic canon. My newest paintings are the result of harvesting image stills from manipulated experimental videos. I would like to showcase my multidisciplinary practice which allowed me to enter a new conversation with my imagery. Instead of dominating the canvas with paint, I first have a dialog with the video. The resulting paintings are surreal, have a sense of movement and time that addresses the obsessive cultural programming of the female psyche. There is a dialog between artistic intuition of using the paint body and the technical automation of video that blurs the virtual and real which can create dynamic images that can adhere well to the seductive surface of a canvas. It can be used as a tool to reinvent painting and bypass an ideology that does not represent female artists.

4   Weed Control Using Goats for Holistic Land Management

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Noxious weeds hinder crop and livestock production, compete with native vegetation and cause significant agronomic damage to landowners and producers. Herbicides are the most commonly used tool to manage weeds in modern agriculture and this method has been effective in controlling weeds and increasing crop yield. However, chemical use is a barrier for producers adopting organic methods and its use has various environmental concerns. This study explores the use of goats as biological control tools for establishing a long-term integrated weed management system. Six goats were used for the study which was conducted on a ranch in Pagosa Springs, Colorado in the summer of 2020. Observations were collected regarding the behavior of goats with respect to different weed species, their palatability, viability of seeds, their impact on land and the feasibility of the process. It was observed that goats might not take to browsing weeds automatically but can be trained to do so. Their browsing pattern and preferences can differ by breed and reduced size grazing plots increases the speed of browsing among goats by creating a sense of competition. Canada thistle was the most preferred weed for these goats while leafy spurge was the least preferred. Viability of any seeds consumed and excreted is still under observation. The droppings, which are incorporated into the soil as the goats browse, are natural fertilizers and a source of moisture for the soil.

5   Mechanisms of Rejection through the Forgotten Act of Walking

ZACH LEONARD

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With the experience of almost losing the ability to walk, the appreciation for the forgotten act is demonstrated through my artistic strategy (process).

The use of psychogeography, which blends geography and psychology together to reveal how social engagement, produce attached emotions allows myself to make sense of my surroundings through the physical but also psychological parameters of the world.

What motivates me to continue in this practice is the fact that I see walking as a connection to our direct bodily experience and it expresses it as a subjective processing of experience. It became a tool for me to encounter my surroundings and activate it a phycological investigation (recontextualizing the walks as I reflect on uncomfortable events within my life my bus accident and recovery).

In my walks, I observe materials that can be viewed as disposable or dejected, and I find

myself collecting these common materials. This way of paying attention to the world around me was influenced by my work for the City of Vancouver as a Recycling Coordinator.

My drift takes me close to materials that are discarded and ultimately would end up in a landfill. I see my gesture of lifting dejected materials out of their deject-context, symbolical as it may be, to be an intervention into this irresponsible circuit.

In the end, I strive for a sense of poetry in humble materials by, creating works that exist in the present moment, reflect the fragility of the world, and allow for individual experiences and perceptions.

6 Tracings

LEILA MALEKADELI

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My work is process-based with high conceptual flair, delving into repetition led obsessions. I am interested in examining identity and language through the human experience and our relationship with technology. Creating language through the arts is paramount to our way of knowing the world around us. We can only describe that for which we have language, and the way to create language is in dissecting the objects, acts, and states for which are still unknown. My current research looks into how information is processed by both man and machine, along with their similarities and differences. Tracings chronologies a design first drawn by machine and then retraced by hand in 275 sequential iterations. Each individual trace is on 8.5 x 8.5 inches of copy paper utilizing black oil pastels. The subsequent breakdown of the pattern examines the miscommunication known to occur within the body. By manipulating self-identified rules for my processes to mimic algorithms found in technological binaries, the output is a mixture of hand-made and machine-made. This leads me to finding new ways in which to interpret information as a way of knowing by placing myself and tools in reciprocal relationships. To discover all aspects of identity, I find myself looking through a technological lens only capable of black and white processes, understanding that it cannot yet compute the shades of grey I see. I hope to further these explorations through meaningful clarification in order to create the language necessary in developing my own communications of identity.

8 The Body Beyond

MARIAH SHELBY

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Metalsmithing and Jewelry has a unique ability to interact within the public sphere because of its relation to the body. My research is centralized around stigma and bias in everyday life;

currently, my work focuses on sexual health and STD stigmas. How does stigma impact an individual, and why is sexual health a topic that so many people have in common but is taboo to discuss openly? In my work, I strive to create an opportunity for discussion. Communication is a great way to understand disease and how it affects a person mentally, physically, and emotionally. I hope to further the conversation in the Healthcare system through an approachable visual Art.

9   Field of Dreams: A Visual Representation of Modular Multiplicative Inverses

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Mathematics is full of artful symmetry, and one such example is the symmetric pairings of multiplicative inverses in a modular field taken over a prime number. To showcase this symmetry, I've created a set of dreamcatchers- representative of the fields created by taking the integers modulo 13, 73, and 181, and notated $Z_{(13)}$, $Z_{(73)}$, and $Z_{(181)}$ respectively- that highlight the distinct and intricate symmetries displayed in such fields amongst their multiplicative inverses. The construction comes from a careful, evenly-spaced numbering from 0 to (n-1) for n = 13, n = 73, and n = 181 around the circumference of appropriately sized metal rings, and then from connecting multiplicative inverse pairings with thin yarn to create the pattern depicted in the dreamcatchers. This construction not only creates a beautiful and mathematically-based decoration, it also calls to attention interesting properties, such as inverse pairings that are both multiplicative and additive inverses of each other within a modular field. This phenomena only occurs in modular fields taken over primes for which the primes themselves equate to 1 mod (4), and as such these pairings can be seen in the dreamcatchers representing the fields $Z_{(181)}$ and $Z_{(13)}$ as a horizontal line of yarn that spans the width of the dreamcatcher. While none of this is novel mathematical discovery, the dreamcatcher construction of these mathematical symmetries and attributes of fields adds new depth in visualization to how we perceive and depict multiplicative inverses in such fields.

10   Unifying Marks: The Process Drawings of Clark Valentine

CLARK VALENTINE

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Clark Valentine's artwork explores topics of mysticism through process-based drawing and printmaking. Inspired by Taoism, Hermetic traditions, Zen Buddhism and German Pietism, Valentine's artwork serves as an opportunity for mystical experience. Utilizing these processes, Valentine creates work through a private performance of devotional, laborious mark making techniques. The final image is a relic of the performance. Rather than depicting religious practices, Valentine has allowed his work to become a meditation itself. He seeks

to find a place of Taoist "no-action" in his work, responding naturally to the materials and the marks which have come before.

In this contemplative practice, Valentine's work references the accumulation of small marks to create an ephemeral image of spiritual energy. The transcendence of the human soul and the imminence of Divine energy coincide in these works, revealing the Unio Mystica - the unification of a mystics soul with the heart of the Sacred.

11 Pastiche and Parody of Nostalgia

AMY YOUNG

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With an intense shift in digital advancements in contemporary culture, there seems to be an increased longing for the past. We see this in every fiber of American culture but especially in entertainment. With remakes, remixes, and throwbacks, advertisers have also caught onto the trend of the past and have adopted it as a marketing tool. Its safe to say, we are drowning in societal nostalgia. In my work I point this out, but also transpose our obsession with the past by blending it with the uncanny.

By using uncanny pastiche and parody as a tool to draw peoples interest, I channel attention to be placed on topics surrounding human development. These topics often center around rites of passage, identity formation, and analysis of my personal upbringing. Through material collage and weaving, I use materials to set the theme of each artwork I create. For example, in an artwork titled Gone Fishing, I wove soft plastic baits into cloth to create an object that is referencing the sport of fishing directly. Weaving is a passion of mine because of fibers ability to create cloth out of unconventional matter. Continuing my thesis research, I plan to push the boundaries of materials that can be successfully woven. In future exploration, I will lean further into personal matters to allow viewers to see more of who I am so that the artwork may be a cathartic experience for myself and the viewer.

Research, Scholarship, and Entrepreneurship
12 Vulnerability of seaports to climate change.

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Approximately 10% of the worlds population lives and works in low-lying coastal regions that are less than 10 meters above sea level. This percentage is likely to increase during the remainder of the 21st century due to population growth and economic development. This growth brings the potential for increasing damage and economic losses due to tropical cyclones (hurricanes in North America) accompanied by storm surge and sea-level rise (SLR) in an era of climate change. This study reviews and critically appraises the potential

impact of the aforementioned multi-hazards on a typical coastal seaport community in the Gulf Coast of the United States. A new model for quantifying the functionality of seaports subject to these multi-hazards is implemented in a fault tree analysis. An analysis to enable the study the impact of hurricanes, storm surge and SLR on port facilities is validated using data from Hurricane Katrina. A case study of the Port of Mobile, AL reveals that if a Katrina-like hurricane were to occur late in the 21st Century, damages to the Port of Mobile would increase by a factor of nearly 7 under an RCP 8.5 scenario when compared to the damages caused by Hurricane Katrina alone.

13 Scale of Effect: Land Cover and Household Electricity Consumption

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As global population grows and shifts to urban living, household energy consumption, without changes to utility resources, will result in higher carbon dioxide emissions from urban centers and magnify the impact climate change. It is currently understood that main drivers of energy consumption include land cover, urban form, building characteristics, and lifestyle. While all of these drivers could be targeted in the creation of energy efficiency strategies, there is a growing body of research that supports trees to be viable contenders for reductions in energy use. However, previous literature has shown that trees planted beyond 18m of a home do not affect energy use directly through shading. To understand if the extent of 18m held true in our study area of Fort Collins, Colorado, we performed a preliminary, multi-scale analysis and looked at the effect of tree cover, as well as other land cover types, on peak summertime (June-August) consumption in single-family homes. To determine the scale of effect, we used buffer sizes of 6m, 12m, 18m, and 24m and ran generalized linear models using the percentage of land cover in each buffer size. We found that the scale of effect varied among land cover types and between our two study locations. The lack of agreement in our study locations indicates that more progress needs to be made before drawing any sweeping conclusions about the scale of effect of tree canopy, and other land cover types, on summertime electricity consumption.

14 Links Among Art, Mindfulness, Immune Response, and Disease Risk

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Purpose: To leverage insight from one discipline for progress in another by linking literature, from molecular disease mechanisms to using art as therapy. Procedure: This literature synthesis combines insight from psychology and molecular human physiological links between stress and disease, with a focus on connections between art as therapy, mindfulness as stress reduction, human immune response, and chronic disease and dysfunction. Results: A common root cause of modern diseases and disorders is immune

system dysfunction. The immune system is strongly modulated by external factors, such as chronic psychological stress. These responses to environmental cues were presumably originally adaptive but become derailed in the modern environment (Adams et al., 2016). Psychological stress can be reduced by mindfulness exercises, and photography may produce similar benefits. Mindfulness therapies encourage observation of the present and reduce rumination about past and future, thus reducing the risk for depression and anxiety. Similarly, photography focuses attention on an object or situation in the present, can promote appreciation, e.g., for the outside world, and places the photographer in the position of an observer. Processing emotion and stress from an observers perspective is a central feature of mindfulness therapy. Future directions: Research is needed to evaluate how photography may be used as a tool to teach mindfulness and to get people out and interacting with therapeutic landscapes such as parks or hospital gardens to reap the benefits of these environments.

16 Assessing the Effect of Pollutants on Neuronal and Glial Cells

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There are more than 50 million individuals with dementia worldwide and the number expected to continue to grow really fast. Alzheimers disease is the most prevalent type of dementia and it may account for 60-70% of cases. Several studies stated that air pollution especially PM 2.5 (particulate matter 2.5 micrometers and smaller) contribute to Alzheimers related changes in the brain. These changes include neuroinflammation, tau phosphorylation, microglia activation and oxidative injury. This topic was investigated in all study designs (in vitro, in vivo and brain autopsies after sudden death). We want to hypothesize that agricultural workers in northern Colorado may also suffer from increased rates of dementia due to pesticide, farm equipment pollution and dust (ie. PM 2.5). To address this hypothesis, we plan to expose primary neuronal and glial cells with pollutants collected outside dairies in the northern Colorado area. We will then assess the levels of inflammatory signaling and neurotoxicity in both cell types.

18 Early metabolic priming under differing carbon supply influences peach quality

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Crop load management is an important preharvest factor to balance yield and quality in peach production. However, the maturity status of the fruit directly influences fruit characteristics such as the internal quality and metabolome. Few studies have investigated how preharvest factors truly impact quality and metabolism on fruit, by controlling for equal maturity. An experiment was conducted to understand how carbon competition impacts fruit internal quality and metabolism in Cresthaven peach trees by imposing distinct thinning severities (i.e. crop loads). Fruit quality was also evaluated at three developmental stages

(S2, S3, S4), while controlling for equal maturity using non-destructive near-infrared spectroscopy. Non-targeted metabolite profiling was used to characterize fruit at each developmental stage from trees that were unthinned (carbon starvation) or thinned (carbon sufficiency). Carbon sufficiency fruit were of enhanced quality, resulting in significantly higher fruit dry matter content and soluble solids concentration at harvest when compared to the carbon starved conditions. This underscores the true impact of carbon manipulation on fruit quality, as maturation was not a confounding variable. Significant differences in the fruit metabolome between treatments were observed at S2 when fruit phenotypes were similar, while less differences were observed at S4 when the carbon sufficient fruit exhibited a superior phenotype. This suggests a potential metabolic priming effect on fruit quality when carbon is sufficiently supplied during early fruit growth and development. In particular, elevated levels of catechin, a flavanol with antioxidant properties, may suggest a link between secondary/primary metabolism and fruit quality development.

19 Time-resolved microwave photoconductivity of tin bromide perovskite thin films

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Solar cells are a renewable energy source that converts sunlight into electricity. Traditional silicon solar cells have an efficiency of over 25%. While structurally different, perovskites with the formula ABX_3 (A = CH_3NH_3 (MA), NH_2CHNH_2 (FA) or Cs, B = Pb, or Sn, X= Cl, Br or I) have efficiencies on par with Si solar cells. When exposed to light, photoconductivity is one way to determine how much electricity moves through a substance. This study aims to discuss the photoconductivity measurements in $CH_3NH_3SnBr_3$ and $CsSnBr_3$ perovskites using contact and contactless experimental methods. The contact method, where perovskite thin films of $CH_3NH_3SnBr_3$ and $CsSnBr_3$ were in physical contact with an electrode, showed evidence of short-circuiting due to chemical interactions during the electrode deposition process. These films were fabricated by spin-coating at 500 rpm at 60 seconds and annealed at 125 oC. The thin films were connected to a circuit chip using silver paste and platinum wire. These contacts etched the perovskite layer, preventing measurements from avoiding the issues that arise with contact methods. Time-Resolved Microwave Conductivity (TRMC), a contactless method of determining $CH_3NH_3SnBr_3$ and $CsSnBr_3$ thin films' photoconductivity through a drop-casting method onto a SiO_2 substrate after dispersion in a polystyrene matrix. Analysis of TRMC measurements can provide information about both equilibrium conductivity and photoconductivity data of the thin films.

20 Identifying compositional features facilitating prionlike domain recruitment to stress granules

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Stress granules are highly dynamic nonmembranous cytoplasmic RNAprotein assemblies

that form via interactions between mRNAs stalled in translation initiation and RNAbinding proteins. Many of the RNAbinding proteins in stress granules contain prionlike domains (PrLDs). PrLDs are intrinsically disordered protein domains that compositionally resemble yeast prion domains; some PrLDs have been identified as playing a key role in stress granule formation. PrLDs are thought to be recruited to stress granules in part by liquidliquid phase separation (LLPS). Mutations in various RNA binding proteins containing PrLDs are associated with degenerative diseases, including Amyotrophic Lateral Sclerosis. These mutations are associated with the formation of cytoplasmic inclusions that share common components with stress granules, suggesting that the mutations perturb stress granule dynamics. However, the sequence features that drive recruitment of PrLDs into stress granules have yet to be completely defined. We recently demonstrated that many PrLDs are sufficient for stress granule recruitment in yeast, and that this recruitment is driven largely by amino acid composition. Here, we utilize synthetic prionlike domains to rigorously examine the compositional features driving stress granule recruitment. We show that based solely on amino acid composition, we can rationally design synthetic PrLDs that are recruited to stressinduced assemblies. Surprisingly, although aromatic amino acids are widely believed to play a key role in recruitment of PrLDs to stress granules, we find that aliphatic amino acids can functionally replace aromatic amino acids in supporting recruitment.

21 Evidence of Maillard Reactions in Thermally Decomposed Soil Organic Matter

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Wildfires in forested watersheds dramatically alter labile soil organic matter (SOM) pools and the export of dissolved organic matter. These changes dictate ecosystem response by altering the nutrients available to soil microbial communities, affecting carbon stabilization, and exporting particulate and charred residues through ground and surface water that degrade water quality. In this work, soils were leached after simulated lab burns at discrete temperatures to study the impacts of fire intensity to the chemical composition of SOM that lead to the enhanced mobilization of organic matter following fires. The greatest changes occurred at moderate intensities, where water-extractable SOM content was highest and carbon-to-nitrogen ratios (C/N) decreased, indicating an enrichment in nitrogen. Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) analysis of the water-extractable SOM displayed highly abundant nitrogen-containing residues that exhibited carboxylated and aromatic features, corroborated by solid-state 13C NMR. Transformation pathways during heating were modeled using steps in the Maillard reaction, where residues were identified that exhibited the presence of dehydration series and amino acid condensations. Nitrogen-containing residues matched Maillard reaction product features from low to moderate intensities and exhibited patterns that suggest chemical indicators for fire intensity across surface soils. These findings help explain the typical post-wildfire nitrogen loss to streams with implications for water quality and the health of watershed and stream biota.

22 Associations Between Activity, Mobility and Balance in People with MS

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Approximately 80% of people with multiple sclerosis (PwMS) experience impaired balance and mobility. While exercise interventions improve these outcomes, the effects of the volume, type and intensity of habitual physical activity (PA) on balance and mobility are poorly understood.
PURPOSE: Examine associations between PA volume, type and intensity with mobility and balance in PwMS.
PROCEDURE: Twenty-seven PwMS (48+12 years, 24.9+3.8 kg·m2) reported their typical PA routine, including volume [(days/week)x(minutes/bout)], type (resistance and/or plyometric (R/P), aerobic training (AT), and yoga), and intensity (rating of perceived exertion (RPE) 2-20). Balance was assessed by the mini Balance Evaluation Systems Test (Mini-BEST). Mobility was measured through gait speed during two-minute walk tests at a self-selected and fast pace. Spearmans correlations examined associations among PA volume, intensity, and balance, and gait speeds. Independent t-tests examined differences in balance and gait speeds between participants who did vs. did not perform each PA type.
RESULTS: PwMS reported M=252+234 PA minutes/week, MRPE=13±3 and participation in R/P (44%), AT (89%), and yoga (30%). RPE was associated with reactive postural control ($r = 0.446$, $p = 0.025$), sensory orientation ($r = 0.453$, $p = 0.023$) and dynamic gait ($r = 0.410$, $p = 0.042$). PwMS who reported R/P training had higher dynamic balance scores ($p < 0.05$) than those who did not.
IMPLICATIONS: Higher RPE and habitual R/P training were associated with better balance and mobility among PwMS. Future studies should examine the effects of increasing PA intensity and incorporating R/P training into PA routines on mobility and balance outcomes.

23 Disability Policy and Siblings

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This literature review and policy analysis will explore current national and local policies that impact the disability community. A special focus on adult siblings of individuals with intellectual and developmental disabilities will drive the analysis from a family focused perspective using Family Stress Theory. Wrapping up this review will be implications for policymakers and advocates to consider.

24 A probabilistic economic and environmental evaluation of biofuel from cyanobacteria

AUDREY BEATTIE

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A large contributor to climate change is energy production specifically, the fossil fuels that are combusted to power cars and airplanes. Alternative fuels require less energy to produce and are considered a pathway for sustainable transportation. Techno-economic (TEA) and life cycle analysis (LCA) are methods for assessing the economic and environmental impact of various technologies, such as biofuel from microalgae. These assessments are based on a modular engineering process model, which captures the mass and energy flows through the system. Overlaying economic and life cycle data yields economic and environmental impact results, in the form of fuel selling price and global warming potential, respectively. While these metrics allow for a refined understanding of a biofuel facility at scale, they are usually considered static with time. Costs, such as for feedstocks or labor, are considered constant over the lifetime of the facility. In reality, these fluctuate with time and are dependent both on outside factors and associated randomness. Generally, this kind of uncertainty in parameters is addressed by scenario analysis: assigning a range of input parameters that define conservative, baseline and optimistic cases. While this captures a range of results, there is no indication of likelihood attached to them. Monte Carlo analysis, a statistical method that pulls input values from probabilistic functions, more comprehensively captures the range of results for the system. This work presents the probabilistic results of a cyanobacterial biofuel system, evaluating the economic and environmental impacts and assessing the probability of success in meeting sustainability targets.

25 The Microbiome of a Newly Constructed Meat Processing Facility

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Significant progress has been made toward reducing the occurrence of foodborne illness in the US; however, foodborne pathogens still present a public health risk as they often find unique niches in meat processing facilities where they can then contaminate products. There is a knowledge gap in where these organisms originate and how they colonize spaces. A new meat processing facility was constructed at CSU, providing an opportunity to study succession of microbiomes and the establishment of Listeria on surfaces in a new environment. Objectives were to determine patterns of microbiome composition within a new facility and how they associate with Listeria presence. To investigate this, a longitudinal experiment was designed to characterize microbial communities and detect Listeria throughout the processing facility at 11 distinct timepoints. At each, microbiome samples for 16S sequencing and Listeria swabs were collected from drains and door handles in all production rooms. No resident population of Listeria was observed in any production room, though transient populations were identified. The microbiomes identified in the facility associated more closely with the microbiome source and function of the room than the sampling timepoint. Within a room, there were changes in the microbiome over time, though it appeared a consistent community was not established within the first year of sampling. Also, rooms contained distinct microbial taxa that were similar based on function. Results suggest that the microbiome develops based on contents and functions of spaces and that a resident Listeria community may not form in the first year of production.

26 Total Synthesis of 6-epi-Notoamide-T and Towards the Synthesis of Citrinalin-C

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Utilizing the power of biomimetic total synthesis, the synthesis of 6-epi-Notoamide T is described, as well as a route towards the synthesis of Citrinalin C. These are two compounds in a broad family of prenylated indole alkaloids containing a unique bicyclo[2.2.2]diazaoctane core. This unique ring structure, combined with the heavily functionalized indole derivative, has prompted questions about the biogenesis of these secondary metabolites. 6-epi-Notoamide T has been identified as a precursor to Stephacidin A, as well as the family 6-epi-Notoamide T3-T9. Citrinalin C is a suspected intermediate to Citrinalins A and B. These syntheses focus heavily on following the same synthetic pathway that natures fungi use to create these compounds. Concise, biomimetic syntheses of the final natural products and biosynthetic intermediates of related compounds will be developed and used to fully elucidate the biosynthetic pathways of the producing fungi. Genome sequencing, gene cluster identification, functional expression of biosynthetic genes, and protein engineering technologies will be utilized to develop biocatalytic methods to produce complex and structurally diverse alkaloidsexpanding our pharmaceutical production capabilities.

27 Novel route of morphine-induced sleep disorders

NIKOLAS BERGUM

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Despite their strong addictive potential, opioids remain the most widely used drugs for treating pain. While opioids effectively decrease pain acutely, long-term opioid use causes sleep disturbance, which in turn triggers hyperalgesia; this positive feedback loop exacerbates pain-related sleep problems. Sleep disruptions that result from chronic opioid use also increase the risk of depression and even suicide. Thus, a better mechanistic understanding opioid-induced circadian disruption could minimize the negative effects associated with long-term opioid use.
Intrinsically photosensitive retinal ganglion cells (ipRGCs) are the sole synchronizers of circadian rhythms to light. Importantly, past research determined that these cells express -opioid receptors (the primary target for opioids) that are accessible for systemically administered opioids. To examine the role that ipRGC -opioid receptors (MORs) in modulating circadian behavior, we generated a transgenic mouse line (McKO) in which only ipRGCs lack MORs. Then, we implanted mini telemetry transmitters into McKO and control mice to accurately monitor activity over several weeks. Here, we show that McKO mice have altered circadian activity compared to controls, especially in trials with repeat morphine exposure. Following this chronic morphine paradigm, we will assess the performance of these mice in an assay of depression-like behavior. We predict that McKO mice will exhibit less depression-like behavior compared to controls. These findings would expand on past results, causally linking opioid-induced circadian disruptions to the affective mood associated

with chronic opioid use. Moreover, these results implicate ipRGC MORs as a potential therapeutic target to combat the negative consequences of long-term opioid use.

28 Development of a High-Efficiency Ultra-Low Emissions Heavy-Duty Natural Gas Engine

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The race for cleaner and reliable alternative fuels in the transportation sector, triggered by environmental concerns, has forced researchers and engineers to seek solutions with the potential to have an impact in the short term. Although much progress has been made, most of the current alternative solutions still lack reliability, availability, efficiency, and/or cost-effectiveness. The heavy-duty transportation sector imposes an additional challenge to moving into alternative fuels since it demands high availability, rapid transient response, high power output, low cost, and high efficiency, demands that have led Diesel to dominate the heavy-duty sector for decades. A possible cost-effective and highly-available alternative to Diesel is Natural Gas (NG), a cleaner alternative fuel with high domestic availability costing five times less than Diesel on an energy-equivalent basis. However, NG engines suffer from lower thermal efficiencies and power outputs, a problem further complicated by the wide range of chemical reactivity quality found across the U.S., which leads manufacturers to design for the worst chemical quality. For this reason, to accelerate NG engines market penetration, this project has been developing a high-efficient ultra-low-emission NG engine for variable chemical reactivity quality utilizing a novel combustion strategy called Controlled End-Gas Autoignition. Current experimental and modeling works have shown promising results in increasing NG engine efficiencies and achieving this novel combustion strategy. If successfully designed, this project could be easily implemented in new engine platforms through the implementation of the novel engine/combustion control strategy.

31 Clonable Nanoparticle Tags: In Situ Protein Labeling and Tracking

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Biological microscopic studies, once revolutionized by the discovery of encodable fluorophores such as Green Fluorescent Protein (GFP), engender foundational evidence for cellular processes via in situ protein labeling and tracking by fluorescence. As light microscopy is inherently hindered by the diffraction barrier, electron microscopy unveils details of cellular ultrastructure with nanometer level resolution. However, the limitation of biological electron microscopy is creating target specific contrast within a cell or tissue. While methods have been developed to generate localized contrast agents, none have achieved the specificity of a genetically encodable tag. Thus, our lab began developing clonable nanoparticles to be used as markers for electron microscopy. We isolated a glutathione-like metalloid reductase from a selenophilic plant capable of reducing selenium precursors into

nanoparticles. After confirming the portability of the enzyme through maintenance of its activity in vitro and in vivo, modification of the wild type further enhanced its performance as a clonable selenium nanoparticle (cSeNP) tag. We then used the cSeNP marker in a proof of concept study that involved tracking filamenting protein FtsZ in vivo using electron microscopy and elemental mapping. Once we fused the cSeNP to FtsZ, initial results closely matched previous fluorescence microscopy studies of GFP tagged FtsZ in vivo. Ongoing work not only includes collaborating with experts in the field of 3D electron microscopy to reveal nanoparticle-decorated filaments but also expanding our library of clonable nanoparticle tags through the discovery of other metal reducing enzymes.

32 Pollen exclusion as a management practice for high-CBD hemp production.

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Production of high-CBD hemp (Cannabis sativa L.) is steadily increasing in Colorado and across the United States. However, the impact of management practices for this crop remain relatively unexplored. For example, there is high potential for male hemp plants from fiber and grain cultivars to pollinate female hemp plants grown in close proximity, but it is unknown how the cannabinoid content of high-CBD hemp flowers is affected by pollination. We hypothesized that high seed content following pollination will negatively impact the phytocannabinoid profile of the flower. In this study, 3 experimental pollen exclusion treatments were applied to two cultivars of high-CBD hemp, Cherry Uno and Wife. Conditions included non-woven thick row cover, non-woven thin row cover, woven insect netting, and uncovered controls. Total biomass and seed weights for 48 whole plants were evaluated. Additionally, 5 cm (2-inch) inflorescence samples were taken from each plant, as described in the Colorado Department of Agriculture (CDA) sampling protocol. Seeds and flower material were weighed separately before samples were homogenized in preparation for cannabinoid analysis. Extracts were analyzed by ultra-high performance liquid chromatography coupled with tandem mass spectrometry (UHPLC-MS/MS) to determine the quantitative profiles of 18 phytocannabinoids. Results indicate that the covered treatments for Cherry Uno all significantly reduced pollination compared to Cherry Uno uncovered controls, but this trend was not seen in Wife. No biomass differences were seen between covered treatments and controls for either cultivar, suggesting the coverings themselves did not affect biomass. Differences in cannabinoid content between conditions will be discussed.

34 Galbut Virus Implications on a Selected Set of Fitness Factors

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Partitivirus infections have largely been known only to occur in plants, fungi, and protozoa, but during metagenomic sequencing, some similar sequences have been found in a variety of arthropod species. Recently, we described that galbut virus infects Drosophila

melanogaster, and have since set forth to answer the question "what fitness implications occur during galbut virus infection?". By using several strains of flies from the Drosophila Genetic Reference Panel (DGRP) which only differed in their galbut virus infection status, we were able to look at fitness measurements across both sexes. Lifespan was not significantly changed and there was no effect on fecundity, however the development speed from egg to adult was significantly impacted. Pathogen interference by selected fungi, viruses, and bacteria showed some fly sensitivity. These changes varied by both strain and sex. All fitness aspects attributable to galbut virus were small, but we found that they were dependent on strain and sex. More importantly, it was determined that these fitness aspects were largely attributable solely to strain and sex, reinforcing predominantly cryptic phenotypes within partitivirus infections

35 Carbon-Ion Cancer Radiotherapy Double-Strand DNA Break Distribution and Repair

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The sharp high dose Bragg peak of the carbon-ion beam helps it to deliver the highest dosage to the malignant cells while relatively sparing the surrounding normal healthy cells. However, the precise range in which it distributes dosages that significantly induce double-stranded DNA breaks (DSBs) causing biological effects surrounding its Bragg peak remains unknown. We have developed a technique utilizing -H2AX assay allowing us to examine DSB distribution throughout the full beam length in a single system to address DSB complexity, carbon-ion nuclear fragmentation-induced DSBs, as well as, at different time points to address cellular capability for DNA repair at different beam depths. Furthermore, we addressed DSB repair by comparing the differences in survival fractions of cells deficient in either non-homologous end joining (NHEJ) or homologous repair (HR) DSB repair mechanisms at various depths within the beam range to help identify the ranges in which these repairs may be more important.

36 Barriers and Opportunities to a Successful Commercial FL Lionfish Market

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Lionfish (Pterois volitans) are an invasive aquatic species that have contributed to large-scale negative social, ecological, and economic impacts within the tropical western Atlantic regions. With high fecundity, a generalist diet, and the ability to thrive in diverse habitats, lionfish are abundant and spreading, posing a large challenge to marine managers and to aquatic systems at large. This species disrupts coral reef community dynamics, outcompetes native fish species harvested for seafood, and have 17-18 venomous spines that can cause intense physical pain to humans. This research narrowed in on one specific management effort that has been overlooked in much of the academic literature: the culinary market.

Chefs are a linchpin in the lionfish management system due to their role as educators to the general public, and front line members of the invasive removal team. By grilling, sauteeing, frying, and slow cooking these apparently delicious fish, chefs are vital in the long term management of this invasive species. For our Master's Capstone research, we interviewed a large sample of lionfish chefs in Florida, where the commercial market is most abundant, and found significant patterns as to what barriers and opportunities exist to maintaining a sustainable lionfish removal effort through spearfish, fork and knife.

38 An Autism-Linked Mutation Intensifies Signalling in Stem Cell-Derived Human Neurons

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Autism spectrum disorder (ASD) is a developmental disorder characterized by difficulty with social interactions, abnormal language development, repetitive behaviors, and a narrow range of interests. Though each individual with ASD exhibits unique behaviors, and connections between cases are difficult to establish, recent studies suggest a majority of ASD cases are closely linked to the functionality of synapses, the specialized communicative junctions between neurons.
One class of proteins that regulate synapse function are Neuroligins. These proteins are trafficked to the post-synaptic terminal, where they recruit neurotransmitter receptors, thus influencing the recipient neurons sensitivity to synapses. The human-specific Neuroligin-4 (NLGN4) gene has been reported to be mutated in many patients with ASD and other neurodevelopmental disorders. However, it remained unclear how these mutations might alter the molecular and physical properties of NLGN4, and thus affect synaptic transmission in human neurons.
Here, we describe a severely autistic individual carrying an uncharacterized mutation in the NLGN4 gene. When expressed in mammalian cells, the mutation impaired the maturation of NLGN4 protein. As a result, the surface trafficking of the mutant protein was severely decreased, and it remained stuck in the endoplasmic reticulum and Golgi apparatus.
In stem cell-derived human neurons, the mutation also similarly reduced the synaptic localization of NLGN4. This mutation-induced trafficking defect substantially diminished NLGN4s ability to form excitatory synapses and modulate their functional properties. Viewed together, our findings suggest that this mutation is pathogenic for NLGN4 and can lead to synaptic dysfunction in autism.

39 Assessment of Plant Waste as a Mixotrophic Algae Substrate

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Partners at Los Alamos National Laboratory (LANL) are studying microalgae grown mixotrophically for biofuels and renewable products. Microalgae are highly efficient at capturing carbon dioxide (CO_2) and sunlight through photosynthesis (a.k.a.

photoautotrophy) compared to land crops. However, atmospheric CO2 concentrations cannot support algal growth for large-scale cultivation, which creates a dependence on concentrated fossil fuel emission sources for CO2 supply. Some species of algae can utilize organic carbon substrates through heterotrophy. Mixotrophy takes advantage of both photoautrophic and heterotrophic modes to produce better-performing strains for algae products. The Leveraging Algae Traits for Fuels (LEAF) project has shown in lab-scale experiments that some algae strains can naturally break down cellulose and thrive in mixotrophic growth on cellulosic materials like corn stover, switchgrass, and yard waste. Higher biomass productivity, cell density, and eicopentaenoic acid (EPA) content were reported in mixotrophically-grown algae. These results were entered in a robust process model including cultivation and conversion to fuels and co-products to determine if mixotrophic growth could improve metrics for economic and environmental sustainability. Transportation of cellulosic plant material to the cultivation site is noted as a major economic sensitivity of the mixotrophic algae system. Overall economic and environmental sustainability results are discussed to set up the direction for the near- and distant-future of the LEAF project.

40 Hemp Virome and BCTV Ecology in Colorado Cropping Systems

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Hemp (Cannabis sativa L.), is a rapidly growing industry in the United States. Colorado is one of the biggest hemp growing states having over doubled its acreage from 35,950 in 2018 to over 75,000 in 2019. However, the crop has been understudied in the U.S. since its production declined in the late 1950s and information on the biological and agricultural factors affecting hemp under current conditions is limited. Disease identification and management is an increasing challenge for hemp growers across the country. For instance, beet curly top virus (BCTV), which is transmitted by the beet leafhopper, was recently shown to infect hemp plants in Colorado. Since its initial detection, we have confirmed the virus from 9 counties in Colorado, with several fields reporting disease incidence levels above 50%. We found BCTV-Worland and BCTV-CO strains and many mixed infections. Using next generation based metagenomics we have characterized the virome of hemp. Life history assays were performed in BCTV viruliferous and non-viruliferous beet leafhopper to understand the impact-if any, the virus has on vector survival and fecundity. A survey of the timing of beet leafhopper and BCTV was performed in hemp and sugar beet cropping systems to understand the phenology of BCTV in Colorado. The results of this research will improve diagnostics through the development of and accessibility of species-specific primers. Accurate and efficient identification of viruses and viroids will help target control strategies through integrated pest management and interruption of transmission cycles, in turn reducing yield losses.

41 Temporal Change of Cs-137 in Forest-stream Ecosystem in Fukushima, Japan

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Nine years have passed since Fukushima Daiichi Nuclear Power Plant accident in Japan, but large amount of radioactive cesium (Cs-137) still remains in forests. Understanding the fate of Cs-137 in forest environment is indispensable because of the long half-life of Cs-137 (30.1 yr). Forests in Japan are associated with well-structured stream system, and those in the contaminated area are typically mono-cultures of evergreen, where Cs-137 migrates within terrestrial and stream ecosystems via physical processes such as litterfall and soil erosion as well as biological processes such as food web. In this study, we examined the temporal change of Cs-137 concentration based on a comprehensive field sampling in a headwater forest ecosystem in Fukushima in 2012-13 and 2016-17. Cs-137 concentration significantly decreased between the two sampling periods for all the target ecosystem components. However, the decreasing rates of Cs-137, which is descried as ecological half-lives (Teco), were largely varied. The relatively longer Teco of soil indicated the accumulation of Cs-137, and stream insects had different Teco depending on their feeding functions. Overall, the terrestrial ecosystem showed higher contamination compared to stream in 2012-13, while the systems had similar contamination in 2016-17 except significantly high contamination in soil, indicating the soil will be the main source of Cs-137 in forest ecosystem in future. Considering the increasing demand of nuclear power plant in the world, this study can be useful for the long-time risk assessment of Cs-137 contamination in the environment of Japan as well as other countries with warm and humid climate.

42 Visualizing gene expression silencing by Ago2 in live human cells

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Gene expression is an incredibly complicated process. Many nuanced cellular mechanisms tune gene expression at the DNA level of transcription and the RNA level of translation. Translation regulation can be caused by protein Argonaute, which is essential, conserved across species, and targets about 60% of the human genome. Translation silencing is difficult to study in bulk, and aspects of the Argonaute-silencing mechanism are still unclear. To overcome limitations, my work created a system capable of studying this process happening in real time in live human cells. Thus, we determined where and when Argonaute-mediated gene silencing happens. Instead of studying this phenomenon in bulk, we tracked single translating mRNA with a powerful microscope. Then, we visualized how Argonaute affected translation by physically tethering Argonaute to the transcripts. At the single-cell level, gene expression was significantly silenced: Argonaute-tetherable mRNA were fewer in number, less likely to be translated, and produced less mature protein. Early on, a small, dynamic fraction (46%) of tethered mRNA were still translationally active. By tracking thousands of single mRNA, we were able to capture rare Argonaute-tethering events, which led to translational silencing in just 15 minutes on average. This timescale was similar to how long it takes a ribosome to translate the reporter. This suggested translation initiation is inhibited rapidly after Argonaute tethering. Beyond Argonaute, researchers can now use our tethering technology to visualize in real time the impact of other proteins-of-interest on

translating mRNA in live human cells.

43 Species persistence through climate change: Reassessing flexibility in thermal tolerance.

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Trying to predict whether species will persist through unprecedented rates of environmental change has become a major task for scientists. As temperatures rise across the earth, focusing on thermal tolerance traits may be critical. A species ability to quickly cope with rapid temperature increases without dispersing to a new habitat will partly depend on the flexibility of its thermal tolerance. This flexibility is often considered to be a temporal buffer against changing environments as species can alter their traits within a single generation. Experimental approaches assessing flexibility in thermal tolerance often assume that instantaneous effects of temperature on biochemical processes within cells are equal among populations within a species. These studies thus do not account for these effects when estimating the magnitude of flexibility. Moreover, many studies extrapolate temporal buffers for an entire species based on results from one or few populations. We present the results of thermal tolerance flexibility experiments from 13 populations of a cold-adapted frog species. We found that instantaneous effects of temperature varied among populations and may inflate estimates of flexibility. Therefore, the common assumption that instantaneous effects of temperature are constant among populations is incorrect. When accounting for instantaneous effects of temperature, populations varied in their estimated flexibility, ultimately varying in the estimated temporal buffer against warming temperatures. This result demonstrates the importance of including multiple populations when characterizing a species thermal tolerance flexibility. Accounting for instantaneous effects of temperature is essential when estimating thermal tolerance flexibility and assessing vulnerability to climate change.

44 Mindfulness Associations among Depression, Sleep, and Insulin Resistance in Adolescents

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Background: Sleep difficulties may underlie the association between depression and insulin resistance; yet, explicit tests of this hypothesis are lacking. We aimed to determine if sleep duration explains the depression-insulin resistance association in adolescents at-risk for excess weight gain. We also investigated whether dispositional mindfulness moderates the interconnections among depression, sleep, and insulin resistance.

Methods: 90 adolescents (14.2±1.6y; 50% female) at-risk for excess weight gain (BMIz 1.6±0.6) participated in the cross-sectional phase of a health behaviors study. Depression was assessed with the Center for Epidemiologic StudiesDepression Scale, sleep duration

with the Sleep Habits Survey, and dispositional mindfulness with the Mindful Attention and Awareness Scale. Homeostasis model assessment of insulin resistance was determined from fasting insulin/glucose. The product-of-coefficients method was used to test sleep as a meditator of the depression-insulin resistance association, accounting for age, sex, and BMIz. Mindfulness was tested as a moderator of the direct pairwise associations among depression, sleep, and insulin resistance.

Results: Sleep duration mediated the depression-insulin resistance association, controlling for age, sex, and BMIz. Dispositional mindfulness moderated the association of sleep and insulin, such that sleep duration inversely related to insulin resistance only at lower mindfulness. Mindfulness did not affect the depression-sleep connection; these variables were inversely related regardless of mindfulness.

Conclusions: Inadequate sleep is one explanatory factor in the depression-insulin resistance association in adolescents at-risk for excess weight gain. Adolescents with poorer mindfulness and insufficient sleep are at highest risk for insulin resistance, whereas higher mindfulness may be protective.

46 Multi-Objective Optimization of Produced Water Recovery through Various Treatment Methods

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Water and energy are interconnected; energy production requires water, and water treatment requires energy. Produced water, manifesting at both conventional and unconventional oil and gas wells, requires careful handling to minimize environmental and human health damages due to high concentrations of salt and other contaminants. Transporting large volumes of produced water by truck to treatment or re-injection locations often accounts for a majority of these handling costs. Common practice is to truck produced water from the well site to a designated salt-water re-injection or disposal well. Onsite desalination has the potential to lower handling cost by reducing the volume of brine requiring transport to salt-water disposal wells while producing water suitable for irrigation, agriculture, or surface water discharge. However, onsite treatment poses unique challenges: 1) A majority of produced water emerges in the first three months after well completion and 2) Unsteady and variable flows make it difficult to operate a treatment unit at its design capacity, which increases treatment costs. Mobile desalination units can address these two issues by moving between wells to match their water intake to their treatment capacity. This work explores different combinations of produced water management strategies in Weld County, Colorado, using optimization methods to determine the optimal combination of treatment and disposal from a techno-economic perspective. Current research focuses on including life cycle assessment to support a multi-objective optimization. Preliminary results show increasing water recovery reduces the freshwater footprint of oil and gas production at the expense of additional greenhouse gas emissions.

47 The adaption of SIVmac239 using humanized mice

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The cross-species transmission of simian immunodeficiency virus (SIVsm) native to nonhuman primates into humans gave rise to HIV-2 through the accumulation of adaptive genetic mutations. Other examples of SIVsm cross-species transmission exist. For example, when captive sooty mangabeys infected with SIVsm were housed with rhesus macaques, they accidentally became infected with SIVsm. The resulting pathogenic virus that was generated is called SIVmac. This virus has become an important model for studying HIV pathogenesis, latency, and therapeutics in NHPs. Similarly, SIVB670, a progenitor of SIVmac, inadvertently crossed over into a human patient resulting in the isolation of the human virus SIVhu. To understand how these viruses adapt to an in vivo human immune environment, we serially passaged SIVmac, SIVB670 and SIVhu over three generations in humanized mice to assess genetic changes. Humanized mice are an ideal surrogate model for human immune function and produce cells permissive for HIV and SIV infection. We found that over the course of three generations, the plasma viral loads varied across these passages for each respective virus. CD4+ T cell decline, reminiscent of HIV infection, was observed in SIVmac239 and SIVB670, though not in SIVhu. Illumina-based deep sequencing identified numerous nonsynonymous mutations in all three viruses that may be involved in their adaptation to human immune cells. These data showcase that other SIVsm-derived viruses are capable of human infection and may shed light on the critical mutations necessary for these viruses to adapt to a new host.

48 Z-hunt, Developing a program to find Z-DNA Structures

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Purines (A & G) and pyrimidines (C, U, & T) can exist in either the anti or syn confirmation, where anti denoted the base positioned over its connected sugar and syn denotes the base positioned away from the sugar. All based can be positioned in either conformation, but there are preferences with purines forming a larger range of anti conformations and pyrimidines forming a larger range of syn conformations. Traditionally, the propensity for a sequence to form Z-DNA could quickly be calculated based on a purine-pyrimidine alternating sequence. This method is only a rough estimate and only depends on the adjoining sequences, which greatly limits the true representation of Z-DNA in a given region.Taking this into account, a new computational method, Z-hunt, was developed in 1986 utilizing the free energy of transition for each dinucleotide from the B-DNA to Z-DNA conformation. Free energies were determined from the energy associated with negative supercoiling of DNA and has continually been updated with new experimentation. When calculating the free energy, the program determines the anti or syn conformation based on the max difference to give an overall energy minimization to the Z-DNA conformation. Penalties are applied to the energy whenever the anti-syn alternation is interrupted; however, it does not completely negate the overall propensity. Recently, cytosine-methylation energies were added to the code, Z-mhunt. This epigenetic marker has an important influence on Z-DNA formation and therefore provides a more accurate

representation within a sequence.

49 Extreme Drought and Crop Abandonment in the Ogallala Aquifer Region

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Following the 2012 Midwest and 2011-2017 California drought disasters, there has been an increased interest in the economic impacts of drought in the United States. This paper related to previous studies that measure the sensitivity of agricultural outcomes to climate variation. We expand on this research by evaluating the impact of extreme drought on the incidence of crop abandonment and the extent to which groundwater access in the Ogallala region moderates the impact of drought. The main measure of drought is sourced from weekly measurements of the Palmer Drought Severity Index (PDSI), where we categorize extreme drought as a PDSI of less than -3. The empirical analysis is conducted on four different crops: corn, soy, wheat, and sorghum, using a county-level dataset from the USDA National Agricultural Statistics Service. Utilizing a Fractional Logit model specification over the period 1979 to 2018, our most general results show that an additional week of severe drought, is predicted to increase the incidence of crop abandonment between 0.5 to 2 percent for a typical county in the study area, all else equal. Additional models that break down drought impacts by quarter, reveal that extreme drought in the third quarter, where crops like corn are most vulnerable to water deficit, has the largest impact on crop abandonment. Further, the impact of drought is dampened in counties within the Ogallala aquifer. Ongoing work seeks to quantify the economic cost associated of crop abandonment to better understand the magnitude of these losses associated with extreme drought.

50 Forest thinning associated with increased native bee habitat and abundances

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In North American conifer forests, thinning operations are broadly implemented as a means of fire hazard mitigation, ecological restoration, and timber harvest. Effects of thinning on forest bee communities are poorly understood but could be important for conservation of biodiversity and ecosystem services. Here, we test the hypothesis that thinned forest stands have greater diversity of native bee species than non-treated forests. To address this, native bee assemblages were collected across the growing season and compared between ponderosa pine stands treated by mechanical thinning and non-treated stands. Associations between native bee communities and forest conditions were analyzed. Forest structure, floral resources, nesting habitat, and bee assemblages differed between treated and non-treated stands. Forest basal area at non-treated sites was on average 3.5 times greater than treated sites, and canopy openness was greater at treated sites. Fuel loads were similar between treated and non-treated sites. Floral resources were >2.5 times more abundant at

treated sites; floral abundance was highest in June and decreased throughout the summer. Native bees were two times more abundant in treated stands. Our results suggest that (1) forest thinning has significant impacts on both floral resources and bee nesting habitats within 2-8 years post-treatment; (2) bee assemblages likely respond to this variation, and this difference is especially apparent later in the growing season. We conclude that forest thinning for ecological restoration in ponderosa pine habitats is likely to improve resources utilized by native bees and are associated with increased bee abundances in the wildland-urban interface.

51 The influence of trace mineral source on beef cattle.

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Twelve Angus steers (BW 452.8 ±21.8 kg) were used to determine the impact of mineral source on neutral detergent fiber (NDF), short chain fatty acid (SCFA) production, and ruminal solubility of Cu, Mn, and Zn. Steers were fed a low-quality grass hay diet (10.8% CP, 63.1% NDF, 6.9 mg Cu/kg, 65.5 mg Mn/kg, and 39.4 mg Zn/kg). Treatments consisted of 20, 40, and 60 mg supplemental Cu, Mn, and Zn/kg DM, respectively from either sulfate (STM) or hydroxy (HTM) sources (n=6 steers/treatment). Following an adaptation period total output was collected for 5 d. Dry matter digestibility tended ($P < 0.07$) to be reduced and NDF digestibility was reduced in STM vs. HTM steers. On d-6, rumen fluid was collected at 0, 2, and 4h post feeding. Steers receiving HTM had lesser ($P < 0.02$) butyric acid and greater ($P < 0.05$) total SCFA than STM steers. Steers were then fed the same diet without supplemental Cu, Zn, or Mn for 14 d. On d 15 steers received a pulse dose of 20, 40, and 60 mg Cu, Mn, and Zn/kg DM, respectively from either STM or HTM. Ruminal samples were obtained at 2h intervals starting at -4 and ending at 24h relative to dosing. Ruminal soluble mineral concentrations were greater ($P < 0.05$) for Cu; for Mn; and for Zn post dosing in STM compared to HTM steers. Results indicate that solubility of Cu, Mn, and Zn differs between STM and HTM sources and that may impact ruminal fermentation.

52 Increasing Pulse Consumption for Health: A Translational Approach

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Unhealthy eating patterns are a major risk factor for chronic diseases, which cause over 70% of mortalities worldwide. Whereas treatment of chronic disease is expensive, primary prevention is a cost-effective approach to improving public health. Pulses (e.g., chickpeas, common beans, dry peas, and lentils) are healthful and affordable, and consumption is associated with numerous positive outcomes, including healthy weight maintenance and lower chronic disease (e.g., heart disease, diabetes, and cancer) rates. However, consumption is low due to concerns over intestinal discomfort, long cooking times, and the presence of antinutrients (e.g., lectins that can cause hemagglutination reactions). Proper

processing can alleviate these concerns. Thus, the aim of this study is to identify an optimized cooking method to decrease antinutrients within pulses while maintaining healthful nutrients (e.g., fiber), subsequently increasing their consumption. This will be accomplished by evaluating different processing techniques on a variety of pinto bean that we have previously demonstrated to promote gut health. We will use a Mattson cooker to evaluate the reduction in cooking time resulting from different cooking techniques, SDS-PAGE and ELISA to assess lectins, and conduct fiber analyses. Expected outcomes include: 1.) soaking pintos in a solution containing sodium chloride (NaCl) or sodium bicarbonate (NaHCO3), followed by cooking, will improve their health attributes by eliminating lectins; and 2.) soaking in NaHCO3 will result in greater leaching of healthful nutrients than soaking in NaCl; thus a quick soak will allow for greater retention of healthful nutrients than a 12-hour soak when using NaHCO3.

54 Reactive Oxygen Species Modulate Activity-Dependent Glutamate Receptor Transport

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Cognition, learning and memory depend on regulatory changes in the number and function of the glutamate receptors (GluRs) at synapses, the connections between neurons. This regulation requires long-distance transport of GluRs from the cell body, where they are made, to synapses. Neuronal signaling as well as this transport are metabolically demanding processes in which energy consumption and production are tightly coupled and regulated. The majority of energy production unavoidably produces a class of chemically reactive molecules called reactive oxygen species (ROS), which are modulators of calcium signaling. Although a role for calcium signaling in GluR transport has been described, it is unclear what mechanisms are involved and if it is linked to physiological ROS signaling. To investigate whether an interplay between calcium and ROS signaling regulates GluR transport, we use the transparent genetic model C. elegans to visualize GluRs in vivo in real-time. This approach revealed that small changes in ROS levels decrease GluR transport out of the cell body, as well as decrease delivery and exocytosis at synapses. Furthermore, it revealed that this change in GluR transport is due to ROS acting on or directly downstream of calcium channels. For future experiments, we aim to determine how ROS and calcium regulate the delivery of GluRs to individual synapses to ultimately impact neuronal excitation. These studies demonstrate a physiological signaling role for ROS and provide insight as to why unnaturally high ROS levels are correlated with abnormal cognitive function, learning and memory in the aged and diseased brain.

56 Low-Temperature Synthesis of Solid-State Materials Using an Organic Flux

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Though solid-state materials have widespread applications, making them can be quite challenging. There is a limited library of synthetic techniques particularly when targeting materials that are only stable at low temperatures since temperatures of around 1000 °C are often necessary to promote reactivity between solids. Many interesting materials are only stable at lower temperatures, so finding new syntheses to make these materials is necessary. This research focuses on synthesizing metal chalcogenides using organic compounds as a molten and reactive flux. The reactions presented here are the first examples of an organic flux being used to enable selective reactivity in solid-state synthesis. It is hypothesized that the organic compound changes the stability of the possible products to promote selective reactivity between the metal and the chalcogen. This idea of changing fluxes to impact product stability in opposite ways to target different materials is proposed. Being able to target specific materials based on which flux is used promises the idea of synthesis by design in the solid-state. This research demonstrates a novel technique that enables materials discovery and simplifies the synthesis of known materials.

57 Attica A Secure Platform for Online Voting.

CHRISTIAN FERGUSON

 DEPARTMENT: COLLEGE OF BUSINESS
 COLLEGE: BUSINESS

Attica is working to revolutionize the way we cast our votes. Utilizing cutting-edge distributed ledger technology (DLT) and one of the most innovative decentralized public networks (DCPNs), Attica has built a web-based application that enables an authenticated voter to cast a digital ballot that is unalterable, accountable, and accurately counted. Their vote is anonymous to others, yet verifiable to them. Atticas platform is a superior alternative to cumbersome paper ballots and insecure voting kiosks, and much less resource intensive, promoting sustainability. Attica is motivated by the opportunity to help reestablish voters trust in electoral processes and their access to voting systems. We wholeheartedly expect that Atticas platform will strength the integrity of electoral processes, plus increase equity and access to voting. Moreover, we at Attica understand that the technologies we employ are not currently well known by the general public. So, one of our parallel initiatives is to create and share public educational content, that is free and engaging, about DLT and DCPNs, also about cybersecurity, cryptography, computer science, and entrepreneurship. Eventually, we will build a mobile application as a sibling to the web-based voting platform. There are many opportunities for our venture, world-wide, but our initial target market is Colorados universities, be the system for student government elections. And we are already making progress on our goal, as we are slated to be the voting system for the next ASCSU elections. We are proud to represent CSU as we launch our tech start-up. Further business planning is underway.

58 Longitudinal Surveillance for SARS-CoV-2 in Skilled Nursing Facilities

EMILY FITZMEYER

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COLLEGE: VETERINARY MED AND BIOMED SCI

Skilled nursing facilities (SNFs) have been, and continue to be, important avenues of SARS-CoV-2 transmission. In order to assess the extent of asymptomatic SARS-CoV-2 infection in the workforce operating within these facilities we tested staff for SARS-CoV-2 at 6 SNFs in the Denver/Fort Collins area for 8 consecutive weeks. In addition to weekly testing we conducted follow-up surveys with 244 of our participants. This surveillance-based approach has allowed us to observe asymptomatic infections among those participants who tested positive for SARS-CoV-2. Using the participant information obtained through survey responses we intend to characterize symptom status and severity among participants both with and without prior SARS-CoV-2 infections. We also aim to determine the extent of asymptomatic SARS-CoV-2 within the infected cohort. Preliminary results have revealed that symptoms commonly used to screen individuals for SARS-CoV-2 (cough, fever over 100.4°F, etc.) are reported in less than 25% of our infected participants. Additionally, we have observed no correlation between symptom severity and virus levels. Going forward this survey data will inform our work as we seek to determine how the host immune response impacts symptom status, symptom severity, and length of infection in individuals infected with SARS-CoV-2. Assessing symptom status and severity within our surveillance-based cohort will allow us to generate a more comprehensive picture of the frequency and severity of symptoms within SARS-CoV-2 infections.

59 Biomechanical Model for Sound Transmission in the Frog Middle Ear

RACHEL FLEMING

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The ancestors of modern-day amphibians were the first vertebrates to evolve a middle ear for land-based hearing. Todays amphibians retain a simple and effective middle ear structure similar to those of their ancestors, and the fundamental mechanisms of these ears may reflect those that served as foundations of hearing in terrestrial vertebrates. Understanding amphibian hearing mechanisms can therefore offer insights into the evolution of more sophisticated hearing we observe in land-dwelling vertebrates today. Although the anatomy of the amphibian middle ear has been thoroughly described, it is not known to what extent various anatomical properties, such as material properties or shape and size of ear structures, influence sound transduction. To study how these factors may influence hearing, I created a 3D finite element (FE) model of a middle ear from a frog diceCT scan. I segmented middle ear parts from the scan, processed them into a volumetric FE model, and created a finite-element simulation. I am now subjecting this model to harmonic response simulations at a range of frequencies and measuring the sensitivity of the model to changes in various properties to determine which parameters most influence sound transfer to the inner ear. We are currently using this model to better understand the biomechanics of hearing in amphibians and how variation in the middle ear affects sound transmission. Advancing knowledge of amphibian hearing may provide insights into fundamental principles

of hearing in terrestrial vertebrates.

60 Effects of fire and thinning disturbance on wild forest-bee communities

RYLEIGH GELLES

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COLLEGE: WARNER COLL OF NATURAL RESRCES

Forest restoration goals within Colorados lower-montane forests align with conservationists goals of creating desirable habitat for bees through improving habitat connectivity and herbaceous production, though current knowledge of how forest management impacts bee communities is limited. In this project, blue vane traps were used to sample native bee community assemblages across the growing season within 39 ponderosa pine forest sites in central-Colorado to assess effects of fire and forest thinning disturbances on bee populations. We quantified bee abundance, richness, and diversity as well as floral resources (abundance, richness) and nesting habitat (woody debris) to understand factors that predict bee distributions. Four key findings emerged: (1) Overall -diversity was high and consisted of 4 families (Andrenidae, Apidae, Halictidae, Megachilidae), 20 genera, and 57 unique species. (2) Bee abundance did not vary due to effects of thinning or fire, though species richness was highest at sites that experienced high-severity fire. (3) Floral resources were positively-correlated with bee abundance and species richness, and woody debris was positively-correlated with bee species richness. (4) Bee community composition varied across disturbance types, with ~40% of genera found in specific habitats. We conclude that forest thinning operations are not associated with reductions in bee abundances or species richness, and fire disturbances generate foraging and nesting habitats important for native bee diversity. However, community structure varied across disturbance types and specific assemblages were associated with non-treated, thinned, and burned sites, indicating that managers can use thinning and burning treatments as tools for conserving bee biodiversity on the landscape.

62 Economic Performance and Volatility Among Historically Underserved Farmers and Ranchers

REGAN GILMORE

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COLLEGE: AGRICULTURAL SCIENCES

Evaluating the economic performance of historically underserved farmers and ranchers has become a topic of increasing interest, but empirical analysis to date has been relatively limited. Historically underserved farmers and ranchers are classified by the U.S. Department of Agriculture (USDA) as socially disadvantaged, beginning, limited resource, and veteran operators. This research proposes to use USDA Agricultural Resource Management Survey (ARMS) data from 1996 to 2018 to analyze changes and volatility in U.S. farm and ranch income and assets (dependent variables) as a function of operation characteristics, financial factors, demographic variables, and household characteristics (independent variables). The results will indicate which factors are associated with differences in economic performance

among operators who fall into one or more historically underserved groups. This analysis will help academics, stakeholders, and policymakers understand the role that these factors may play in achieving equitable outcomes. This research is in the early stages of gathering summary statistics and determining which ARMS data is fit for analysis.

63 EFFICACY OF ANTIMICROBIAL TREATMENTS AGAINST CAMPYLOBACTER JEJUNI INOCULATED ON CHICKEN

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DEPARTMENT: ANIMAL SCIENCES
COLLEGE: AGRICULTURAL SCIENCES

A study was conducted to evaluate decontamination efficacy of chemical treatments when applied, by immersion or spray application, to chicken wings inoculated with Campylobacter jejuni. Skin-on chicken wings surface-inoculated with C. jejuni were left untreated (control) or were treated by immersion (500 mL/wing; 5 s) or spray application (10-12 psi; 4 s) with water, a sulfuric acid and sodium sulfate blend (SSS; pH 1.2), formic acid (FA; 1.5%), peroxyacetic acid (PAA; 550 ppm), or PAA (550 ppm) acidified with SSS (pH 1.2) or FA (1.5%). Samples were analyzed for C. jejuni counts immediately after treatment (0 h) and following 24 h of refrigerated (4°C) storage. All chemical treatments evaluated in this study were effective ($P < 0.05$) at reducing the initial inoculated (3.9 log CFU/mL) C. jejuni populations on wings, regardless of application method. Spray application of the chemical treatments resulted in immediate (0 h) pathogen reductions ranging from 0.5 (SSS) to 1.2 (PAA acidified with FA) log CFU/mL, whereas their application by immersion resulted in reductions ranging from 1.7 (SSS) to 2.2 (PAA and PAA acidified with SSS) log CFU/mL. The PAA and acidified PAA treatments were equally (P 0.05) effective at reducing initial C. jejuni populations; however, after refrigerated storage, samples that had been treated with SSS- or FA-acidified PAA had lower ($P < 0.05$) pathogen counts than those that had been treated with PAA alone. Findings of this study should be useful to the poultry industry as they consider new interventions against Campylobacter on chicken parts.

65 Reviewing Effective Compliance Gaining Messaging Strategies for National Parks

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COLLEGE: LIBERAL ARTS

A significant portion of outdoor recreation in the United States occurs on federally owned public land such as national parks, recreation areas, monuments, and preserves. These lands are managed by the US National Park Service which is charged with preserving unimpaired the natural and cultural resources and values of the National Park System. Visitors engaging in noncompliant behaviors have made it increasingly hard for managers to make good on that promise. Asking visitors to comply with park rules and guidelines are often akin to seeking conservation behaviors, but many of these behaviors also put visitors at higher risk for injury or death. There is a noted management preference to mitigate the impact of these behaviors by attaining voluntary compliance using indirect methods such as

signage, brochures, and interpersonal communication. These measures dovetail with the NPS emphasis on interpretation and education and situate strategic communication as an indispensable tool to help managers execute the agencys mission statement. Informed by recent research in such areas as social marketing, risk communication, social psychology, and message framing, this presentation synthesizes the disparate literature to highlight the communication strategies that have garnered conservation behavior in parks and protected areas. Further, key areas for future research will be summarized and discussed.

66 Analysis of gut microbial composition using edgeR and ANCOVA

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INTRODUCTION: A mechanistic understanding of the relationship between gut microbiota composition and chronic disease may rely on identifying specific taxa that differ between healthy and disease states. An array of statistical methods have been employed to analyze differentially abundant taxa between microbial communities. However, due to the sparsity, non-Gaussian distribution, and variation in sample sequencing depth of 16s data, the robustness of these statistical approaches can vary. PURPOSE: To compare and contrast the statistical output between edgeR and ANCOVA analyses on microbiota datasets from high fat (HFD; diseased) and standard diet-fed (CON; healthy) mice. PROCEDURE: Initial analysis of metagenomic samples (n=152) were completed in myPhyloDB (http://www.myphylodb.org, version 1.1.2). Samples with fewer than 5000 reads were removed. EdgeR and ANCOVA analyses, conducted in R/Rstudio (version 4.0.0), were used to compare differences in taxa abundance between HFD and CON mice. RESULTS: EdgeR controlled for false discoveries through FDR adjustment, while ANCOVA p-values were adjusted via Tukey HSD. EdgeR increased statistical power as well as type 1 error, while ANCOVA reduced statistical power and type 1 error rates. IMPLICATIONS: Both edgeR and ANCOVA are frequently used in microbiome analyses. Interestingly, the consistent use of ANCOVAs in microbiology suggests its robustness to non-normal data, yet further evidence is necessary. Ultimately, the use of either edgeR or ANCOVA is dependent on what is of more concern to the investigator- reduced statistical power or heightened type 1 error rates. Increased efforts are needed to further establish the biologic relevance of taxa differences between various microbial populations.

67 Accelerated Drug Discovery Using Electrochemistry in Organic Synthesis

JAKE GREENWOOD

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COLLEGE: NATURAL SCIENCES

Pyridines are ubiquitous within pharmaceuticals due to the medicinally relevant properties they impart to the drug, thus methods to functionalize these scaffolds are highly desired. N-fluoropyridinium salts are extremely versatile organic reagents that react through a variety of

pathways to give valuable products which are challenging to synthesize using currently available methods for pyridine functionalization. Unfortunately, the current methodology cannot be applied to drugs or drug-like molecules due to the synthesis of N-fluoropyridiniums requiring fluorine gas, which is extremely reactive and necessitates specialized equipment for safe handling. A mild, alternative method for synthesizing these reagents would expand this manifold to late-stage functionalization of pharmaceuticals, lowering the cost and time required for discovery of life-changing medicines.

In the last decade, electrosynthesis has been leveraged to enable transformations previously inaccessible through traditional chemical-mediated synthesis. In 2016, Budnikova and coworkers reported the synthesis of N-fluoropyridiniums through the electrolysis of pyridine and cobalt trifluoride using two platinum electrodes. While this is an important contribution to expanding N-fluoropyridinium chemistry without the use of fluorine gas, it was only shown on two simple pyridines in moderate yield. This technology has the potential to be expanded to more complex, drug-like pyridine scaffolds followed by transformation using the rich chemistry of N-fluoropyridiniums for rapid synthesis of previously inaccessible drug targets. We propose an investigation of the initial finding from Budnikova, optimization of those conditions, and exploration of the generality of this transformation to complex pyridines.

69 End-consumer Market Research for Methane-reduced Beef/Dairy Products

ETHAN HAHN

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COLLEGE: BUSINESS

Our team spent the last nine months researching the practicability and feasibility of a seaweed feed additive for cattle to reduce their methane emissions by up to 90%. The cattle industry accounts for 14 per cent of the 570 million metric tons of methane emissions worldwide. We believe that this groundbreaking research could be a potentially significant strategy to reinvent the reputation of the cattle industry, and reduce global methane emissions. We would like to apply our skills in business to create a market for methane-reduced beef products. Before a market can be established, however, end-consumer data demonstrating willingness to pay and underlying attitudes for methane-reduced products must be established. Moreover, a target customer profile must be described. In order to gauge customer willingness to pay and understand the underlying attitudes and buying behaviors of end consumers, we set about creating a survey. The survey consisted of 34 questions covering demographic data, grocery shopping behaviors, attitudes towards the environment, motivating factors for purchase, and A/B testing of hypothetical methane-reduced beef and dairy products. The team was able to capture a sample size of 500 respondents, providing statistical significance. Following receipt of all data, thorough data analysis was conducted, revealing that consumers are willing to pay a premium for methane-reduced products for the price sensitivity was very low. Additionally, we identified a target consumer profile and the buying behaviors that are important to them. We intend to utilize this information to continue developing our venture. The research validated our hypothesis.

70 Creating Space for Environmental Education during a Community Crisis

ISABELLA HARRIS

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COLLEGE: WARNER COLL OF NATURAL RESRCES

During the COVID-19 crisis, many community educators have had to work through new challenges with little to no guidance, and have gained valuable experiences that can help adapt environmental education frameworks. Learning to adapt and prioritize environmental education during a crisis is necessary for both ecological and social development across the world. Ecologically, issues like climate change and deforestation are directly related to worldwide crises. Socially, environmental justice and outdoor exploration helps communities persevere through crises, and education is needed to bring light to these relationships.

This research project will involve evaluating the experiences of educators to create recommendations for prioritizing environmental education in Northern Colorado during community crises. Virtually based environmental education in Northern Colorado will be compared with participant testimonies in terms of expectations and experiences. This information will be gathered using interviews.

In conclusion, this project will provide a diverse and comprehensive report of recommendations for future environmental educators and a framework for outdoor engagement during a community crisis.

In the future, this case study will serve as an insight into perseverance within environmental education, and be used as a framework for engaging communities in outdoor education during unstable times.

This research is currently in its beginning phase. Interviews of educators and community members have started but have yet to be evaluated and virtual social media engagement is currently being interviewed, I expect my results to reflect the struggles, successes, setbacks and adaptations experienced by environmental educators in Northern Colorado in the form of a recommendation framework.

71 Education and Healthcare Networks Resilience as a Social Stability Index

EMAD HASSAN

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Healthcare and education systems have been identified by various national and international organizations as the main pillars of communities stability. Understanding the correlation between these main social institutions is critical to determining the tipping point of communities following natural disasters. Despite being defined as social stability indicators, to date, no studies have been conducted to determine the level of interdependence between schools and hospitals and their collective influence on their recoveries following extreme events. In this presentation, we devise an agent-based model to investigate the complex interaction between healthcare and education networks while considering the communities physical, social, and economic sectors that affect overall recovery. We employ comprehensive models to simulate the functionality processes within each facility and to optimize their recovery trajectories after earthquake occurrence. The results highlight significant interdependency between hospitals and schools including direct and indirect relationships, suggesting the need for collective coupling of their recovery to achieve full functionality of either of the two systems following natural disasters. Recognizing this high

level of interdependence, we then establish a social stability index, which can be used by policymakers and community leaders to quantify the impact of healthcare and education services on community resilience and social stability.

72 Reducing Inflammation And Promoting Neuronal Regeneration In Neurodegenerative Disease

ARIELLE HAY

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COLLEGE: VETERINARY MED AND BIOMED SCI

By 2040, the World Health Organization predicts that neurodegenerative diseases will be the second most common cause of death in the developed world. Many of these diseases, such as Alzheimers and Parkinsons, are the result of a specific protein in the brain becoming misshapen and forming aggregates. Other hallmarks of neurodegenerative diseases are inflammation in the brain followed by the irreversible loss of neurons. This is best demonstrated by the prion protein, which causes a rare but deadly group of diseases called prion diseases. Having the prion protein is critical for these diseases to occur. We will test our therapeutic in prion-diseased mice as a model for other neurodegenerative diseases. We propose the use of two different types of stem cells as a therapy. Adipose-derived mesenchymal stem cells can be isolated from the fat tissue of adult mice. These cells produce immunomodulatory and anti-inflammatory mediators that have been found to reduce inflammation in the brain. Olfactory neuronal progenitors can be taken from the nasal cavity and be differentiated into neurons to replace those that have been lost due to disease. We will remove the prion protein from these cells using CRISPR/Cas9 gene editing, making them resistant to developing the disease. Using nasal instillation, we will introduce these gene-edited stem cells into the brains of prion-infected mice, where we predict the cells will migrate to sites of inflammation and neuronal damage. We hypothesize that together these cells will reduce neuroinflammation and regenerate disease-resistant neurons, preventing the progression of neurodegeneration.

73 Establishing Pseudo Pelger-Huët Anomalies as Radiation Biomarkers in Rhesus Macaques

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Radiation exposures can be a dangerous occupational hazard associated with handling high-level radioactive materials in several industries including, but not limited to, power generation and medical facilities. Following an exposure to radiation, medical intervention is pivotal to the survivability of the patient and the sooner the appropriate measures are taken the better the odds for survival are. Early estimates of doses can be determined via biomarkers such as dicentric chromosome analysis or scenario reconstruction using computer software. However, both take valuable time, and can be expensive. Here, potentially faster, and cheaper quantitative biomarkers for radiation exposure were evaluated in acutely exposed Rhesus Macaques from the Wake Forest University Primate Center.

Increased frequencies of abnormal neutrophils in peripheral blood, referred to as pseudo Pelger-Huët anomalies (PPHAs), have been shown to be potential biomarkers of radiation exposure in several scenarios, including the 1958 Y-12 criticality accident and the radium dial painters. We have confirmed the PPHA morphology to be present in Rhesus Macaques and a dose response curve, a biokinetics model, and determination of background prevalence of the morphology has been constructed utilizing peripheral blood smears. The dose response curve consists of monkeys ranging from 0Gy to 8.5Gy (LD90) exposures, and the biokinetics model utilized 4Gy exposures and periodically taken blood smears over a 3-year period following irradiation. Results have the potential to substantially reduce the cost both in terms of time and resources required for biodosimetric analyses in the event of future large-scale accidental or occupational exposures.

74 Effect of Urban Growth on Flood Risk and Community Resilience

MONA HEMMATI

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COLLEGE: WALTER SCOTT COLLEGE OF ENGR

Flood risk to urban communities is increasing worldwide due to the effect of climate change and socio-economic development. The latter effect, being one of the main drivers of rising flood risk, has received less attention in comparison to climate change. Economic development and population growth are major causes of urban expansion in flood-prone areas, and a comprehensive understanding of the impact of urban growth on flood risk is an essential ingredient of effective flood risk management. The objective of this research is to evaluate the effect of urban growth, climate change, and their relative importance in future river flood risk. The effect of urban growth needs to be evaluated by building spatial explicit dynamic models such as Cellular Automata (CA). A Cellular Automata model is applied to predict the future urban growth of a community in terms of not only its extent (city boundary) but also locations of future residential, commercial, and industrial occupancy zones. Finally, to generate floodplain maps for all considered riverine flooding scenarios, a coupled 1D/2D unsteady hydraulic model is used to simulate floodplain depths and extents. The results have demonstrated optimal development plans to protect the community against riverine flooding events. These results will assist city planners and stakeholders to examine tradeoffs between costs and benefits of future land development, considering uncertainties in flood hazard, the performance of the built environment, and population growth during the remainder of the 21st century.

75 Risky Business: Agricultural Risk Impacts on Conservation Program Enrollment

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This project aims to explore the impacts of both drought risk and commodity price risk on conservation program enrollment for agricultural producers at a national scale. Specifically,

we will be analyzing enrollment in the Environmental Quality Incentives Program (EQIP) which is a USDA program funded under the conservation title of the U.S. Farm Bill. This topic was explored specifically for drought risk by Wallander et al. (2013) and the current project will replicate this prior exploration method with more recent data while adding price risk as an additional risk factor that may impact the decision to engage with conservation programming. This project will employ a conditional logit model, exploiting both spatial (county) and temporal (yearly) variation to understand effects. Price risk is determined from data extracted from the Livestock Marketing Information Center, drought risk is determined from various drought indexes, and EQIP enrollment data comes from the National Resource Conservation Service. Models will be run for three types of conservation practices: irrigation efficiency, tillage, and grazing improvements. Early results for irrigation practices indicate that drought risk does positively impact program enrollment, but further investigation is merited. Farming and ranching businesses are steeped in risk, and only getting riskier. Research into how this increased risk will impact the decision to engage in conservation programming will allow policy makers and conservation advocates to better understand the feedback loop of risk and resiliency in building conservation programs for agricultural producers.

76 Student Perceptions of Online Peer Learning in Music Teacher Education

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COLLEGE: LIBERAL ARTS

The purpose of this study is to explore student perceptions of online peer-assisted learning (PAL) experiences in a music education environment via motivation orientation, social-emotional learning, and classroom climate. PAL has been identified as one of many successful strategies for meeting the diverse needs of students in online contexts; however, there is a dearth of scholarly literature surrounding online PAL in music. Given the increasing demand for flexible online learning solutions, music educators will benefit from context-specific knowledge about the interaction of PAL with online music environments. A quantitative design was selected in order to depict the overall learning experience of the class while the inclusion of follow-up interviews will provide insight into the unique experiences of individual students. Data will be collected and organized into two strands: Strand I consists of data gathered via (1) achievement-goal orientation questionnaire; (2) social-emotional learning scale; and (3) online learning climate scale. Strand II will include artifacts, observations, and interviews from information rich cases that become apparent during Strand I. Examining individual and environmental factors via both strands is intended to paint a vivid and in-depth portrait of student perceptions and experiences. This project has been granted IRB approval and data collection will begin in October. Data will be analyzed using descriptive statistics and interviews will be organized according to emergent themes. Implications of this study are intended to inform future research to augment the existing body of literature and provide empirical data to guide practicing music educators in curricular and instructional design.

77 Adaptive clothing: A review of clothing patents targeting disabled users

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Adaptive clothing has traditionally been designed with elderly users in mind, however, more and more research is being done to help advance the market of adaptive clothing to include young people and adults with disabilities as well. This research reviewed all utility patents from 1990 to present day that relate to adaptive clothing targeted fully or partially toward people with disabilities. The purpose of this research is to understand the patent landscape and track innovation levels in the field of adaptive clothing. Google Patents was used to search all patents related to clothing and disability. These patents were imported into a data sheet and coded according to several factors, including target audience and target feature. Through future analysis of these data, it will be possible to begin to understand the patent-based adaptive clothing market. This research is expected to have implications for both innovators and clothing industry leaders, in that understanding current patent trends will outline areas of opportunity and thus may inform future adaptive clothing market trends.

78 Economic Feasibility of Reusing Electric Vehicle Batteries for Grid Storage

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After their first useful life in electric vehicles, electric vehicle batteries can be reused and then recycled. Second life batteries can be reused for several applications including grid energy storage. Second life battery modules can have an imbalanced State of Health among cells. This limits the life and depth of discharge of the second life battery modules. This research determines the economics of refurbishing second life battery modules to improve their performance. The refurbishing methods analyzed are traditional binning and a novel process that uses a Heterogeneous Unifying Battery (HUB) system. The resale price of the battery modules is first determined for each refurbishing method. This analysis determines the HUB system to have a lower resale price than traditional binning. The economics of each refurbishing method is then used to determine the minimum grid revenue from the battery modules when used in an Energy Storage System (ESS). The economic feasibility of the ESSs is evaluated based on current market revenues from potential power and energy market grid applications found in literature. This study determines that the only potential grid application for refurbished batteries to be economically viable is frequency regulation which has too small of a market size for all second life batteries to operate in. To make other grid applications economical, this study recommends additional research on value stacking, reducing second life battery refurbishing costs, and reducing ESS hardware costs.

79 System for grocery shopping recommendations based on one's health profiles

MO HUSSEIN

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COLLEGE: WALTER SCOTT COLLEGE OF ENGR

We aim to develop a system that enables people to shop for groceries based on their health profiles. Our software allows people to enter their health conditions and receive recommended nutrition from their preferred online or local store. The software tracks what people order and provide data insights into the impact of what they eat on their health.

This goal can be achieved through the below high-level steps:
1. Get a comprehensive dataset of lab test biomarkers, nutrition, and grocery items.
2. Develop a Natural Language Processing (NLP) model to recognize text from lab reports.
3. Select a representative set of biomarkers
4. Choose a classification model
5. Train the data to incrementally improve the models ability to predict the health conditions (classifications) associated with the lab results.
6. Make reasonable, evidence-based predictions of nutrition that have been suggested by research to positively impact the biomarkers.
7. Develop a process for automatically predicting a list of recommended grocery items based on health conditions.
8. Develop a process for automatically generating a health meter for each grocery item based on the health conditions.
9. Evaluate and test the data model and perform parameter tuning.

Given that 133 million Americans, or 45 percent of the population, have at least one chronic condition. Achieving these objectives would provide them with a mobile and web application that will help them make better dietary decisions and, therefore, improve their preexisting health conditions and mitigate the risk of future potential health conditions.

81 Improving the Mechanical Stiffness of 3D-Printed Bones through Design Optimization

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In cases of trauma or diseases such as cancer, bone can be damaged beyond the point of natural healing. Though grafts can provide a level of aid, they carry significant risks such as infection, ill-fit, or being out-right rejected by the body. Therefore, the research and development of methods that reduce the risks associated while providing adequate blood flow through the wound, all while maintaining structural support to the body, is a high-priority area. Hydroxyapatite-based bone scaffolds are a promising solution to this problem, as not only will they provide the support needed, they will also be absorbed by the body over time. Of significant additional interest is material that can be 3D-printed into complex, freestanding shapes. This allows us to begin analyzing intricate designs that provide greater support and stiffness while maintaining the porosity necessary to facilitate the bodys own natural healing processes.

Our lab is successfully able to 3D print Hydroxyapatite-based scaffolds. While aiding a

parallel study, we were able to successfully implant our scaffolds into the legs of sheep that had been suffering from osteoporosis. Months later, the scaffolds show signs of bone growth in and around them, validating our concept as being capable of aiding and sustaining growth. We are currently in the process of developing mechanical tests to quantify the properties of our designs. Once these are determined, we will begin designing and then testing the new designs in order to ultimately match the properties of natural bone.

82 Moderation of Physical Health on Mental Health among Grandparents

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An estimated 69.5 million older adults in the United States report being grandparents. It is also evident that the number of grandparents raising grandchildren among them is increasing. Although caring for their grandchildren often provides grandparents a sense of purpose and increased life satisfaction, unexpected responsibilities of parenting worsen the already challenging experience of aging (e.g., potential for poor physical and mental health). Thus, it is essential to study the well-being of grandparents raising grandchildren. Links between depressive symptoms and emotional health have been widely studied in previous research. However, limited research has focused on physical health as a potential moderator, despite indirect evidence shown that more depressive symptoms may be observed among those with worse physical health conditions. To address this, we used Optum® SF-36v2® Health Survey to collect physical- and mental-health data and Center for Epidemiological Studies Depression Scale (CES-D-10) to collect information on depressive symptoms in 137 grandparents raising grandchildren (age 40-83) before, immediately after, and six months after a six-week intervention focused on self-care practices. The presence of more depressive symptoms indicated worse emotional health. Physical health moderated these associations at all three time points, such that depressive symptoms were less strongly related to emotional health if grandparents self-reported better physical-health scores. These findings have important implications for future intervention studies. The importance of good physical health practices for grandparents raising grandchildren is evident, including increased physical engagement and better pain management.

84 Exploring reaction pathway and phase selectivity in Cu-Sb-Se nanoparticle synthesis

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Copper antimony selenides are of interest for a variety of applications, including their use in solar cells and thermoelectrics. Solution-phase nanoparticle synthesis allows control over particle shape and size; however, phase purity remains a challenge in the Cu-Sb-Se system.

In this work, I explore the synthetic knobs in hot-injection synthesis that can be used to favor

different phases, sizes, and morphologies. Aliquots were removed as the reaction progressed to gain insight into reaction pathway. X-ray diffraction was used to determine phase composition and transmission electron microscopy was used to evaluate particle morphology. I have determined that stoichiometry, solvent, precursors, and temperature can be manipulated to favor each of the $CuSbSe_2$, Cu_3SbSe_3 and Cu_3SbSe_4 phases individually. The reaction pathway for formation of $CuSbSe_2$ as well as the particle morphology appears to change depending on the temperature of synthesis. The addition of a lithium amide base allows formation of $CuSbSe_2$ phases at a lower temperature than with no base present. The role of this base is particularly interesting, as it appears to change particle morphology as well. Investigations into reaction pathways for these phases are ongoing.

85 Giving Dollars & Sense: How Generosity Impacts our Capitalist Economy

KRYSTAL KAPPELER

 DEPARTMENT: ECONOMICS
 COLLEGE: LIBERAL ARTS

Consumers are faced with a plethora of goods and services to drive their own satisfaction, yet many consciously choose to give their resources away philanthropically. Economists disagree regarding relevant variables for an ideal empirical model of this phenomenon. This research begins with an in-depth literature synthesis investigating factors that drive philanthropy, marrying schools of economic thought, and consumer behavior with a review of economic research articles, interviews, and industry reports. This study then utilizes panel data to test theoretical models and inform policy decisions, to ultimately contribute to quantifying the impact of philanthropy on the United States capitalist market.

86 Impacts of Co-Disposing High-Moisture-Waste and Municipal-Solid-Waste on Hydraulic Conductivity

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Landfilling is an integral part of solid waste management, and approximately 50% of municipal solid waste (MSW) generated in the U.S. disposed in MSW landfills. Other types of non-hazardous waste can be disposed in MSW landfills. High moisture waste (HMW) is a non-hazardous, non-MSW solid waste that can be disposed in MSW landfills. HMWs often include a bulking agent. Bulking agents are waste materials with low moisture content and high moisture capacity, which can absorb moisture from liquid wastes or sludges to create HMWs for landfill disposal.
Disposing HMW in MSW landfills is advantageous to landfill owners as this waste stream generates revenue. In addition, disposal of HMW can provide moisture and potentially nutrients or microorganisms to a landfill that can lead to benefits associated with in situ anaerobic treatment of MSW. However, the addition of HMW to an MSW landfill can have negative consequences, such as reduced landfill stability, decreased fluid and air

permeability that can impede extraction of biogas and injection of liquids, release of unknown contaminants, and biochemical incompatibility that can destabilize MSW biodegradation.

The balance between benefits and consequences of HMW disposal in MSW landfills depends on the amount of HMW added to MSW, composition of the HMW, and vertical stress. A recent landfill slope failure in the U.S. was associated with disposing low shear strength sludge with low permeability in the landfill waste mass.

The objective of this study will be to assess the influence of co-disposing HMW with MSW on hydraulic behavior of MSW.

87 End-of-life Care in Correctional Settings: A Scoping Literature Review

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The complexities of care, in addition to the lack of access to funding and resources, are only a few of the numerous challenges in providing end-of-life care in a correctional setting. With an aging incarcerated population comes an increased need to access health care professionals and services; however, research indicates an alarming number of barriers associated with access to and quality of care. The objective of this scoping literature review is to summarize the quality and primary outcomes measured within the end-of-life care in correctional settings literature. Social workers have played critical roles in mental health and health care provision in correctional facilities. With a deep understanding of the hospice philosophy, social workers champion for increased visiting hours for families, encourage correctional staff members to communicate with families about an inmates health, and advocate for inmate requests for special foods and accommodations to increase comfort. There is vast potential to close the health gap, reflecting one of the Grand Challenges for Social Work. This presentation will synthesize the current state of the literature, gaps in care, and potential areas for social work clinical interventions and research.

88 Application of XR Technology Across the Humanities and Sciences

BRENDAN KELLEY

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Extended Reality (XR) technology is a still evolving medium with the potential to dramatically alter a variety of different fields in both the humanities and sciences.

XR shows the same potential as computing technology for adoption within every academic discipline. Applications such as Orillas Del Ebro VR, which is a VR visualization of historic poetry used to communicate connections between hydrology and humankind, are capable of reaching multiple disciplines in a tangible and relatable way.

Orillas Del Ebro VR is still in development, however like many other XR projects our team and others on campus have produced it is brimming with potential for collaboration between the humanities and the sciences. Providing an avenue for communication between often segregated fields and helping to increase engagement from audiences.

While XR technology is still developing there are already major changes within multiple fields, from medical, to environmental, to art all disciplines can benefit from the application of XR technologies. Orillas Del Ebro VR is but one project in a promising line of influential XR applications.

89 Impact of time-restricted feeding on circulating factors and insulin sensitivity

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Background. More than 35% of American adults have impaired fasting glucose or diabetes. A combination of dietary and activity patterns are key components of diabetes risk. Recent research suggests the timing of eating is an important determinant of metabolic homeostasis. Time-restricted feeding (TRF, a form of intermittent fasting) is a circadian-based countermeasure involving eating within a period of 6-10 hours, followed by a prolonged overnight fast. Many studies report improved metabolic function and insulin sensitivity as a result of TRF. However, no studies have assessed the impact of TRF on overnight circulating factors. Therefore, the purpose of the present study is to examine the impact of TRF on overnight (OVN) free fatty acids (FFA), glucose, insulin, and morning insulin sensitivity.

Methods. Eight healthy adults (6F; 27±3.8y; 22.6±2.1kg/m2; mean±SD) completed a 2-week protocol. In Week 1, participants were instructed to maintain normal food intake spread across 13h. In Week 2, participants were instructed to match food intake from Week 1 but restrict intake to an 8h period. At the end of each week, participants were admitted to the lab for an overnight stay involving hourly blood samples and an oral glucose tolerance test the following morning.

Results and implications. TRF increased OVN-FFA (p=0.04), decreased OVN-insulin (p=0.005), but didnt impact OVN-glucose (p=0.39) or morning insulin sensitivity (p=0.38). The knowledge to be gained by this project supports the development of cost-effective programs that may inform our approach to metabolic disease prevention in at-risk populations (e.g. shift-workers and anyone who eats outside daytime hours).

90 Arab Spring and The Impact of Corruption on Economic Growth

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  COLLEGE: LIBERAL ARTS

The Middle East and North Africa (MENA) is known as one of the most corrupt regions of the globe according to many indicators. This is the result of high perception of corruption in political and social areas which causes lower economic growth as a consequence. It is a fact that measurement of corruption in a country or region is always a challenge. The macroeconomic studies mostly rely on survey data sets which provide possible biased results. However, having a strong correlation between the indexes gives at least a holistic picture that corruption is understood the same. In this paper, I investigate how Arab Spring affects the impact of corruption on economic growth in the MENA region. My preliminary regression results show that negative repercussions of Arab Spring in terms of corruption varies in each country. Egypt, Libya, Tunisia, Syria and Yemen are hit more severely than other countries especially the Gulf region. These countries have radical and transformative political changes after the Arab Spring and the impact of corruption on their economic growth seems detrimental. Although there are some robustness issues because of insufficient data points, I believe that this work opens doors for policy makers to tackle corruption phenomenon in the MENA.

91 Soil health, agricultural productivity and household welfare: Evidence from India.

SIDDHARTH KISHORE

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COLLEGE: AGRICULTURAL SCIENCES

How changes in soil health measured as soil carbon content affects agricultural productivity and rural household welfare in India. We apply satellite data to environmental and developmental economics. We will focus on two major data sources first SoilGrids Information to explore the physical (e.g., Clay content (in g/kg), Sand (in g/kg) and Silt (in g/kg) and chemical (e.g., Nitrogen (in cg/kg), Soil organic carbon (in dg/kg), and pH water) characteristics of soil in India. Second, we will use climate data store, Copernicus, to explore soil moisture gridded data from 1978 to present to construct a time-series dataset. We match the soil health variable constructed at village level to the India Human Development Survey.

Soil quality will be determined using various indicators such as soil moisture, nutrient availability and organic carbon content. As soil quality determinations are made, recommendations will be provided in the form of land restoration techniques and/or sustainable agricultural practices. Using an econometrics model, we estimate the linkage between soil health, agricultural productivity and rural household welfare in India. The results would contribute to target developmental and environmental policies in India.

92 A Multi-scale Investigation of Allostery, the Biological Butterfly Effect

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Allosteric regulation occurs when a molecule perturbs the function of a macromolecule by

binding at a location distant from the primary active site. This can be likened to the butterfly effect, where a seemingly inconsequential event substantially alters the outcome. Rational design of allosteric drugs is a rapidly developing field because they may have fewer adverse side-effects, and target undruggable macromolecules. There are many unknowns regarding the allosteric mechanism, which prohibits rational design efforts. Therefore, it is necessary to study well-known allosteric systems at atomistic detail. I use quantum and classical mechanics to investigate the requirements of a system to be allosterically active. The imidazole glycerol phosphate synthase (IGPS) protein was selected for these studies. When the allosteric effector, PrFAR, binds there is a 4500-fold increase in catalytic activity over 25 Å away. IGPS function is critical in microorganismal biosynthesis pathways, which makes it an attractive antimicrobial drug target. By measuring the pairwise covariance between amino acids from molecular dynamics simulations we have identified communication pathways that link the PrFAR binding site to the primary active site. Quantum mechanical evidence supports that the proximity of the Gly52 amide is responsible for reducing the effective energy barrier, thus enhancing the reaction rate. With this information, we can consider the rational design of a molecule that invokes communication pathways that consequentially disrupt the necessary active site interactions. This work paves the way for the development of a computational procedure that can be applied to a wide variety of biological systems.

93 Couple-Level Minority Stress, Coping, and Outness in LGBTQ Couples

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Lesbian, gay, bisexual, transgender, and queer (LGBTQ) couples face sexual-minority identity stressors that are uniquely different from heterosexual couple experiences. Much of the literature has focused on the effect of minority stressors on the individual level, however, no current research has examined couple-level minority stress. Couple-level minority stress impacts both individuals in a romantic relationship and adds a second dimension to negative outcomes related to minority stress. The current study sought to fill this gap in the literature by creating and testing a measure of LGBTQ couple-level minority stress, adapted from established qualitative research on the subject (Frost et al., 2017). LGBTQ couple-level minority stress can be conceptualized as stressors related to the sexual-minority status of each individual within the couple, and how these stressors manifest within the couple and affect couple functioning. Couple-level minority stress likely impacts relationship satisfaction, and we hypothesize that this relationship is moderated by degree of outness (e.g., level of disclosure of ones sexual identity) and by engagement in dyadic-coping (e.g., how partners cope with stress jointly). Individuals who report being in a same-sex relationship are currently being recruited to partake in the research. One-time self-report measures are being used to collect data on outness, dyadic coping, impact of LGBTQ couple-level minority stress, and relationship satisfaction. We suspect the results to reveal a positive association between couple-level minority stress and relationship satisfaction, moderated by higher levels of outness and higher levels of dyadic-coping.

94 Correlating structural dynamics and white light emission in layered perovskites

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Efficient, single material white light emitters are rare and of interest for solid-state lighting applications. Layered perovskites with the formula A2PbBr4 (A = R-NH3+) are a single material with inorganic and organic sublayers that emit tunable white light. The inorganic sublayer has been studied extensively; however, the role the organic sublayer plays in white light emission is not well understood. To understand the role of the organic spacer cation in layered hybrid perovskites we have prepared a series of lead bromide perovskites with varying white light emission; (nBA)2PbBr4, (ODA)PbBr4, (GABA)2PbBr4 (nBA = n-butylammonium, ODA = 1,8-diaminooctammonium, GABA = 4-aminobutyric acid). Quasielastic neutron scattering (QENS) is an advanced scattering technique used to probe the motion of the A-site cations. Here, QENS and photoluminescence show more intense white light emission is observed in materials with slower cation motion. In (ODA)PbBr4 and (GABA)2PbBr4, slower cation dynamics compared to (nBA)2PbBr4 were observed concurrently with an increase in white light emission. If the dynamics of these materials can be altered synthetically, white light emission could be induced in materials that do not typically emit white light. This project provides an understanding of the underlying dynamics in these materials and could allow for the strategic design of new, higher-performing white light-emitting materials.

95 Ultraviolet fluorescence discovered in New World flying squirrels (Glaucomys)

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Fluorescence of visible wavelengths under ultraviolet (UV) light has been previously detected in a wide range of birds, reptiles, amphibians and a few marsupial mammals. Here, we report the discovery of vivid UV fluorescence of the pelage in Glaucomys, the New World flying squirrels. Fluorescence in varying intensities of pink was observed in females and males of all extant species (G. oregonensis, G. sabrinus, and G. volans) across all sampled geographic areas in North and Central America and a temporal range of 130 years. We observed fluorescence in museum specimens (n = 109) and wild individuals (n = 5) on both dorsal and ventral surfaces. Museum specimens of three co-occurring, diurnal sciurid species (Sciurus carolinensis, S. niger, and Tamiasciurus hudsonicus) were also examined but did not fluoresce. The ecological significance of this trait in the nocturnalcrepuscular flying squirrels warrants further investigation.

96 The Impact of Fossil Fuel Extraction on Student Test Performance

SAM KOSS

DEPARTMENT: AGRICULTURAL AND RESOURCE ECON
COLLEGE: AGRICULTURAL SCIENCES

This research connects oil and gas well activity to near schools to students' test scores, examining the effect of drilling and hydraulic fracturing activity on standardized test outcomes at all public schools in Colorado. Given the air pollution and noise that has been observed at Colorado wells and the known cognitive responses to pollution and distractions, we aim to determine how these wells impact nearby students' performance.

We use spatially- and temporally-explicit data on well drilling and student standardized test results across 1653 Colorado schools from 2007-2019 to estimate a causal impact of drilling activity on the proportion of students that fail. In addition to controlling for observable school characteristics and weather, our rich dataset allows us to control for unobservable factors influencing test scores by school, grade, subject, and year. The results indicate that over the course of the study period, the 1,057 wells drilled within 5km of schools (221) during the test period caused 2,264 students to fail a subject test, which accounted for 1.26% of all fails at schools near wells.

Our findings suggest that oil and gas drilling near schools can have an economically significant effect on academic outcomes. These results can inform future efforts to minimize the external costs associated with energy production.

97 Open questions on the biological roles of first-row transition metals

KATE KOSTENKOVA

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First-row transition metals have a variety of applications and play several roles in biological processes and medicine. Many roles of these elements have been investigated; however, there are many questions regarding the toxicity and the biological properties of these elements that are yet to be answered and which speciation chemistry may be able to solve. This presentation will cover the biomedical applications and the toxicity of first-row transition metals, and then focus on two classes of vanadium coordination compounds that can potentially be used for the treatment of disease. Vanadium salts have been used for more than a decade; however, the complexation of the vanadium has been found to lead to more efficacious and less toxic compounds. The first class of vanadium coordination compounds, vanadium(V) dipicolinates, was found to enhance the oncolytic viruses and, as a result, be used as a more potent combination therapy against cancer. This led the Crans group to explore other vanadium compounds in combination with the oncolytic viruses, as well as different forms of cancer. The second class of vanadium compounds to be discussed here is homo- and heteropolyoxovanadates which were found to inhibit the growth of Mycobacterium smegmatis. These studies are also put in the broader context of some of the

open questions about the biological roles of first-row transition metals.

98 Keeping Public Restrooms COVID19 Free: Cell phone sanitizer and charger

MARIJA KRUNIC

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COLLEGE: WALTER SCOTT COLLEGE OF ENGR

Ever found yourself in the stall of a public bathroom with cell phone in hand? Right. The design goal is to create a holder/shelving for a cell phone that would by its very design beckon the user to place the cell phone on it and override the modern urge to use the cell phone while on the toilet seat by offering add-on value other than just a place to set the phone down. Solution: Set it, charge it, sanitize it!
We have created such a device and demonstrated its use (ENGR 581, Spring 2020) with a vision of aiding in the COVID19 prevention and creating a device convenient and accessible to general public as well as elderly and vulnerable population. The device utilizes a hands-off inductive charging and germicidal UV LED strips with 2835SMD type beads positioned to allow for complete device sanitation. The device represents a proof of concept and a functional prototype designed for contemporary look, durability and ease of installation and maintenance in a public setting. The next step is to obtain the feedback from the target user group and refine the design accordingly and with the help of the CSU Technology Transfer Office explore the market interest and pathways to technology licensing.

99 Using Camera Traps to Capture Elk Calf Avoidance of Predators

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COLLEGE: WARNER COLL OF NATURAL RESRCES

This research provides a novel method for analyzing animal behavior. The elk populations in Uncompahgre National Forest and near Trinidad, CO are experiencing declines in calf recruitment, and rates have already dropped to half of historical populations. One possible cause for this decline is increased predation rates. Typical studies utilize GPS collars and directly estimate mortality sources for the population, however these complex technologies come with significant costs and a multitude of technical difficulties, not to mention potential animal stress and biases to the data. We want to evaluate more passive, cheaper techniques that utilize more reliable technologies, in this case trail cameras. We will utilize a Cox proportional hazards model, which relies on a time-to-event strategy, similar to many of the aforementioned GPS collar studies. Instead of measuring mortality events, we will measure time to return to a camera trap. By measuring variation in how much time it takes for elk to return to areas when a predator is sighted, we will indirectly measure avoidance behaviors. This will be evaluated by factors such as calf presence in the herd, habitat type, or predator species. From this, we will be able to capture a potential component of maternal investment in elk; for example, a cow sacrificing good forage habitat for her calf because a predator is present. As well, we will have an index for which predators potentially cause the

most stress and predation pressure for elk calves, since elk adapt their behavior to local stressors.

100 Neuropathogenesis in Guinea Pigs Exposed to Mycobacterium tuberculosis

AMANDA LATHAM

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COLLEGE: VETERINARY MED AND BIOMED SCI

Tuberculosis (TB), a disease caused by the bacterium Mycobacterium tuberculosis, is one of the top ten leading causes of death worldwide. Tuberculosis infection of the meninges (TBM) is the most severe form of this disease, especially in children and immune compromised patients, such as those diagnosed with HIV/AIDS. Our long-term goal is to therapeutically treat burdened individuals. Currently, we aim to develop a clinically relevant animal model of TBM using the guinea pig, investigate an alternative route of central nervous system infection by Mtb, as well as demonstrate neuropathogenesis caused by peripheral infection. Guinea pigs exposed to Mtb are a well-characterized laboratory model of infection and most closely resemble naturally occurring TB disease in humans compared to other common animal models. We predict that we can isolate and infect olfactory neuronal precursor (ONPs) cells from adult animals and intranasally instill these into the brain to model central nervous system (CNS) exposure. Critically, we are able to isolate these cells in the guinea pig and, via flow cytometry, verify their infection with a BSL-2 fluorescently labelled strain of Mtb. We also hypothesize that Mtb is able to cause gliosis and accumulation of misfolded proteins, producing neurotoxic signaling which damages neurons. Preliminary data using immunohistochemistry and various staining techniques show that infection by aerosolized Mtb causes damage with aggregation of amyloid and glial inflammation in the brain. This data will allow us to uncover a better understanding of how TBM occurs and the mechanisms behind its pathogenesis.

101 In God We Trust?: U.S. Theist-normative Rhetoric

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Phrases such as In God We Trust and One nation under God are two of the most prominent examples of religion being mixed with politics in the United States. These phrases have often been categorized as examples of American Civil Religion. In this paper, however, I contend that much of the perceived unifying civil religion in U.S. political rhetoric is theist-normative rhetoric. When theist-normative rhetorics are categorized as civil religion, their privileging and marginalizing tendencies are often overlooked. Using the national motto In God We Trust" as a case study, I argue that theist-normative rhetorics work to maintain Christian privilege through their dualist function of appearing more religiously tolerant while simultaneously preserving a Christian meaning that is used by Christian nationalists to advance their agenda. Using archival documents, I demonstrate how those officials involved in implanting and maintaining the use of In God We Trust on coins and as the national motto

were explicitly pushing a Christian nationalist agenda that promoted Christian identity as an American ideal while simultaneously framing non-Christians and non-theists as un-American. Over time, the motto In God We Trust became valuable tool for Christian nationalist to use to justify laws based on fundamentalist Biblical understandings of issues relating to abortion and LGBTQ+ rights and to rationalize policies that discriminate against religious minorities, particularly non-theists. I encourage scholars to focus more critical attention to the normative rhetorical promotion and containment of religious identities.

102   Environmental Security: A Source of Legitimacy in Market Governance

JULIE LIEBENGUTH

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COLLEGE: LIBERAL ARTS

Environmental security concepts are proliferating among global debates about environmental change and sustainable development. It is increasingly crucial to understand how security logics function in environmental politics and how securitization influences the architecture of global environmental governance, especially in relation to sources of legitimacy. This project explores environmental security discourses across the food-water-energy (FEW) nexus to examine the implications of securitizing complex and systemic environmental issues. The FEWs nexus is a particularly relevant political space because actors working within and across the nexus frequently evoke the concept of security to articulate the risks and vulnerabilities associated with food, energy, and water issues. The persistent inclusion of businesses in proposed solutions to FEW issues also prompts questions about the role of non-state actors in governing environmental security challenges, and how they can or should utilize such authority. In practice, discourses about agents of security have significant implications for the way complex, socio-ecological issues are governed by certain actors, for whom, and how. My intent is to explore such discursive trends to uncover emerging agents of environmental security. More specifically, I use critical discourse analysis to analyze the authority claims of large businesses and corporations across food, energy, and water sectors to understand how they approach their position as providers of security, and to whom their authority claims are directed. Ultimately, this project seeks to understand whether and how security is used as a source of legitimacy in environmental politics and to elucidate the broader relationship between market-driven governance and environmental security.

103   Citizen Scientist or Citizen Technician: A case study of communication

DANI LIN HUNTER

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Citizen science involves the public in scientific research in varying capacities. It can be mutually beneficial for both science and the members of the public who volunteer, helping to answer questions at broader scales and promoting scientific literacy and public buy-in for

science. We performed an inductive content analysis of citizen science project descriptions on CitSci.org and websites hyperlinked within the descriptions. We categorized the tasks that volunteers were asked to perform as high-, medium-, and low-order tasks according to Blooms Taxonomy, an educational framework for classifying depth of knowledge. We also considered who was described as benefiting from the tasks that volunteers were asked to perform and compared them to known motives for engaging in citizen science. Our analysis suggests that citizen science leaders describe limited engagement in the scientific process, which has implications for volunteer scientific literacy. It also suggests that described benefits may not align with common volunteer motivations. We ultimately conclude that scientists communicate about citizen science in a way that describes volunteers as technicians rather than scientists.

104   Investigating Relationships between Cover Crop Species and the Soil Microbiome.

VALERIE LINDSTROM

DEPARTMENT: UNIVERSITY WIDE - CELL AND MOLECULAR BIOLOGY
COLLEGE: INTRA-UNIVERSITY

Current agricultural systems use cover cropping as a strategy to promote soil health and increase microbial biomass. The relationship between cover crops and the soil microbial community can influence soil health attributes such as soil aggregation, water infiltration, nutrient cycling, and total organic matter which can translate to improvements in crop health. Cover crops mediate this interaction with soil microbes through root exudation, the release of small molecular weight compounds by plant roots to surrounding soils. The long-term goal of our research is to characterize the molecular relationships between cover crops, the composition and function of the soil microbiome and agricultural soil health. Preliminary results demonstrate significant chemical variation in root exudates from five different cover crop species. For example, Triticosecale (Triticale) exudates were observed to be enriched in compounds such as glucose, glutamic acid, oxoproline, and xylose whereas Fagopyrum esculentum (Buckwheat) exudates were enriched in threose, hydroxylamine, boric acid, and isonicotinic acid. Synthetic root exudates representing the major species variation in organic acid and sugar composition were applied to laboratory microcosms inoculated with agricultural soil. Results show that 1) the microbial community structure differed between the two amended exudate treatments; and 2) microbial metabolic functions were significantly enriched in microcosms that had been supplemented with a higher-sugar synthetic root exudate. Future work will focus on expanding our characterization of species diversity in exudate profiles, identification of microbial taxa that respond to the different cover crop exudate profiles in agricultural soils, and translation of our laboratory findings to field-scale environments.

105   ReKaivery: Recovering Local Food Networks, Reducing Food and Resource Waste.

NATASHA LLOYD

DEPARTMENT: COLLEGE OF BUSINESS
COLLEGE: BUSINESS

More than 30% of all edible food within the United States expires in the landfill. This anaerobic decomposition emits chronic levels of methane gas. For all edible food disposed, valuable resources are also wasted. The COVID-19 pandemic exposed the fragility of food supply chains. The collapse of these systems meant supermarkets bore naked shelves and farmers suffered losses. Current food distribution options are inadequate due to lack of scalability, exposure risks, high operational costs, or environmental impacts.

ReKaivery is the solution. We developed a micro-distribution model to decrease the environmental footprint of food distribution while building resilient, stable food networks. Our online platform facilitates connections and sales between local farmers and commercial kitchens.

Interest in this service within Fort Collins has been outstanding with many potential users expressing dire need for this service and committing to joining our platform. User inquiries and partnerships from Denver businesses have aided our rapid expansion beyond Fort Collins.

The value of this network will increase exponentially as we expand. Our model will scale like Uber in that our service connects suppliers and buyers dependent on location. Additionally, we intend to expand services to food distributors which currently contribute more than one-third of the edible food wasted.

ReKaivery brings communities closer to their food sources. We support local economies. We reduce the carbon footprint of food distribution and ensure valuable resources are utilized to their full potential.

106   Single-cell multi-omics reveals similarities between early trophoblast and neurons

DEIRDRE LOGSDON

DEPARTMENT: BIOMEDICAL SCIENCES
COLLEGE: VETERINARY MED AND BIOMED SCI

Molecular events associated with human implantation are poorly understood. Here, we performed single-cell whole genome bisulfite sequencing (scWGBS) on human trophoblast cells (TB; cytoTB, syncytioTB, and migratory TB) obtained from peri-implantation stage human embryos cultured to embryonic day (D) 8, D10, and D12 as described earlier for single cell RNA sequencing (scRNA-seq) experiments (PMID: 31636193). Ninety-six samples were sequenced and approximately 25 million 150 bp paired-end reads per sample were obtained. We captured approximately 20 million CpG sites with 66% total coverage of all CpG sites in the human genome. Global DNA methylation of cytoTB increased from D8 to D10 and maintained relatively constant to D12. SyncytioTB had a lower, and migratory TB a similar global methylation level compared to cytoTB. Global DNA hypomethylation in syncytioTB may be correlated with the significantly reduced ($p < 0.001$) DNMT3A mRNA expression compared to migratory TB and reduced ($p < 0.0001$) DNMT3b mRNA expression compared to cytoTB. We then identified differentially methylated regions within each cell type and noted a large number of significantly hypomethylated pathways ($p < 0.0001$) linked to neuronal behavior and used these pathways to look for genes differentially expressed at the transcription level. By applying a multiomics approach, our data suggest that DNA methylation is an important driving force for directing TB lineage emergence during implantation and that there are analogies between early trophoblast differentiation and neuronal behavior. This research was funded by Colorado Center for Reproductive Medicine and approved by Western Institutional Review Board (Study no: 1179872).

109   Emergent Hydrologic Properties Associated with Channel Complexity in River Corridors

ANNA MARSHALL

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COLLEGE: WARNER COLL OF NATURAL RESRCES

Scientific literature has documented the benefits of increased channel complexity, such as large wood (LW), in river corridors. One of these benefits is enhanced hyporheic exchange flow (HEF). HEF is critical for (i) ameliorating temperature fluctuations, (ii) transferring dissolved oxygen, solutes, and nutrients, and (iii) providing microbial and macroinvertebrate habitat, and therefore plays an important role in stream health. Studies thus far have focused on simplified river systems with singular LW. There have not yet been studies that examine the effect of multiple, complex jams, but understanding these alternative scenarios has important implications for improving river function and management as the climate warms. The primary objective of this study is to quantify how HEF changes in relation to increasing channel complexity. Field measurements were conducted using near-surface electrical resistivity imaging in a mountain stream along Colorados Front Range in order to examine how spatial variation in LW and temporal variation in discharge influence the magnitude of HEF. Parallel methods are presently being used in a physical model at CSU's Engineering Research Center. We hypothesize that 1) increased logjams along single and multiple channels will increase HEF, and 2) the relative change in HEF exchange will be larger between peak flow and base flow in the stream reaches that are most complex in terms of channel planform and wood quantity. Results will provide insight into the magnitude of HEF in natural and human-altered forested channels and can be used to inform river management and restoration designed to enhance HEF.

110   Bridging the Science-Practice Gap in Conservation through Researcher-Decision Maker Partnerships

COURTNEY MASSEY

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The field of conservation broadly recognizes the need for research to be more effectively translated into action. The science-practice gap, a term describing the complex disconnect between research and how it is or is not used in decision-making, is a multifaceted problem with numerous proposed solutions. We reviewed the peer-reviewed literature addressing the science-practice gap in conservation to identify and describe prominent barriers and recommendations to bridge the gap. To further explore one prominent recommendation for bridging the gap, collaboration, we assembled four case studies of partnerships between Colorado State University researchers and conservation decision makers to understand how these partnerships are formed, designed, and utilized by partners in decision-making. These case studies advance the understanding of how these partnerships aid in bridging the science-practice gap, as well as factors that impact the success of collaboration. The results of this project will help advance conservation efforts by highlighting lessons learned and best practices for bridging the science-practice gap through collaboration that can be

incorporated into future conservation efforts by both researchers and decision makers.

113   Enabling Synthetic Control in Solid State Double Displacement Reactions

BRENNAN MCBRIDE

DEPARTMENT: CHEMISTRY
COLLEGE: NATURAL SCIENCES

The issue of solid-state selective synthesis has plagued chemists reactions for many generations. The limited ability for solid compounds to diffuse in one another has required that solid-state reactions take place at high temperatures. This can subvert chemical control by causing a reaction to proceed to a thermodynamically stable product, with the lowest energy state. Solid-state double displacement reactions have been shown to lower reaction temperatures, thus enabling different chemical pathways to proceed. Our target system, $BiFeO_3$ is known to have synthetic challenges when utilizing traditional high temperature methods. Additionally, $BiFeO_3$ is a technologically relevant multiferroic material that has the ability to couple electric and magnetic dipoles. With decreased reaction temperatures, we have shown that changing chemical precursor can affect the product selectivity and chemical pathway within the $BiFeO_3$ system. X-ray powder diffraction data has been measured while reactions are in progress to investigate the chemical pathways of double displacement reactions with different alkali iron oxide precursors and $BiOCl$. Understanding solid-state chemical mechanisms of $BiFeO_3$ will allow for the broad improvement of reaction design for experimental methodology by allowing full control of product selectivity.

114   Alpha-synuclein neuroprotective against insult with Western Equine Encephalitic Virus

CASEY MCDERMOTT

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COLLEGE: VETERINARY MED AND BIOMED SCI

Parkinsons disease (PD) is a multifaceted movement disorder caused by a variety of different exposures and/or pre-dispositions. The hallmarks of PD include glial reactivity, neuronal loss in the Substantia Nigra (the movement center of the brain), loss of dopamine in the striatum, and alpha synuclein aggregation. Western Equine Encephalitic Virus (WEEV) has been previously characterized to be an exposure that yields a parkinsonian phenotype. In this study, we examined how WEEV could propagate pathology in an A53T transgenic mouse model. A53T is a point mutation from serine to threonine on the protein alpha-synuclein (a-syn) which genetically predisposes the protein to aggregation. Normally, this mouse would not show any motor deficits, a-syn aggregation, or neuronal loss until 16 months of age. We postulate that infection with WEEV would capitulate a model of PD that would carry major hallmarks of disease as early as 4 months of age (1 month post infection). To test this hypothesis, mice were intranasally infected with WEEV at 3 months of age, sacked at 1 month and 3 months post infection, and then probed via IF/IHC for glial reactivity, protein aggregation, and neuronal loss. Data thus far shows glial reactivity and neuronal loss, surprisingly however protein aggregation has been less than significant. This

supports the field in such that a-syn could have an anti-viral application, even in a form that should be pre-disposed to misfolding, this elucidates unknown mechanisms behind neurodegenerative diseases.

115 Teaching While Trans: Experiences of a Nonbinary Postsecondary Educator

THEODOIR MCFARLAND

DEPARTMENT: LIBERAL ARTS
COLLEGE: LIBERAL ARTS

While the experiences of transgender students, and the pedagogy associated with gender-inclusive education, are beginning to emerge in educational research, the same cannot be said for transgender educators. This autoethnographic study was conducted to explore the experiences of the researcher, a nonbinary transgender educator, in order to begin filling in that gap. This research project is still in the process of being completed. Thus far, journals from August 2018 to May 2020 have been coded to discover themes from the experience of this individual. A literature review that encompasses previous research related to gender identity and education have been analyzed, as well as literature related to trauma theory and postcolonial theory. Moving forward, trauma and postcolonial theories will be used to frame the themes that have been synthesized from the coding process. Finally, the project will eventually aim to discuss the future implications of this study for other transgender educators as well as administration in order to more fully support transgender teachers.

117 DIFFERENCES IN ESTROGEN RECEPTOR CONCENTRATION BETWEEN LIPEDEMA PATIENTS AND CONTROLS

KARA MCIVER

DEPARTMENT: FOOD SCIENCE & HUMAN NUTRITION
COLLEGE: HEALTH AND HUMAN SCIENCES

Lipedema is a chronic medical condition that affects up to ~11% of women. The disease is characterized by the painful, bilateral accumulation of subcutaneous adipose tissue in the legs and arms. The causes of lipedema are not yet well understood, but it is reported to start or escalate during periods of hormonal flux, including puberty, pregnancy, and menopause. As such, we hypothesize that atypical estrogen action sparks the onset of adipose tissue accumulation. The Lipedema Foundation supports research with aims to better understand the differences between the adipose tissue seen in the extremities of lipedema patients and the fat accumulation that occurs as a result of other diseases including obesity and lymphedema. Our research utilizes rapid automated Western blot testing to quantify, characterize, and compare the abundance of two estrogen receptors and associated proteins between various tissue types within patients and patients versus controls. Estrogens have been shown to regulate lipid metabolism in adipose tissue. Therefore, we are studying not just the differences in concentration of both estrogen receptors, alpha, and beta, but also key enzymes within the estrogen production pathway in order to identify divergent mechanisms in lipedema patients. Currently, we see higher concentrations of

estrogen receptors and synthesis enzymes in lipedema patients compared to their counterparts. Overall, a better understanding of specific adipose characteristics could lead to improved diagnosis and novel treatment avenues for exploration.

118 Aerobic exercise training increases T1w/T2w in the aging white matter

ANDREA MENDEZ COLMENARES

DEPARTMENT: PSYCHOLOGY
COLLEGE: NATURAL SCIENCES

Objective: White matter (WM) deterioration is an important mechanism of cognitive decline in healthy aging and dementia. Engaging in aerobic exercise is one of the most promising ways to improve cognitive and brain health in healthy older adults. Few randomized controlled trials have reported benefits of aerobic exercise interventions on WM microstructure. Our aim was to study the effects of a 6-month exercise intervention on WM using a novel index of WM integrity, the ratio of the standardized T1 and T2-weighted images (T1w/T2w).
Methods: We included 180 cognitively healthy older adults (6079 years) from a 6-month randomized controlled trial (NCT01472744). Participants were randomized to one of four groups including a low intensity activity with complex cognitive demands (Dance), Walking, Walking + nutrition or an active control.
Results: We found that over a 6-month period, in the active control group, the T1w/T2w signal declined in nine and was stable in two of 11 studied WM regions. We found significant time-by-intervention interactions in the total WM, genu and splenium of the corpus callosum, forceps minor, and cingulum, indicating an increase in T1w/T2w signal in the Walking group when compared to the control. This effect was observed in total WM and genu in the Dance group. Lastly, a positive change in the T1w/T2w correlated with episodic memory in the Walking, but not in the active control.
Conclusions: Our study provides the first evidence for the standardized T1w/T2w as a WM metric capable of detecting the effects of intervention-induced plasticity in the WM.

119 Regionally biased CNVs accompany large-scale chromosomal rearrangements in S. cerevisiae

SEAN MERRIMAN

DEPARTMENT: UNIVERSITY WIDE - CELL AND MOLECULAR BIOLOGY
COLLEGE: INTRA-UNIVERSITY

In the last decade the field of genomic medicine has experienced unprecedented growth made possible by massive improvements in DNA sequencing technologies. One of the main breakthroughs that followed was the discovery that many of the genetic differences that exist between healthy and cancer cells are variations in the number of copies of their genes. Such gene copy number variations (CNVs) are a particularly important component of the altered genomes of breast and ovarian cancer cells. Despite the importance of CNVs to cancer development, our understanding of the mechanisms that trigger these large-scale mutations is still very limited. Using yeast as a model in which to study such CNV-generating mutations, the J.L. Argueso lab has discovered that a specific region of S. cerevisiae

genome (the right arm of chromosome 7; Chr7R) is much more susceptible to the formation of chromosomal rearrangements leading to large deletions or translocations than other apparently similar segments of the genome. To further illuminate the nature of these rearrangements, we are utilizing cell-based genetic assays, pulsed-field gel electrophoresis, and array comparative genomic hybridization, techniques which facilitate detection of both novel fusion chromosomes as well as genome-wide CNVs. We are hopeful that our findings will open a window into the fundamental cellular processes that are responsible for CNVs found in eukaryotic genomes, and inform translational implications for modeling this class of mutation in cancer.

120   Cattle as Partners in Conservation: Collaborative Management of Public Lands

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COLLEGE: WARNER COLL OF NATURAL RESRCES

Could conceptualizing cattle as partners in conservation be a win-win for the livestock and rangeland conservation sectors, resolving the [often] paradoxical objectives of food production and natural resource management? To learn more about the collaborative grazing management that occurs across much of Colorados rangelands, we are conducting an investigation of partnerships between private ranchers and public land managers along the Front Range. Our research process addresses the sustainability of these rangelands as complex social-ecological systems where livestock production and natural resource conservation are woven together in a tapestry of management, culture, and science. Recent literature indicates that scientific research engaging the ecological, economic and social elements of grazing management is lacking. Therefore, our study reflects a holistic model evaluating these three components of sustainability (ecological, economic, and social) to answer our overarching question: Can strategic grazing partnerships on multi-use public landscapes achieve the dual goals of assisting land management agencies with natural resource conservation, and ranchers with maintaining sustainable beef production? We are exploring multiple themes in alignment with the three components of sustainability: soil health, plant biodiversity, forage nutritive quality, ecosystem services, and socio-cultural values. System dynamics modeling will be used to examine relationships and interactions among these themes within and across our study sites. System dynamics modeling will allow us to apply qualitative and quantitative context-specific variables to generate and visualize management alternatives that will ultimately aid in adaptive and integrated decision-making. Our intention is to produce results that are meaningful to stakeholders, solution-focused, and application-oriented.

121   Epistemic Network Analysis: Unveiling Connections on Asynchronous Online Discussions

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Asynchronous online discussions is a commonly used strategy to maximize the quality of online learning experiences by facilitating the social construction of knowledge and promoting critical thinking. However, not all participations and interactions demonstrate in-depth reflections and contribute to a meaningful social construction of knowledge. In addition, instructors lack tools to assist them in monitoring and evaluating activities on asynchronous online discussion. In order to assist instructors to evaluate the contributions of individual students in asynchronous online discussion, we propose the use of Epistemic Network Analysis (ENA) to unveil what concepts students are discussing as well as the relationships that they are building among those concepts. ENA is a network analysis technique that supports thick descriptions based on Big Data about learning to assess learner performance. The theory that supports ENA is the epistemic frames, which understand expertise in complex domains as a network of connections among codes assigned to different elements of collaborative discourse. The study was carried out in an online class for organizational leaders as part of a Masters of Education program at a Research 1, land-grant university, in the Fall 2017. A convenience sample of 24 working, adult learners were registered for the course with 19 consenting to participate in the research. The dataset composed of 77 postings was extracted from Canvas and anonymized. Initial findings indicate that ENA is a beneficial tool for evaluating students online discussion participation and provides insight into the connections students are making including their integration of course concepts with practice.

122 Experiences of women of color navigating risk in the sciences

MO MOREIRA

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Using Foucault's analysis of parrhesia (speaking truth to power), I explore how women of color at various stages of their education and career in the sciences navigate risk within their various educational and professional relationships. Rooted in Critical Race Theory and Critical Feminist Theory, I join other critical researchers in exposing the systemic oppression the sciences perpetuate for women of color. Qualitative interviews will be conducted and analyzed to identify themes. With this research, I aim to center these women's collective voice towards a critical science framework, which problematizes truth, objectivity, and inquiry as we know it today.

123 Distributed Lag Mixture Models

DANIEL MORK

DEPARTMENT: STATISTICS
COLLEGE: NATURAL SCIENCES

Maternal exposure to environmental chemicals during pregnancy is an important public health concern due to potential impact on childrens health. Distributed lag models (DLMs) are frequently employed to estimate the association between material exposure to a single

environmental chemical and childrens health outcomes. DLMs regress an outcome on an exposure measured repeatedly throughout pregnancy. Extending DLMs to multiple chemicals observed at high temporal resolution poses a dimensionality problem and statistical methods are lacking. We propose a model for mixtures of exposures that are observed at high temporal resolution. The proposed model is based on the Bayesian additive regression tree framework with structure added specifically to account for high-correlation in time-resolved measures of exposure. We introduce a novel tree-pair concept to allow for structured main effects and interactions between time-varying predictors and variable selection to select out of the model time-varying predictors not correlated with the outcome. We apply our method to estimate the relationship between six exposures measured weekly throughout pregnancy and resulting birth weight in a Denver, CO birth cohort. Software is made available in the R package dlmtree.

124 Muscle diacylglycerol accumulation and impaired insulin sensitivity during insufficient sleep

SARAH MORTON

DEPARTMENT: HEALTH AND EXERCISE SCIENCE
COLLEGE: HEALTH AND HUMAN SCIENCES

Insufficient sleep impairs insulin sensitivity; however, the mechanism(s) by which this occurs are unknown. We previously reported an elevation in plasma free fatty acid concentration during insufficient sleep, suggesting dysregulated lipid metabolism. Lipid accumulation in musclespecifically certain species of diacylglycerol (DAG)is associated with impaired insulin sensitivity. We therefore tested the hypothesis that insufficient sleep leads to skeletal muscle DAG accumulation.

Thirteen sedentary, healthy, lean adults (25.8 ± 3.2y; 22.7 ± 1.9kg/m2; 3F; mean±SD) participated in a 6-day in-laboratory protocol with 9h in bed (habitual sleep) followed by 4 nights of 5h in bed (insufficient sleep). For one week prior to the study, participants maintained a 9h sleep schedule. Participants consumed energy balanced diets 3 days prior to and throughout the laboratory protocol. Insulin sensitivity was assessed using a hyperinsulinemic euglycemic clamp before and after insufficient sleep. Skeletal muscle biopsies of the vastus lateralis were taken immediately before each clamp. In a subset of subjects (n=10), quantitative lipidomic analyses were performed on biopsied muscle tissue.

Insulin sensitivity was impaired following insufficient sleep (10.7 ± 1.5 vs 9.6 ± 1.2 mg/kg/min, $p < 0.05$, mean±SEM). Insufficient sleep tended to increase skeletal muscle accumulation of total 1,2-DAGs (p=0.13) and significantly increased specific saturated species of 1,2-DAG, including Di-C18:0 DAG ($p < 0.05$), previously implicated in insulin resistance. In contrast, 1,3-DAGs are not thought to impair insulin sensitivity and specific species were decreased or unchanged during insufficient sleep.

Preliminary findings suggest that skeletal muscle lipid accumulation of diacylglycerol species during insufficient sleep may be a contributing mechanism by which insufficient sleep dysregulates metabolic physiology.

126 Should Students Create Their Own Practice Tests?

SARAH MYERS

DEPARTMENT: PSYCHOLOGY
COLLEGE: NATURAL SCIENCES

Although surprising to some, taking a practice test is one of the best study strategies students can use to improve their memory. Thus, researchers that are aware of the memory benefits of testing often recommend that students test themselves while studying. However, what should students do if they are not provided practice tests? Should they spend time creating their own practice test questions? Unfortunately, previous research has not fully answered this question. To address this issue, we experimentally investigated whether self-testing is an effective study strategy. In the experiments, participants read two passages. Then, participants generated questions and later answered them from memory (i.e., self-testing), answered pre-made practice questions, or restudied key facts from each passage. Lastly, all participants took a final test. Interestingly, across 2 experiments, self-testing led to worse final test performance than answering pre-made questions or restudying. Participants gained the least from self-testing when they created questions that did not overlap with material that was on the final test, which may suggest that not all participants could accurately choose the most important material to focus on in their questions. Most importantly, these results suggest that educators may need to provide students with practice test questions or instruction on creating good-quality questions so that students can prosper from practice testing.

129   Do Wearable Fitness Trackers Really Motivate Us To Be Active?

KAYLA NUSS

DEPARTMENT: HEALTH AND EXERCISE SCIENCE
COLLEGE: HEALTH AND HUMAN SCIENCES

Background: Millions of Americans purchase wearable fitness trackers (WFTs); devices intended to support improvements in physical activity (PA) in inactive populations. Despite this, fewer than a third of Americans meet PA guidelines. Furthermore, a large proportion of WFT users abandon their devices shortly after acquisition. It is unclear how WFTs impact both PA and a mediating variable, motivation, as described by the Self-Determination Theory (SDT) in both former and current users.

Purpose: To assess and describe PA, and SDT constructs as they pertain to PA motivation in former and current WFT users.

Methods: This mixed-method study used a survey and semi-structured interviews. Survey items included the Global Physical Activity Questionnaire (GPAQ) and Behavioral Regulation in Exercise Questionnaire version 3 (BREQ-3).

Results: Two-hundred and eighty-eight participants responded to survey items and 17 individuals participated in interviews. Groups did not differ in measures of PA, but former users reported more sedentary minutes per week. Current users scored higher on measures of introjected regulation and identified regulation for PA and reported they used the device to collect data, rather than for motivation. Former users reported that the WFT had little impact on their PA, doubted the device accuracy, and some felt guilty when they did not meet WFT goals.

Conclusion: WFTs may be useful for people with particular traits that protect them from the negative impact of WFT feedback on autonomous motivation for PA. Future studies

should focus on assessing these traits to determine for whom WFTs are most impactful.

130   A Modeling Framework for Electrical Distributions Containing Harmonic Producing Loads

AVPREET SINGH OTHEE

DEPARTMENT: WALTER SCOTT COLLEGE OF ENGR
COLLEGE: WALTER SCOTT COLLEGE OF ENGR

My research focuses on studying energy efficiency in electrical distribution networks. Electrical loads made from semiconductor devices, such as, LED light fixtures, personal computers etc., have seen an increasing usage in commercial and residential buildings. These devices are nonlinear loads and are a source of harmonics in an electrical distribution. Conventional power flow techniques, such as fundamental power flow cannot accurately model systems containing nonlinear loads. A time-domain simulation can accurately model such loads but suffers from impractical simulation times and requires great amount of computational resources. Therefore, there was a need for a modeling framework that can accurately model system losses in electrical distributions containing AC nonlinear loads and DC loads in a mixed AC-DC distribution while having the advantages of speed of simulation of a fundamental power flow and the ability to accurately model system harmonics.

Harmonic power flow is a technique for analyzing power flows in electrical distribution containing nonlinear loads. In my research, I have developed a modeling toolkit library written in an equation based system modeling language called Modelica. A comparison of simulation results with laboratory measurements show the efficacy of the toolkit library in correctly predicting system losses, and distribution harmonics. Simulation results show an improvement of about eight times when compared with a time domain simulation of an equivalent system, besides significant improvements in memory utilization and post processing time. Furthermore, the toolkit library provides a rich platform for future research into new harmonic models and generic harmonic analysis.

131   Braking the fight-or-flight response

SEBASTIAN PACE

DEPARTMENT: BIOMEDICAL SCIENCES
COLLEGE: VETERINARY MED AND BIOMED SCI

Whether confronted with a mountain lion or a grant deadline, our body adapts to meet those challenges and maintain our health and safety. Unfortunately, stress over time can cause maladaptive deficits that lead to the risk of neuropsychiatric and cardiovascular diseases. These deficits are characterized by neural malfunctions that can incite a constant state of fight-or-flight stress responses. To investigate how neural regulation of stress responses change after chronic stress, we focused on the ventrolateral medulla (VLM), which contains adrenaline-synthesizing neurons that trigger the fight or flight stress response. Here, gene expression analysis examined stress-induced changes in VLM signaling molecules. Chronic stress caused decreased expression of an inhibitory signaling receptor and increased expression of adrenaline-precursor molecules. Next, we sought out brain regions targeting

the VLM and found direct inputs from the infralimbic area (IL) of the prefrontal cortex. The IL is the rodent homolog of a human prefrontal cortex region that processes stress-related information. Here, we used a viral-packaged fluorescent protein to map IL neuronal projections onto VLM inhibitory neurons. Lastly, to understand the function of the IL-VLM circuit, we activated it by using fiber optics in the VLM to target light-sensitive ion channels inserted in IL neurons. Photoactivated IL synapses in the VLM blunted the glycemic component of the stress response. These studies produced structural and functional evidence indicating the IL targets VLM inhibitory neurons to brake stress responses. Moreover, the IL-VLM circuit is susceptible to genomic and signaling changes that may underlie the diseases associated with stress.

133 Characterizing nanoparticle localization for improving drug therapy against pulmonary tuberculosis

CAMRON PEARCE

DEPARTMENT: UNIVERSITY WIDE - CELL AND MOLECULAR BIOLOGY
COLLEGE: INTRA-UNIVERSITY

Mycobacterium tuberculosis (Mtb) is the causative agent of tuberculosis (TB), which is one of the top 10 causes of death and the leading cause of death from a single infectious agent. 1 During the course of infection, a variety of Mtb filled lesions and granulomas are formed that create heterogenous microenvironments within the lungs, and result in bacterial populations with different phenotypes. Varying lesion characteristics can affect how an administered drug will distribute throughout the lungs and likely prevents a bactericidal dose from reaching most of the bacteria. This project utilized fluorescent nanoparticles to deliver a drug payload directly to the Mtb filled lesion, with an aim to characterize the specific nanoparticle localization and cellular uptake/delivery of these particles to the site of infection. The results of this include a novel computational approach that utilizes an automated image analysis software, combined with an R based data pipeline, to provide a quantitative and qualitative analysis of the fluorescent particle distribution in Mtb infected lungs. This study is laying the groundwork for a deeper understanding of particle localization within the lesion microenvironment. On-going studies are in progress that will determine how the lesion-directed particles may improve the bactericidal effect of the drug.

134 Identifying sources of resistance to sawfly in wild wheat

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COLLEGE: INTRA-UNIVERSITY

A major pest of cultivated wheat, the wheat stem sawfly (Cephus cinctus Norton) has been a prevalent pest for over 100 years. It is difficult to estimate the damage of this insect, but conservative calculations estimate grain-yield loss to exceed 30% and the economic losses exceed $350 million annually. This estimate does not include Colorado, so we expect the current figure to be much higher. Most economic loss is caused when the larva reaches the final instar when it creates a hibernaculum (stub) by cutting the stem above ground level just before harvest, which causes the wheat head to fall. Fallen stems are difficult to harvest and

are easily blown away. Host plant resistance is considered the most effective way to manage wheat stem sawfly. The most common resistance mechanism is solid pith expression which impedes movement and increases larval mortality. However solid-stemmed cultivars yield lower when compared to hollow-stemmed cultivars and pith expression can be highly variable. There are a few other sources of resistance that have been identified but their effectiveness and durability have not been examined. Due to the limited options for resistance traits in elite germplasms we decided to evaluate diverse wheat genetic resources for additional alleles. We used wild wheat species from the Wheat Genetics Resource Center to screen for novel wheat stem sawfly resistance alleles. Growing the wild wheat varieties in the greenhouse and infesting them in an outdoor setting allowed us to examine novel resistance traits.

135   Enzymatic Conversion of Synaptic Identity

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  COLLEGE: NATURAL SCIENCES

Synapses are neuronal junctions that allow neurons to electrochemically communicate via release of neurotransmitter molecules. There are two fundamental types of synapse: (1) excitatory synapses depolarize the membrane and cause action potential firing to communicate to the next neuron and (2) inhibitory synapses hyperpolarize the membrane and inhibit action potential firing. Understanding how these synapses form and respond to changes is essential in understanding higher-order brain function and development and is applicable to a wide range of diseases and disabilities. Here, we expand on two previous studies that show postsynaptic spines can form solely due to neurotransmitter release. By utilizing a direct embryonic stem cell differentiation method, we are able to determine how postsynaptic identity changes when inhibitory neurotransmitters are released from excitatory neurons. We have determined that excitatory synapses are lacking inhibitory presynaptic neurotransmitter synthesis and packaging proteins. Over-expressing these proteins in excitatory neurons is sufficient to cause a 50% conversion of excitatory post synapses into inhibitory ones. As we continue to study this system, we will be able to shed light on the mechanism of postsynaptic conversion to better understand brain development and operation.

138   Designing metal-free catalysts for sustainable light-driven chemistry.

MARIEL PRICE

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  COLLEGE: NATURAL SCIENCES

Photoredox catalysis has gained increased traction over the last decade as a powerful method through which new and challenging chemical transformations can be accomplished under mild conditions. The Miyake research group has made significant contributions to this field through the development of strongly reducing metal-free, or organic, photoredox catalysts (PCs). The development of organic PCs is important to the field of chemistry from a

sustainability perspectivenot only can organic PCs drive chemical reactions using visible light as the sole source of energy, but they are comprised of earth abundant elements rather than the rare and expensive metals employed by many commonly used catalysts. This work investigates the structure-property relationships of new dihydrophenazine-based organic PCs and how those properties effect catalyst performance. Thorough assessment of these new organic PCs has shed light on the tunability of their properties, their ability to access unique excited states, and their effectiveness at low concentrations. Careful evaluation of the structure-property relationships within new catalyst families helps direct rapid innovation in the field by increasing the level of conviction with which chemists can develop and/or select catalysts with properties tailored for specific purposes.

140   Residential Environmental Quality & Energy-Use: Consequences of Energy Efficiency Retrofits

ANDREW PURGIEL

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COLLEGE: WALTER SCOTT COLLEGE OF ENGR

Both the issues of indoor environmental quality (particulate matter, volatile organic compounds, temperature, and relative humidity levels) and of home energy-use may have significant implications for the social, physical, and financial well-being of urban and sub-urban residents. There are also significant challenges in the improvement of residential conditions with respect to both issues, and evaluating the success of programs involved in such efforts, such as the Weatherization Assistance Program (WAP), has been an important and challenging goal by itself.

This long-term longitudinal study will evaluate the effects of city-incentivized energy efficiency retrofits on home energy-use and indoor environmental quality (IEQ) in Fort Collins. The objectives of this research will be to (1) investigate the role of resident behavior on IEQ and energy-use in homes (2) evaluate metrics that are currently used to measure the success of programs aimed at tackling energy poverty and propose additional options.

Thus far, real-time environmental quality measurement and energy-use tracking devices have been installed in 12 homes throughout the city of Fort Collins, and the devices have been collecting continuous data for one to two months. By pairing the collected data with behavioral data gathered from questionnaires, the goal is to identify behaviors that may be correlated with changes in IEQ and energy-use. The collection of data before and after energy efficiency retrofits will allow for assessment of metrics that are currently used to evaluate the success of government-sponsored weatherization programs; this will ideally provide evidence for the efficacy of additional, more robust, metrics.

141   Feasibility of Algal Biofuels Across the United States

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A primary parameter driving the economics of algae-derived products is the areal productivity of cultivation systems. Providing areal productivity estimates without the complexities of undergoing through expensive cultivation campaigns is essential to assess the viability of algal biomass production for a given location. In addition, a foundational understanding of the variation in productivity over the different seasons is necessary for the sizing of downstream processing systems. Furthermore, the impact of meteorological conditions on areal productivity metrics needs to be understood to achieve the minimum operational days for positive economic results and to ensure the sustainability of the biofuel production process. To address these challenges, this study utilizes a validated open-raceway pond (ORP) dynamic growth model to simulate temporal and geographical algal productivity metrics. The dynamic growth model computes the temperature of the algae culture through an energy balance and proceeds to calculate algae growth rate based on light intensity, culture temperature, and optical density effects. Growth model inputs include growth system geometry, strain characteristics, and historical weather data for a period of 21-years and different locations across the US. Growth model outputs inform downstream system models such as the dewatering and processing of biomass into fuels via hydrothermal liquefaction. A temporal techno-economic analysis was performed to assess the impact of yield variability on the operational and capital expenses of the system, and to provide strategies to achieve a constant annual fuel and biomass production. Life-cycle assessment methodologies were used to evaluate the sustainability of the biomass and fuel production processes.

142 MIXED-STATUS FAMILIES: AN INDUCTIVE ANALYSIS OF LEGAL CLINIC PARTICIPATION

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COLLEGE: LIBERAL ARTS

Fear of deportation and consequent separation of mixed-status families (those with citizen and non-citizen members) is a central issue facing immigrants today. Yet, there is a gap in sociological explorations of legal clinics designed to assist these families. Here, we examine parents of mixed-status families in danger of deportation who visited one such clinic: what factors drove them to seek legal help? While we explore theoretical implications related to legal violence and multigenerational punishment, we also highlight ways to better reach these families and provide free legal services.
Research was conducted through Northern Arizona Immigration Legal Services (NAILS). Using in-depth interviews with nine undocumented Mexican parents, our findings reveal patterns that could aid NAILS and other legal support services in providing assistance to these families. Issues such as (1) the cultural perception of time and urgency, (2) traditional gendered labor division within the family, and (3) the role of social workers were the most relevant themes in seeking legal help. These findings not only contribute to the growing sociological research on immigration but can also help NAILS and other similar community organizations connect with immigrants in more efficient ways, particularly as it relates to mixed-status families.

143 Trial by fire": Experiences and support needs of perinatal fathers

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Purpose: Father involvement in infant care is increasing, and evidence supports the important role fathers have in early child development; however, early parenting resources are frequently aimed at mothers. As calls for additional resources for perinatal fathers build, it is necessary to increase understanding about the support needs and wants of perinatal fathers.

Procedure: Through a university-community partnership, we conducted 6 focus groups with expecting fathers and fathers with an infant less than one year of age. Fathers were separated into groups based on their prenatal or postpartum status. Groups were held using remote video conference and recorded. Participants answered questions about the role of a father, exciting and challenging aspects of emerging fatherhood, stressors, useful resources, and missing resources. Focus groups were transcribed and analyzed to identify patterns and themes.

Results: At the time of this submission, focus groups and analysis are ongoing. Early emerging themes include the importance of classes and information-gathering prenatally, importance of social support resources after birth, mixed impact of COVID-19, supporting their parenting partner, and the value of paternity leave for early adjustment.

Implications: Data will be used to understand potential opportunities for increasing resources and support services for perinatal fathers.

144 Identifying mechanisms required for primary microRNA recognition and processing

KAILEE REED

DEPARTMENT: UNIVERSITY WIDE - CELL AND MOLECULAR BIOLOGY
COLLEGE: INTRA-UNIVERSITY

MicroRNAs (miRNAs) are short, non-coding RNAs that, with their protein cofactors, bind to messenger RNAs that ultimately effect RNA silencing. MiRNAs have been demonstrated to be highly conserved, influence essentially all biological processes and are able to control diverse events such as developmental timing, various types of cancers or even infertility. The miRNA biogenesis pathway is comparable from C. elegans to humans; however, there are key differences in how primary miRNA transcripts are distinguished from other hairpin containing transcripts in the genome. Here, we propose to identify novel mechanistic features pertaining to how miRNAs are distinguished from other hairpin containing transcripts in C. elegans. To do this, we began a forward genetic screen with animals that contain an mCherry-based sensor that reports on primary miRNA processing activity. This will lead to identifying novel cis and trans-acting factors in primary miRNA processing. We identified candidates with elevated levels of mCherry protein expression, isolated their genomic DNA and subjected it to whole genome sequencing. We have identified several causal alleles and are currently elucidating their mechanisms.

145 Increased understanding of soil carbon feedbacks to global environmental change

KATIE ROCCI

DEPARTMENT: UNIVERSITY WIDE - ECOLOGY
COLLEGE: INTRA-UNIVERSITY

Soil organic carbon (SOC) has potential as a natural climate change solution. However, it is not yet clear how SOC dynamics will feed back to global environmental changes. Part of this uncertainty may be due to studying SOC as a whole, rather than separating it into its two most contrasting components: mineral-associated organic carbon (MAOC) and particulate organic carbon (POC). Because MAOC and POC are formed, stabilized, and lost through different pathways, we expect them to respond differently to global change. To test this hypothesis, we performed a systematic meta-analysis on the response of SOC, MAOC, and POC to nitrogen (N) fertilization, elevated carbon dioxide (CO2), warming, and increased precipitation. POC was generally more responsive than MAOC or SOC; while all three responded positively to N fertilization, only POC had strong effect sizes under elevated CO2 (positive response) and warming (negative response). We found key moderating influences of climate and soil variables on the responses of POC and MAOC that highlight the importance of assessing the response of the whole plant-microbe-soil system to global changes to understand net responses of SOC. Given the higher responsiveness of POC to changes observed in this study, we suggest that POC and MAOC should be treated separately in models and management plans. This will enable a better understanding of the feedbacks of SOC to global change and gauge whether promoting SOC storage can help mitigate the climate crisis.

147   Estimating Climate Vulnerability in the Yellow Warbler Full Annual Cycle

MARINA RODRIGUEZ

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Human-caused environmental changes are causing rapid shifts in global temperatures and precipitation. These changes force organisms to adapt and evolve or face extinction. In migratory species who spend portions of the year in different areas, adapting to environmental change may be more difficult than in non-migratory species, making them more sensitive to climate change. Therefore, the preservation of migratory birds may lie in predicting their evolutionary responses in places where they spend large amounts of time during the year, such as their breeding and wintering grounds.
Previous work used genomic sequencing and climate predictions to estimate adaptive potential of Yellow Warblers to climate change on their breeding grounds across North America. The strongest associations between genomic and environmental variation were those related to precipitation. Using this information, the breeding populations that would have the hardest time adapting to future changes in precipitation were identified. However, the gap in knowledge is understanding the adaptive potential of Yellow Warblers on their wintering grounds.
The objective of my proposed project is to determine climate vulnerability of Yellow Warblers on their wintering grounds by determining if populations are locally adapted to precipitation regimes, as they are on their breeding ranges. I will do this by collecting Yellow Warbler blood and feather samples across a precipitation gradient on their wintering grounds in southern Mexico. In addition, I will use telomere shortening as a proxy for fitness to identify

selection on genotypes across a precipitation gradient.

148   Bulk synthesis of the semiconducting ternary nitride, MgZrN2

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Functional inorganic materials containing N^{3-} anionsnitridesare underexplored and present opportunities for technologically important discoveries. Binary nitrides are widely used in durable coatings (e.g. TiN) and energy efficient solid-state lighting (e.g. GaN), and therefore serve critical roles in modern technology. Adding a third element to a binary system, thus making a ternary nitride, allow for precise tuning of the properties of the material. However, simple and generalizable synthetic techniques for ternary nitrides are needed to tailor materials for applications in sustainable electronics.

We have found that solid-state ion exchange reactions (n Mg_2NCl + $ZrCl_4$) allow for the precise synthesis of a ternary nitride with tunable stoichiometry, $Mg_xZr_{2-x}N_2$ (0.2 < x < 1.0), by simply varying the precursor ratio (1.4 n 2.0). The reactions occur when ground mixtures of the precursors, sealed in evacuated ampoules, are heated to 800 °C. This synthesis produces gram-scale quantities of $Mg_xZr_{2-x}N_2$ powders, a material that until now has only been synthesized as thin films using expensive sputtering chambers. By varying the composition, we can control the structure and electronic properties (from conductive to semiconducting). We suspect this method is generalizable to a wide variety of ternary nitride systems, allowing us to precisely tailor materials for specific applications in electronic devices.

149   Rapid Genetic Resistance Detection with Potato Virus Y Recombinant Clone

JEN RUSHTON

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COLLEGE: AGRICULTURAL SCIENCES

Pathogens plague food production as the effects of climate change and a growing population put pressure on food security. In order to prevent the waste of resources, it is important to find sustainable management strategies vulnerable to pathogens. Potato is the fourth most important crop around the world, increasing the necessity for the development of new effective management strategies. Necrotic potato viruses are the primary threat to potato production, specifically, Potato Virus Y (PVY) because it causes reduction in yield and quality, causing severe economic losses. Sources of genetic resistance are the most effective but difficult to find. Currently, potato germplasm can be screened for PVY susceptibility by inoculating potatoes grown in the field and/or in the greenhouse followed by visual observations of virus or molecular methods such as ELISA. However, these methods are time consuming and labor intensive especially when screening large populations. To make screening of germplasm for sources of PVY resistance more rapid and efficient,

molecular tools are required. A recombinant clone of PVY has been developed to facilitate visual analysis of viral infectivity by tagging the virus with Rosea1, and anthocyanin transcription factor. Upon mechanical infection of potato plants with the recombinant PVY clone, PVY-Ros1, the formation of red infection foci is induced in inoculated tissue and solid dark red pigmentation. The use of PVY-Ros1 recombinant virus will facilitate the identification of resistant potato germplasm and could lead to the discovery of new sources of resistance to help with the management of the virus.

150   Evaluating antimicrobial textiles for efficacy against SARS-CoV-2

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COLLEGE: VETERINARY MED AND BIOMED SCI

The COVID-19 pandemic, spurred by the SARS-CoV-2 virus, has drastically expanded the importance of personal protective equipment (PPE) in our every day lives. This expansion has pushed manufacturers of textiles proven to be antimicrobial for other organisms to identify materials that can contribute to slowing the spread of SARS-CoV-2. We hypothesize that emerging and existing textiles will have varying efficacy in SARS-CoV-2 inactivation and aim to identify the most effective textile among polypyrole treated, silver nanofiber, and copper infused material for everyday PPE. We utilized the International Organization for Standardization protocol 18184 for the determination of antiviral activity of textile products as the basis to evaluate the efficacy of the textiles against SARS-CoV2. In all, we tested six experimental materials and the corresponding control textiles from three independent companies. Through median tissue culture infection dose (TCID50) assays using Vero E6 cells, we determined that copper infused textiles are the most effective at inactivating SARS-CoV-2 out of these materials.

151   Understanding the Genetic Basis of Barley Contributions to Beer Flavor

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Barley is an economically important cereal crop and the most used grain for the malting and brewing industry. With the recent rise in craft brewing, there is a higher demand for more diverse beer flavor profiles, but so far, most barley flavor research has been focused on the malt. The goal of this project is to test the hypothesis that barley genotype can contribute to beer flavor and to identify genomic regions associated with different beer flavors. This project used a doubled haploid population, referred to as Oregon Promise, from a cross between the barley varieties Golden Promise and Full Pint. The population was genotyped using the barley 50k iSelect chip and grown for the purpose of micro-malting and nano-brewing. The nano-brews were then evaluated by a sensory panel for different flavor descriptors, and the remainder of the brews were used for metabolomic analysis. Malting quality data was also available from this population. The genotypic information has been

used to generate a linkage map and for QTL mapping of sensory descriptors, malt quality traits and metabolic compounds. A total of 22 significant QTLs across all 7 chromosomes have been identified for many sensory, malting quality and metabolomics traits, some of which are common to multiple traits. Genes underlying those QTLs have also been identified. This is the most comprehensive study to date on the genetic contributors to beer flavor that can be used to develop barley varieties with more desired beer flavor profiles.

152 The Ways Journalism Teaching Hospitals Start, Sustain, & Grow

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The collapse of local news coverage remains a national crisis. One model for filling the gap in local and state level news coverage has seen sustained localized success for decades: the teaching hospital model, which pairs professional journalists with university journalism students to produce publishable state and local news coverage. Through in-depth interviews with eight current and former teaching hospital leaders, this study revealed under what conditions teaching hospitals start, under what conditions they thrive, and what could cause them to fail.

153 "Cybersecurity Workforce Cyber-Physical Systems (CPS) and Control System" Questionnaire

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Adversaries are targeting critical infrastructure and Facility Related Control Systems (FRCS) (such as power, fuel, water, and critical facilities) about Industrial Control Systems (ICS) by cyber-attack. Advanced sensing and intrusion protection capabilities are being developed for cyber-physical system network operations that are augmented by innovative methodologies and new technologies to enable cyber defenders and facilities engineers to identify, respond to, and recover from asymmetric attacks in mission-relevant time on critical infrastructure. While methodologies and technologies are in research and development to address the cyber resiliency challenge, there is a lack in the system engineering community body of knowledge of how to successfully transition these solutions into the system. The purpose of the "Cybersecurity Workforce Cyber-Physical Systems (CPS) and Control System" questionnaire is to identify potential vulnerabilities in the cyber-physical system (CPS) ecosystem, guide future operationally relevant technology transition processes, develop training tailored to address specific gaps, conduct and inform an assessment to identify potential operational limitations and initiate steps necessary for improved processes to ensure technology capability readiness for transition success of new integrated technology for CPS. System engineers are tasked with the design, development, implementation, and management of complex, large-scale systems throughout the entire lifecycle of the project. The whole of the system, including the role of the system and the

environment in which it will operate, can be impacted by any change to any of the system elements. The results of the questionnaire will help the cyber defender better defend critical infrastructure.

154 Optimizing the Number Theoretic Transform for Post Quantum Cryptography

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The Number Theoretic Transform (NTT) is a common subroutine among many Post Quantum Cryptosystems. NTT constitutes the bulk of the operations required in these systems, making it essential to achieve the maximum performance possible for this algorithm. Cryptosystems are run on a wide range of platforms, so producing hardware tuned code by hand is infeasible. The Spiral system was developed to automate the process of producing hardware tuned implementations of Discrete Fourier Transforms on a variety of platforms. The Number Theoretic Transform has a similar structure to the Discrete Fourier Transform, allowing us to adapt Spiral for NTT. We then apply several newly discovered optimizations of NTT to Spiral. These optimizations are not present in Spiral because they are specific to the Number Theoretic Transform and its application in Cryptographic algorithms. Performance results will be measured at the completion of this process.

155 Sex differences in prefrontal cortex-regulated cardiovascular stress responding

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Cardiovascular disease (CVD) and depression have a high prevalence of comorbidity; however, there is limited research establishing mechanisms to link the two. Interestingly, comorbidity of these conditions is more common in women, who are over twice as likely to experience depression as men. In patients with depression, the prefrontal cortex shows altered activity which may lead to mishandled stress responses. Both sympathetic nerve activity and stress hormones elevate blood pressure (BP) and heart rate (HR) in response to stressful stimuli. This suggests neuronal activity in stress-responsive brain regions may account for physiological changes leading to depression-associated CVD.
Previous work in rodents identified a sub-region of prefrontal cortex, infralimbic cortex (IL), as essential for appraisal and processing of stressful stimuli. We hypothesized that increased IL activity may reduce BP and HR responses to stress. In these experiments, we used optical methods to stimulate a subset of excitatory neurons in the IL of male and female rats exposed to a stressful novel environment. Cardiovascular stress responses were recorded by radiotelemetry to measure BP and HR. Our results indicated opposing effects of IL stimulation in males and females. Elevated IL activity dampened HR responses and reduced systolic and diastolic components of BP in males. In contrast, IL stimulation increased HR responses in females without altering BP. These data show sex differences in

how IL activity affects cardiovascular stress responding. Further, the neural basis of stress responding is fundamentally different in males and females, demonstrating a need to consider sex differences in CVD interventions.

156   Climate Change Communication in Rural Communities

MADISON SCHEER

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Earth system science (ESS) education is becoming more important as our understanding of climate change (CC) increases. Moreover, research focused on climate literacy is fundamental to creating an informed generation capable of making conservation, land stewardship, and natural resource management decisions. Climate literacy, however, is threatened by hyper-political discourse regarding the anthropogenic causes of climate change, which is economically charged in rural communities where residents depend on income from mineral rights and ranching industries. For this phenomenological study, we explored how rural rangeland teachers (n=9) explain and justify their climate change education (CCE) instructional choices. Our inductive analysis yielded four major findings; teachers: 1) perceived that they maintained objectivity by not making definitive scientific claims about CC, 2) expected students to find their own evidence of CC, 3) do not model scientific reasoning about CC, and 4) do not prioritize ESS curriculum over other science standards. By learning how rural science teachers communicate CC in their classrooms, these data can be used by science teacher educators to collaborate with communication experts to determine how to effectively describe CC to different stakeholders and to then design curricular materials on CC lessons and arguments for rural teachers.

157   Feverfew: cheerful foliage and source of an anti-cancer compound

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Parthenolide (PTL) is a secondary metabolite of the feverfew plant with anti-cancer properties. In screening 31 cancer cell lines of various types in dogs, we have identified many that are sensitive to PTL. Two deadly cancer typeshistiocytic sarcoma and hemangiosarcomaare relatively more common in some breeds of dogs than they are in humans, and therefore, dogs can be used as a naturally occurring large animal model of these rare cancers to improve treatment outcomes in both dogs and humans. In our work so far, we have demonstrated that PTL-mediated NF-kB inhibition and alteration of cellular redox balance contribute to selective cell death in canine cancer cells, while sparing normal cells from harmful effects of the drug. Pre-treatment with the antioxidant N-acetylcysteine (NAC) mitigates PTL-mediated cell death to varying degrees in different cell lines. Preliminary data from patients with diffuse B cell lymphoma (DLBCL) show that primary cells exhibit reactive oxygen species (ROS) generation and experience significant cell death following PTL therapy, consistent with our observations in cell lines. Work in progress will

determine whether NF-kB activation is increased in preserved tissues from canine patients, which would demonstrate a selective target for PTL therapy in >150 tumor samples. Additionally, we are working on an assay that will help identify ideal combination therapeutics with PTL and are creating a mouse model of disseminated HS to study PTLs effects in a living animal.

158 Inactivation of both RAD51AP1 and RAD54 leads to synthetic lethality

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Radiation therapy (RT) uses ionizing radiation (IR) to produce a plethora of DNA lesions, DNA double-strand break (DSB) being the most toxic. DSBs can be repaired by homologous recombination (HR), one of the least error-prone pathways. In some tumor types, however, the HR pathway is up-regulated, rendering these more resistant to RT. Hence, targeted inhibition of HR during tumor therapy may lead to improved treatment outcome.
In human cells, RAD51-mediated HR is supported by the DNA motor protein RAD54 and by the RAD51 activator RAD51-Associated Protein 1 (RAD51AP1). However, whether these two proteins work independently or together in promoting RAD51 activity during HR is currently unknown.
We hypothesized that simultaneous inactivation of both genes would lead to a synthetic phenotype in HR impairment and increased cellular sensitivity to IR and other genotoxic agents.
We have generated RAD51AP1 and RAD54 single and RAD51AP1/RAD54 double knockout (KO) HeLa cell lines and tested their response to chemotherapeutic agents in cell survival and DNA replication assays. We find that double KO cells are significantly more sensitive to the cytotoxic effects of mitomycin C and PARPi treatment than either single KO cell line. Accordingly, after induced DNA damage double KO cells exhibit a more pronounced G2 arrest, higher levels of chromosomal aberrations and increased sensitivity to DNA replication stress.
Together, our results show that RAD51AP1 and RAD54 have non-overlapping but also overlapping roles in HR. Hence, targeted inactivation of both genes is required to more effectively treat tumors in which the HR pathway is up-regulated.

160 Impact of drought severity on camping demand

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Drought can have substantial impacts on economic well-being and human health. Most studies on the economic impact of drought have focused on agriculture (Wang et al., 2014; Zipper, Qiu, and Kucharik, 2016; Kuwayama et al., 2019), with little research exploring drought impacts on outdoor recreation. Outdoor recreation provides substantial use values (Haefele and Loomis, 2016), which are expected to increase in the future. Drought frequency

is also projected to increase in many parts of the US (Strzepek et al., 2010). Thus, understanding the impact of drought on outdoor recreation demand becomes an important question. This research focuses on estimating the impact of severe drought on camping reservations on US Forest Service land.

Using reservation data from the Recreation Information Database, we construct daily capacity utilization measures for every National Forest campground between 2008 to 2017 and use these results to calculate average monthly utilization rates. We use GRIDMET data of the Palmer drought severity index (PDSI) to calculate the number of weeks in severe drought or moisture for each campground in each month. Using a fractional logit model with campground specific dummy variables, we estimate the impact of severe drought and moisture on capacity utilization.

The results reveal that severe drought and severe moisture both have a statistically significant and negative impact on utilization. In the future, we will further explore the mechanisms that underlie this impact, such as fire risk and water availability.

161 Greenhouse Gas Emission Trading and Air Quality: Evidence from China

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China has launched greenhouse gas Emissions Trading Systems (ETS) since 2013 to achieve the carbon intensity (CO2/GDP) reduction commitment under the Paris Agreement. Previous studies have argued that regulations on greenhouse gas emissions also reduce other air pollutant emissions. This research examines whether China's carbon ETS, a cap-and-trade program aiming CO2 emission reduction, has the co-benefit of reducing local PM2.5 level. In an ETS program, emission allowances are distributed to regulated agents under a cap, and the allowances are tradable among regulated agents. Unlike a traditional ETS which distributes mass-based allowances, Chinas ETS adopts Tradable Performance Standards (TPS) and regulates on the carbon intensity. Under the TPS, regulated agents have incentives to reduce the carbon intensity, but not necessary the total carbon emission level. Therefore, the impact of Chinas ETS on local air quality remains unclear.
I adopt Difference-in-Differences (DD) and Regression Discontinuity (RD) methods to estimate the effect of Chinas ETS on PM 2.5 level for 7 Chinas ETS pilot areas using data from 2006 to 2016. DD and RD designs both show, on average, positive impacts of ETS on PM2.5 level in the ETS pilot areas. Further RD analyses for each ETS pilots reveal heterogeneous responses of PM2.M to ETS across pilot areas. Alternative data sources and econometric specifications will be tested for robustness checks.

162 SKELETAL ANALYSIS OF THE FORMATION OF THE BICONDYLAR ANGLE

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The femoral bicondylar angle is often associated with bipedality in the fossil record because it forms during ontogeny as the result of biomechanical stress. However, the exact mechanisms responsible for its formation remain unknown. Two dominant theories based on static models are assumed in the literature, one focused on skeletal architecture at the proximal femur and one on architecture at the distal femur. The proposed relationships have never been statistically analyzed. This study aims to investigate several of the skeletal measurements at the proximal and distal femur often associated with the theories on the formation of the bicondylar angle, in order to determine if correlations do exist between them and the degree of bicondylar angle in adulthood.

163 Effect of Mycobacterium tuberculosis infection on mice lung microbiome

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COLLEGE: VETERINARY MED AND BIOMED SCI

The lower respiratory tract is colonized by a complex and dynamic microbiota, termed as lung microbiome. Sequencing studies have demonstrated differences in the lung microbiome of healthy and diseased individuals, with a potential use as therapeutic target of infectious diseases, and vaccine efficacy. Few studies have been done about the effect that BCG vaccination and M. tuberculosis infection does in the lung microbiome. This study addresses the lung microbiome profile of mice BCG vaccinated and M. tuberculosis infected. Four groups of C57Bl/6 mice were used in this study. Lung tissue was obtained at four time points: day 0 and 30 post BCG vaccination (infection day) and days 7 and 21 post infection. Mice were vaccinated with BCG Pasteur, and 30 days post vaccination, were infected with M. tuberculosis via aerosol. DNA extracted from lung tissue was used to sequence the V3-V4 regions of the 16S rRNA gene. Next-generation sequencing was performed using Illumina MiSeq. Diversity indexes were assessed using raw Operational Taxonomic Units occurrence counts. Nonparametric WilcoxonMannWhitney test was used to compare quantitative variables between groups. Infected mice show a higher alpha diversity compared with non-infected. Firmicutes and Proteobacteria are the predominant phylum of infected and vaccinated mice, a lower abundance in Firmicutes are observed in control mice compared with infected and vaccinated mice. Beta diversity analysis shows separation among control and infected and vaccinated mice. These results show specific increase in taxa relative abundance that can be associated with disease and healthy outcomes.

164 Learn or leave? Analysis of international students' crisis response

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On July 6, 2020, ICE announcement restricting international students from taking online courses during the fall semester presented an unexpectedly personal and educational crisis for international students on top of the already existing coronavirus pandemic. Although ICE rescinded the policy on July 14, this announcement caused a lot of anxiety and uncertainty for international students living in the United States.

This study aims to analyze international students' crisis responses to the ICE announcement on Twitter through the lens of Media System Dependency theory and the method of Critical Techno-cultural Discourse Analysis. Both interface and discourse analysis will be conducted to study how international students articulated their problems and crisis response on Twitter amidst a global health crisis. In addition to themes emerging from the dataset, this exploratory study will give valuable insights to understand how Twitter, as a social media platform, allows international students to articulate their crisis response.

This relevant study will offer scholarly and policy implications for providing relevant social, academic, and professional resources to international students in the United States. This study will help higher education school officials, policymakers, and administrators better identify international students' problems and the role social media can play to mitigate it. Studying how the affordances of Twitter provides voice and way of expression for diverse communities also furthers the study of social media in general.

Note: This study is in the coding phase and will be completed before the Graduate student showcase.

165   Immpower: Bringing Responsible Financing to Immigrant & Refugee Entrepreneurs

MARYA SKOTTE

  DEPARTMENT: COLLEGE OF BUSINESS
  COLLEGE: BUSINESS

Immpowers mission is to empower refugees and immigrants through financial opportunities. Immigrant and refugee communities face barriers to integrating and succeeding in their new home countries, such as language, cultural, religious, economic, and other barriers. Data shows that immigrant and refugee communities have much higher rates of entrepreneurship than native-born people in the U.S.: However, these entrepreneurs lack access to capital and culturally appropriate financing. Immpower believes that Islamic finance offers a unique opportunity to offer marginalized communities culturally appropriate financing that is more equitable and sustainable than traditional models. Empowering entrepreneurs to start businesses, creates jobs, boosts local economies, and makes our communities more resilient.

Immpower is researching and consulting on socially responsible financing solutions for immigrant and refugee entrepreneurs in the U.S. and is helping financial institutions diversify financial products for marginalized communities. Immpower is conducting in-depth research on the viability of Islamic finance in the U.S. market, which currently is a blue ocean. The Immpower team will launch a LLC around our business model and will be one of the first major players in the U.S. to shape Islamic finance in the U.S., offer appropriate and

sustainable financial services to millions who are currently locked out of the traditional financial system, and empower immigrant and refugee entrepreneurs to achieve their version of the American Dream.

The team is excited to share the findings of our summer research, our business model, and our strategy for launching and shaping the future of Islamic finance in the U.S.

166   Sustainable Nutrition Education: Empowering Rwandan Women with
Participatory Action Research

BRITTNEY SLY

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PURPOSE: Despite national efforts to combat malnutrition in Rwanda, rural residents exhibit a lack of knowledge regarding small-scale vegetable production and nutrition education, particularly regarding diet diversity. Using participatory action research and peer-training methods, we developed an intervention model to determine if sustainable community-level health behaviors, addressing malnutrition at the household-level, can be established. The primary aim of the intervention is improvement in household food security and enhancement of dietary diversity associated with consumption of a greater variety of fruits and vegetables. A secondary aim is to foster dissemination of small-scale agricultural and nutrition information throughout the community.
DESCRIPTION: Small groups of women (n=42) received agriculture and nutrition education over the course of 16 weeks and the support to start and maintain kitchen gardens. Participants became peer educators who trained approximately 84 additional women in the community. Participatory active learning activities were conducted to enhance collaboration, knowledge-sharing and empowerment amongst participants. Evaluation was conducted using food frequency questionnaires and household hunger scores, along with participatory evaluation methods during focus groups and semi-structured interviews, in addition to GPS mapping of kitchen gardens.
OUTCOMES: Changes in dietary patterns that exhibit improved diet diversity and food security, the dissemination of information throughout the community, empowerment by participants in feeding their households, and culturally appropriate training materials for use at the community-level.
FUTURE IMPLICATIONS: This collaborative model can be used as a basis for program design and evaluation with similar populations and communities facing malnutrition and food insecurity, at a regional and global scale.

168   Innovation for Wildlife: Evaluating the State of Conservation Technology

TALIA SPEAKER

  DEPARTMENT: WARNER COLL OF NATURAL RESRCES
  COLLEGE: WARNER COLL OF NATURAL RESRCES

Technology has become an essential component of modern biodiversity conservation efforts, enabling better, faster, and cheaper data collection, more informed management decisions, and monitoring of progress on global agreements. However, systematic issues such as ineffective funding and development cycles, confusion in the market, and duplication of efforts may be limiting the capacity of the still-nascent field of conservation technology to keep pace with escalating conservation challenges. As previous research has focused predominantly on capturing the progress of specific technology applications rather than the discipline as a whole, our understanding of these constraints and opportunities for overcoming them remains limited. This research aimed to address that gap by surveying a global community of conservation technology users and developers to identify 1) perceptions of the current performance and potential impact of existing tools, 2) key user and developer constraints, and 3) future directions and critical opportunities for growth in leveraging technology for conservation. To triangulate findings, we also conducted focus group discussions with leading experts across seven widely used technology applications. We are currently analyzing these data and will have results to report in October. To our knowledge, this research is the first attempt to formally capture the perspectives and needs of the global conservation technology community of practice. As this rapidly developing field gains international attention, we hope that our findings contribute to informing and strategically directing future efforts to meet the even more rapidly evolving needs of conservation practice.

169 The vital role of human sialidases during flavivirus infection.

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The human sialidase enzymes (or neuraminidases) catalyze the removal of -glycosidically linked sialic acid residues from glycoconjugates, including glycoproteins and glycolipids. Sialic acid residues are thought to play vital roles in cellular signaling. Through their physiochemical effect on glycoconjugates, sialic acid residues are involved in conformational changes that determine the active/inactive state of glycoproteins. Sialic acid residues are also important binding recognition and masking sites for cellular processes. There are four known human neuraminidases (NEU1-4), each having specific subcellular localizations and substrate preferences. In previous studies, NEU1-4 activity has been shown to be increased during infection with dengue virus serotype 2 (DENV2). In both in vitro and in vivo models, it was shown that the dengue NS1 protein increased NEU1-4 activity, resulting in an increase in free sialic acid. This increased activity was also shown to be linked to the events resulting in endothelial hyperpermeability/vascular leakage, a hallmark of severe dengue disease. However, the role for this increase in NEU1-4 activity was not understood. In an siRNA screen of enzymes involved in the sphingolipid metabolic pathway, we uncovered that NEU1-4 are vital for DENV2 infectious virus release and replication. Here we will present data that sheds light on the roles of NEU1-4 during the DENV lifecycle.

170 Preserving the Past Through Primers: Public History, Museums, and Education

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As part of my internship with the Berthoud Historical Society, I was asked to create an educational resource, or primer, of Berthouds history for Berthoud teachers to use with their second-grade students as part of their local history unit. Using public history methodologies and best practices in material culture and education, I created a resource that engages young museum visitors with specific aspects of Berthouds past. I collaborated with museum staff and local educators to ensure the digital and printed versions of the primer supported the museums mission and the Second Grade Colorado State Social Studies Standards. The primer is an eight-page booklet that covers Berthouds history from the mid-1800s to the 1960s. It includes eight activities called Think Like a Historian, based on Sam Wineburgs methods in history education, that allow readers to employ practices that historians use to study the past. There is also an accompanying Teachers Guide to support classroom implementation. Museum staff and local teachers look forward to sharing the resource with the communitys students and are excited about making the museums collections and information more accessible online. This versatile primer reflects the increasing role of digital and public historians in connecting two different spaces of learning; museums and schools. Public historians can bring updated scholarship and new historical methods to everyday spaces where the public interacts with the past. Due to the pandemic, we now have a unique opportunity to create digital educational resources to support remote learning and reach new audiences.

171   Green isnt Green: The Environmental Burden of Indoor Cannabis Production

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The legalization of cannabis has caused a substantial increase in commercial production, yet the environmental impact from industry practice has not been thoroughly quantified. A considerable amount of legally grown cannabis is cultivated indoors to ensure that a consistent product can be delivered year-round, despite geographic and seasonal variations in weather. This work analyzes the energy and materials required to grow cannabis indoors and quantifies the corresponding greenhouse gas (GHG) emissions using life cycle assessment methodology. The analysis was performed across the U.S., accounting for geographic variations in meteorological and electrical grid emissions data. Resulting GHG emissions range from 2,283 to 5,184 kg CO_2-eq per kg-dried flower and are largely attributed to indoor environmental controls, high-intensity lights and the supply of carbon dioxide for accelerated plant growth. Regional trends show that areas such as the Mountain West and Midwestern U.S. are especially intensive with respect to GHG emissions from indoor grown cannabis while California, the Pacific Northwest and parts of the Northeast are the least intensive. Relating these results to the consumer level, the GHG emissions from one 10 mg serving size of tetrahydrocannabinol (THC), the psychoactive component in cannabis, is greater than a standard serving size of beer, wine, spirits, cigarettes or coffee in

the majority of U.S. locations analyzed.

172   The Days After Colorados Darkest Day: Unearthing the Julesburg Campaign

RAY SUMNER

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COLLEGE: LIBERAL ARTS

In early 1865, the Cheyenne, Arapaho, and Lakota initiated a complex military campaign in response to the Sand Creek Massacre. Their response, sadly, is viewed as a series of discrete events of revenge waged across Colorado, Nebraska, and Wyoming instead of a planned and organized campaign. My research aims to correct this historical mischaracterization by utilizing the historical, geographic, and archaeological record combined with advanced technologies (thermal imagery/LIDAR/GIS) to develop a better understanding of the tactical actions and then to contextualize them through the prism of modern military theory. My initial research has been on the Native Americans main effort: Julesburg Stage Station (5SW26). Julesburg Station was located in Sedgwick County along the south bank of the South Platte River in far northeastern Colorado. Due to its strategic importance it was raided on two separate occasions despite being only a mile east of Camp Rankin (5SW24). Initial fieldwork has already provided new evidence that has illuminated the actions of the belligerent parties and provided a level of understanding of the battle that was previously not possible. Future research will continue to focus on tactical details, but also will aim to contextualize the conflict at the operational and strategic levels of war. Ultimately, this will allow us to visualize the events of 1865 at a level of fidelity not seen since the commanders, soldiers, chiefs, and warriors met on the fields of battle in 1865 and give a voice to the actions of all parties in the conflict.

173   Chronic wasting disease: A contagious prion epidemic of uncertain risk

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Prions are infectious proteins causing fatal neurodegenerative diseases in humans and animals. Contagious transmission of chronic wasting disease (CWD), a prion disease affecting deer, elk, and other cervids, has caused disease in wild and captive animals in 26 States and 3 Canadian provinces. In the 2000s, disease was inadvertently imported to South Korea from North America where it is now established in native populations of animals. Ongoing studies in our lab using genetically modified mice show that cases in Scandinavia, which were initially discovered in 2016, have characteristics that are different from North American CWD. These studies indicate that CWD in Europe is unlikely to have been transmitted from an infected animal in North America. Here, we focus on investigations of the index case of CWD in Finland. Our preliminary analyses reveal that the strain properties of this Finnish CWD differ from both Norwegian and North American CWD. We hypothesize this case in Finland arose from mutation of Norwegian prions or an entirely new origin.

Since there are currently no cures or treatments for prion diseases, and CWD is decimating cervid populations at alarming rates, ascertaining the origins, mutability, and adaptive properties of established and emergent CWD strains could lend insight into new approaches for therapeutics.

174   Synthesis and Characterizations of Gentamicin-loaded Poly-lactic-co-glycolic (PLGA) Nanoparticles

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Poly-lactic-co-glycolic acid (PLGA) was mixed with gentamicin sulfate via a double emulsion method, resulting in gentamicin-loaded PLGA nanoparticles that exhibited excellent antibacterial properties and great potential in fabricating smart wound dressings integrated with a drug delivery system. The nanoparticles morphologies, particle degradation rates, drug release profiles, and antibacterial properties were investigated using Scanning Electron Microscopy (SEM), Dynamic Light Scattering (DLS), Ultraviolet-visible spectroscopy (UV-vis), and disk diffusion method. The nanoparticles prepared at different PLGA concentrations exhibited different release profiles that were determined by multiple release mechanisms including diffusion, osmotic pumping, and nanoparticle degradation. The antibacterial activities were measured using a disk diffusion method, indicating that the various nanoparticles loaded with antibiotics can control bacterial infection to some degree proving that nanoparticles used in this paper can be used in the pharmaceutical industry. The results suggested that drug release properties of gentamicin loaded PLGA nanoparticles can be affected by the PLGA concentration and PVA concentration in the particle synthesis, providing a guidance in preparing gentamicin loaded PLGA nanoparticles for topical antibiotics delivery applications

175   Neural Mechanisms Controlling Turning Performance in People with Multiple Sclerosis

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Neurodegenerative effects of multiple sclerosis (MS) are associated with decreased mobility and adaptations affecting neural structure and function. Due to cortical influences on mobility, its likely these neural adaptations negatively affect mobility. MS is associated with volumetric alterations affecting cortical grey matter (GM) thickness along with levels of corticospinal inhibition. The purpose of this project was to understand how motor cortex thickness and inhibition contribute to turning performance in people with MS (PwMS) and age-matched healthy participants.
Participants completed a series of 360 turns where measures of turn duration and turn velocity were assessed using wireless inertial sensors. GM thickness of the motor cortices was measured using magnetic resonance imaging. Corticospinal inhibition was measured through transcranial magnetic stimulation targeting the leg regions of each motor cortex.

Forty-eight participants (23-controls, 25-PwMS) were included in the analysis. PwMS demonstrated significantly reduced turning performance for both measures. GM thickness revealed main effects of group and hemisphere. PwMS demonstrated reduced thickness and both groups had less thickness in the right motor cortex. PwMS also had significantly less cortical inhibition, regardless of hemisphere. PwMS displayed a significant positive correlation between left hemisphere GM thickness and inhibition. Both turning measures were significantly associated with GM thickness and inhibition for PwMS, although cortical inhibition displayed greater significant associations with turning performance for PwMS. These results indicate that cortical inhibition, rather than GM thickness, may be more associated with dynamic lower limb movements, and that PwMS may utilize different neural resources to perform movements associated with fall risk.

176   Nutritional Comparison of popular plant-based meat alternatives and animal-derived meats

CALEB SWING

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The objective of this study was to evaluate the nutritional composition of two popular plant-based burgers, the Impossible Foods Burger and the Beyond Meats Burger in comparison to 80% lean 20% fat ground pork and ground beef. Proximate, mineral, vitamin, fatty acid, and amino acid nutrient composition were assessed for each product. Additionally, the United States Department of Agriculture (USDA) nutrient database was used to assess the aforementioned nutrient profiles of raw and cooked 80% lean 20% fat ground beef. Raw and cooked plant-based burgers had higher ($P < 0.05$) amounts of each mineral tested, except phosphorus, potassium, and zinc compared to raw and cooked ground pork. Raw and cooked plant-based burgers were higher ($P < 0.05$) in vitamin E than then ground pork. Additionally, Impossible Food burger was most similar to ground pork in raw and cooked B vitamin nutrient profiles. The fatty acid content of raw and cooked Impossible Food Burger and Beyond Burger were similar to one another and notably higher than ground pork in C 14:0, C18:1 n-9, and C 20:0 but lower in most other fatty acids tested. The cholesterol content for both raw and cooked plant-based products were below the detection limit, while the cholesterol content for ground pork and beef were similar to each other. Beyond Burgers were generally higher in amino acid contents compared to Impossible Food burger and ground pork. Impossible Food burger had the lowest ($P < 0.05$) content in essential amino acids after cooking.

177   Development and Characterization of SARS-CoV-2 Nucleocapsid Protein Specific Monoclonal Antibodies

JAMES TERRY

DEPARTMENT: MICRBIOLGY, IMMUNOLGY & PTHLGY
COLLEGE: VETERINARY MED AND BIOMED SCI

The COVID-19 pandemic has ravaged the world on every societal level with a tremendous cost of human life. To fight this pandemic, new molecular tools specifically targeting the

critical components of the causative agent of the pandemic, SARS-CoV-2, are needed to enhance the development of rapid diagnostics and therapeutics. The SARS-CoV-2 nucleocapsid protein is an integral component of the viral replication and particle assembly process while providing a useful diagnostic marker for infection and immune protection. I have been working to develop and characterize new mouse monoclonal antibodies against the SARS-CoV-2 nucleocapsid protein. Following mouse immunizations, mouse B cells were fused with mouse myeloma cells to produce a new line of hybridoma cells that excrete anti-nucleocapsid protein antibodies. Through ELISA testing, western blots, and immunofluorescence assays we were able to narrow down our pool of hybridomas to a select number that produce highly specific antibodies. Recently developed sequencing techniques were employed for the sequencing of hybridoma antibody mRNA. Western blot analysis was utilized to determine cross reactivity potential between the antibodies with SARS-CoV and other betacoronaviruses. With these novel antibodies characterized and the data shared with the scientific community, my work will assist in the research of SARS-CoV-2 infection mechanisms while providing valuable reagents to the COVID-19 research community for the development of nucleocapsid protein-detecting diagnostic tests. For future directions I intend to pursue the development of single-chain variable fragment antibodies for expression in infected cells to determine if such antibody expression can reduce viral replication rates.

178   Investigating the etiology of sour knuckles in post-chilled beef carcasses

TYLER THOMPSON

DEPARTMENT: ANIMAL SCIENCES
COLLEGE: AGRICULTURAL SCIENCES

Development of sourness in beef round cuts, such as knuckles, has been a long-standing issue in the beef industry with little characterization. Therefore, the objective of this study was to investigate and characterize the sour odor associated with beef knuckles using sensory, analytical (gas chromatography-mass spectrometry; GC-MS), and microbiological approaches. Knuckles (n = 10) with no sour odor (control), a slight sour odor (SLI-SO), or severe sour odor (SVR-SO) were collected from a commercial beef processing plant. Additionally, the synovial fluid from the femur joint, and the femur surface associated with the collected knuckles, were sponge-sampled. Knuckles were separated into two halves, with one half subjected to an odor panel, and GC-MS and microbial analyses on the day of collection (day-0). The remaining half was analyzed for odor and microbial populations following 35 days of vacuum-packaged storage at $0 \pm 2°C$ (day-35). Odor panelists identified differences ($P < 0.05$) between control and sour knuckles for all attributes tested regardless of storage day. GC-MS analysis found no statistical difference ($P > 0.05$) in volatiles between control and SVR-SO. Microbial analysis of muscle on day-0 and day-35 revealed no ($P > 0.05$) differences between the three treatment groups. Similarly, no ($P > 0.05$) differences between the treatment groups were obtained following analysis for psychrotrophic anaerobic sporeformer counts. The findings of the study indicated that the souring condition in knuckles exists at identifiable intensities with no volatile acid or microbial population differences; therefore, further investigation is needed to determine the etiology.

179   Pandemic impact on extracurricular engagement of Animal Science students.

MEGHAN THORNDYKE

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The objective of this retrospective data analysis was to determine the impact of the COVID-19 Pandemic (during online/hybrid delivery) on extracurricular engagement of Animal Science students throughout the 2020 fall semester. Four years of compiled data were used: Fall 2017, Fall 2018, Fall 2019, and Fall 2020. For the past 5 years, the Animal Nutrition group in the Department of Animal Science has always offered extracurricular, experiential hands-on learning opportunities for CSU students. The idea of compiling these data came after an unexpected increase in students requesting volunteer opportunities. In 2017, there were 8 students that showed interest in volunteering but only 2 students completed the semester engaged in research projects. In 2018, 12 students were interested in volunteering, yet 3 students completed the semester participating in our research project activities. In 2019, there were 14 students volunteering initially. However, at the end of the semester, 7 students were still engaged with research. It is important to mention that within both groups of the previous students, 3 from 2018, and 3 (of 7) from 2019 are currently holding student-hourly position in our research group. Interestingly, the fall semester 2020 there were 35 students interested (in the first 3 weeks of classes), 22 of them have completed the initial required training, and 8 of students have been actively involved in hands-on research. Although fall 2020 isn't completed, it appears that undergraduate students are more interested in volunteering. This could be a response to lack of face-to-face interaction in courses this semester.

180 Improving Battery Design Principles via Ultrafast Spectroscopy

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Batteries play an important role in storing energy and are currently used in an array of applications, including many portable devices, electric vehicles, satellites, and power grids. Therefore, there is significant interest in furthering the development of battery technology. Specifically, as sodium or lithium ion batteries are cycled, electrolyte components degrade and form a layer called the solid electrolyte interphase (SEI). How the SEI forms impacts battery lifetime and efficiency. Thus, it is important to characterize electrolyte solutions to gain a better understanding of how each component plays a role in SEI formation. Certain electrolyte components, such as fluoroethylene carbonate, are shown to substantially impact battery lifetime. However, why these molecules have such a drastic effect is not well understood. In this project, a technique called 2DIR spectroscopy is used in conjunction with computational methods to build a better fundamental understanding of how these molecules behave overtime in the electrolyte solution. 2DIR works by using fast pulses of light, to watch molecules move on very short timescales. We show that different amounts of fluoroethylene carbonate impact the overall structure and dynamics of the electrolyte. This base understanding allows us to move forward and use the novel technique of 100 kHz 2DIR microscopy. This technique can spatially resolve how the molecules degrade in a battery while it is cycling providing a clear picture of how each electrolyte component contributes to

SEI formation. Consequently, allowing for the improvement of overall battery design.

181 Development of Full and Partial Models of Mid-Substance ACL Rupture

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COLLEGE: VETERINARY MED AND BIOMED SCI

The anterior cruciate ligament (ACL) is the most commonly injured knee ligament. Surgical reconstruction is the gold standard for treatment of ACL ruptures but results in 20-50% of patients developing post-traumatic osteoarthritis (PTOA). Given the relationship between these two etiologies, there is need to understand the development of PTOA post-ACL rupture to produce novel treatment strategies. The goal of this project was to develop both partial and full models of mid-substance ACL rupture in male and female mice using non-invasive mechanical methods (tibial displacement) and characterize early PTOA changes following full ACL rupture with our model. Mice were anesthetized and placed in a custom bioreactor and received tibial displacement at either 1.6 or 2.0mm (partial or full rupture, respectively). Mice were either euthanized immediately post-injury to determine success rates or 14 days post-injury to evaluate early PTOA progression. Mobility and behavior changes were longitudinally tracked using AnyMaze cage monitoring software. Following injury, mice exhibited altered mobility and potential pain response 1-day post; they returned to pre-surgery movement levels by 14 days. Our model demonstrated high efficacy inciting both full and partial ACL ruptures in both male and female mice. Loads obtained during these protocols (1-2.5N) were less than previously published reports (3-12N), which may contribute to the mid-substance ACL ruptures achieved with our model (versus avulsion fractures in other models). Our developed partial and full ACL rupture models will be utilized as a clinically relevant model for testing potential therapeutics and to further our understanding of PTOA following ACL rupture.

182 Effects of Religion on Empowerment Rights A Cross National Study

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COLLEGE: LIBERAL ARTS

Previous researchers have studied the effect of religious practice on different human rights including womens empowerment (Detraz and Peksen 2017), child hunger (Peterson 2006), supporting for torturing (Mayer and Koizumi 2017, Cole 2016, Price 2002) under different control variables (cultural background, economics, time trends). However, the effect of religion is often unclear and depends on the effect of another variable . Therefore, this paper tests the effect of different religions on empowerment rights (which includes Foreign Movement, Domestic Movement, Freedom of Speech, Freedom of Assembly and Association, Workers Rights, Electoral Self-Determination, and Freedom of Religion) while controlling for world systems positions and military expenditures.

183   A Predictive Internet-Based Model for COVID-19 Hospitalization Census

THAO TRAN

  DEPARTMENT: PSYCHOLOGY
  COLLEGE: NATURAL SCIENCES

In response to COVID-19, a legitimate concern of some hospital systems is the serious danger of being overrun and exceeding their capacity to provide patient care. The current project was conducted by investigators from the Atrium Health Center for Outcomes Research and Evaluation (CORE) to develop an Internet-based forecast model for the number of patients with COVID-19 (i.e. hospital census) to provide advance warning of any anticipated surges in patient care demands.
We pulled all data between February 21 to August 1 in the Mecklemburg county/Greater Charlott region for our study. After preliminary analysis, we determined that the Google Relative Search Volume using six different permutations of the keyword covid testing and the HBs count of people that may have COVID-19 were two important predictors for hospital census. We fitted a Vector-Error Correction Model (VECM) to model multivariate time series. The one-day ahead prediction result suggests that we had a nicely accurate and precise model. To simulate real-world evidence, we also performed cross-validations and found that both the 7-day ahead and 14-day ahead predictions were excellent to very good.
Out-of-sample prediction for the 14-day period from August 2 to August 15 was generated with this model. Nearly all the actual observations were within the 95% prediction interval. The mean absolute prediction error (MAPE) was 6.4, indicating that this VECM model can be used to predict future hospital census. Advantages and limitations of this model were discussed in our paper.

184   Selective Synthesis of Complex Oxide Structures via Modified Double-Displacement Reactions

THINH TRAN

  DEPARTMENT: CHEMISTRY
  COLLEGE: NATURAL SCIENCES

Molecular chemistry mastered selective synthesis of molecules with the same chemical composition but different structures, but it remains a significant challenge in solid-state chemistry. Traditional synthetic methods require high temperature conditions, which favor the reaction to yield the most thermodynamically stable products and offer no selectivity in the products. Solid-state double displacement reactions, also known as metathesis, show promise to bypass the limitations of traditional methods and allow control in the outcome. Here we show that modified metathesis reactions lower reaction temperatures of complex metal oxides by including a mixture of different metal oxygen halide reagents. We used x-ray powder diffraction to explore the reaction pathways in these reactions to understand how lower reaction temperatures are achieved. Understanding the underlying mechanisms allow us to improve on existing experimental methods in solid-state chemistry and eventually achieve complete control over product selectivity in our reactions.

185   ADHD and Provisional Tic Disorder in the Virtual Age

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COLLEGE: BUSINESS

From an early age, children with ADHD and Provisional Tic Disorder can struggle with attention deficits, impulsiveness, hyperactivity, hyperfocus, and may even have uncontrollable urges to tic at inopportune times. These symptoms can make being in traditional classroom settings difficult. According to a study conducted by Appalachia Educational Laboratory, thirty-five percent of children with these disorders eventually drop out of school due to persistent academic difficulties.

However, traditional classroom research is outmoded for the virtual world we are living in now. Due to COVID-19, many schools across the United States have transitioned to virtual learning. So, how does virtual learning fare for children with ADHD and Provisional Tic Disorder? That is the question this research study sets out to answer.

This observational study follows Layton, a Kindergartner who has been diagnosed with ADHD and Provisional Tic Disorder on his journey with virtual school. While admittedly, this study is in its beginning stages, much has already been discovered about ADHD, Provisional Tic Disorder, and the impacts of virtual learning. For instance, having fewer physical classroom transitions (e.g., going from the classroom to the music room) has improved Laytons classroom behavior.

By the end of this study, I expect to uncover a range of scenarios and techniques that worked (and those that did not work) to hopefully help educate parents, teachers, and school administrators alike so successful strategies for children with ADHD and Provisional Tic Disorder in virtual learning environments can be developed.

187   Economic Resilient Strategies for Construction Firms during Recessions

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During the great recession, construction firms struggled to maintain competitiveness. Limited cash flow, inexperience during downturns, and uninformed decision led to high failure rates. As per 2015 Bureau of Labor Statistics, 2.5 million construction workers lost jobs and 16.6% of construction firms disappeared due to impacts of great recession. This happened because the construction industry was not prepared and did not know how to handle the recession. The objective of this research is to develop economic resilient strategies for construction companies to successfully survive future economic recessions. In anticipation for the Covid-19 induced economic downturn, and to better understand the nature of these challenges, we engaged 70+ CFOs, CPAs and Sureties in a Delphi-Method study to identify successful strategies for recession management in the construction industry. From this study, 40 successful recession resilient strategies are developed for the

construction industry across seven categories namely Organizational and Project Management strategies, Financial strategies, Customer focused strategies, Efficiency Strategies, Direct Cost Strategies, Overhead Strategies and Preconstruction & Marketing strategies. This is a timely research considering the potential impact of Covid-19 induced recession on the construction industry. From this study, we are developing analytics program specific for the construction industry. The program helps companies use historical data, track employee productivity, identify relationships between activities (inputs) and outputs in operations, measure effectiveness of market strategies, correlate and increase profitability on construction project. In an industry desperate for managing overwhelming amounts of data, Analytic coaching is a timely and necessary service to strengthen the economy.

188   Sex Differences in the Neural Control of Depression Behaviors

TYLER WALLACE

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  COLLEGE: VETERINARY MED AND BIOMED SCI

Depression is a mood disorder characterized by negative feelings, social isolation, and loss of energy. Yet, even though depression accounts for the most years lived with disability worldwide and the occurance continues to grow, we lack an understanding of how the brain regulates depression-related behaviors. Complicating the disorder further, the rates of depression are nearly twice as high in females, but the neurobiological differences that contribute to this are unknown. To determine the neurobiology underlying these behavioral changes and sex differences we must look at regions altered in depressed patients. One region is the subgenual cingulate cortex, the SCC. In depressed patients, the SCC has altered structure and activity, but how this region fundamentally regulates behavior is not known. To determine how this region regulates mood and social behavior we manipulated it's activity using cutting edge optogenetics techniques in rodents. We found that increasing the activity of a specific neural population in this region increased sociability and had a positive impact on mood in males but not in females. Our results demonstrate fundamental neurobiological differences in how depression-related behaviors are regulated between sexes. Further, these results can guide future therapy development by showing the key roles that specific neural populations play in the regulation of behavior.

189   Machine Learning to Improve Controllable DNA Storage

DAFU WANG

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  COLLEGE: INTRA-UNIVERSITY

This proposed technology is to enable new possibilities for high-density information storage. With fast-growing development of biotechnology, there are new concepts for the study of protein crystals and their interactions with biomolecules. During preliminary study, we have successfully measured interaction between DNA and protein crystals by atomic force microscopy (AFM). As results, we have collected a large data set including hundreds of thousands of interaction trace records. With the help of both supervised and unsupervised

machine learning (using random forest algorithm, cross-validation method, and affinity propagation algorithm) we will be able to recognize and cluster thousands of force-distance curves obtained from AFM, to enhance our understanding and advance applications of DNA interactions with highly porous protein crystals. This application of machine learning enables the rapid processing of very large and information-rich data sets. Initial metrics showed that our classifiers have already achieved an average accuracy of 85% on overall recognition, and 92% to 98% on individual case recognition. With more data feeding the training model, the accuracy of recognition will reach a level very close to 100%. With the help of unsupervised machine learning, we have also obtained initial results for clustering thousands of interaction traces into 8 clustering centers. In sum, machine learning as a powerful tool, that will significantly help us further analyze and understand the mechanisms of interaction between DNA and protein crystals. Machine learning will improve the work in which we optimized nano-structured protein crystals into 3-D nano reservoirs, capable of responding to selective biomolecular recognition.

190   Effect of Building Wind-Retrofit Strategies on Socio-economic Community-Level Resilience Metrics

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COLLEGE: WALTER SCOTT COLLEGE OF ENGR

Tornadoes occur at a high frequency in the United States compared with other natural hazards but have a substantially small footprint. A single high-intensity tornado can result in high casualty rates and catastrophic economic and social consequences, particularly for small to medium communities. Comprehensive community resilience assessment and improvement requires the analyst to develop a model of interacting physical, social, and economic systems, and to measure outcomes that result from specific decisions made. These outcomes often are in the form of metrics such as the number of people injured or the number of households or businesses without water, but it has been recognized that most community resilience metrics have socio-economic characteristics. In this study, for the first time, a fully quantitative interacting model is used to examine the effect of a tornado damaging physical infrastructure (buildings and electrical power network) and the effects on the population and the local economy for a real community. Then, three residential building retrofit strategies are considered as alternatives to improve community resilience and metrics from the physical, economic, and social sectors computed. An illustrative example is presented for the 2011 Joplin tornado in a new open-source Interdependent Networked Community Resilience Modeling Environment (IN-CORE), with a computable general equilibrium (CGE) economics model that computes household income, employment, and domestic supply before and after the tornado. Detailed demographic data was allocated to each structure to calculate resilience metrics related to population dislocation impacts from the tornado.

191   Overestimation of Variability in Ensembles of Line Orientation, Size, Hue

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Ensemble perception utilizes our visual system's natural abilities to extract summary statistics from sets of similar objects. Our perceptual system can accurately detect the mean of these ensembles. However, previous research has shown that our visual system is biased to overestimate variability. This bias to overestimate variability of line orientations was stronger when the objects were more similar to each other. We extended this work to explore whether this overestimation bias is a general phenomenon and therefore applies to other visual features as well. Using the method of adjustment, participants made judgments about the variability of line orientation, size, and hue in sets of ensembles (lines, circles). Participants viewed nine target circles of various sizes presented one-at-a-time, then adjusted the sizes of five comparison circles presented simultaneously to match the variability in the target display. A similar task was used to assess how participants estimated variability in line orientation and hue. Participants overestimated variability for all three features. Moreover, participants overestimated variability to a greater extent when there was less variability in the display for circle size (95%), line orientation (51%), and hue (155%) compared to the highest levels of variability (-11%, -10%, -3%, respectively). Understanding how we perceive variability in ensembles is essential when making judgments about critical information in visualizations. For instance, how distributed calcifications are within a mammogram informs whether a radiologist diagnoses a patient with cancer. Future research hopes to elucidate the mechanisms of ensemble perception and test the robustness of the bias to overestimate variability.

192 Human gut microbiome metabolism of rice bran-derived arsenic exposure

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Arsenic (As) is a group-1 carcinogen of paramount concern from food and water sources of exposure, yet rice as a staple food source of daily exposure has had limited investigation with respect to metabolism by the gut microbiome. There has been limited assessment of As species/concentrations found in rice bran, the outer layer of whole grain-brown rice. Recent health and nutrition research support rice bran is a nutrient-phytochemical-prebiotic-fiber rich ingredient with protective functions against enteric infections, colon cancer, and other metabolic conditions. As contamination potency in rice bran from different geographic regions warrants investigation as this novel food product/ingredient becomes more available in the marketplace. Moreover, given the impact of rice bran on the human gut microbiome, the potential for metabolic detoxification or biotransformation by the gut microbiome merits attention. The central hypothesis of this research is that dietary rice bran as a food source of As exposure results in microbiome compositional changes that enhance metabolic As detoxification. This project will determine dose-response effects of As from rice bran varieties on the gut microbiome and metabolome. Preliminary data on As speciation in rice bran from 55 cultivars demonstrates the geographically and genetically distinct bioaccumulation. Rice bran with varying levels of As was selected from this analysis for mouse feeding trials and for future examination of human gut microbiome responses in the

metabolism of rice bran-As. This study yields new information of direct impact to global public health nutrition and advances our understanding of gut microbiome influences on heavy metal bioaccessibility/absorption.

193   Trustworthy Computing and Communications so You Can Cyber in Peace

JAMES WHEATON

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  COLLEGE: WALTER SCOTT COLLEGE OF ENGR

The modern era of cyber-warfare, rampant theft and exploitation of user data by cybercriminals is facilitated by our inscrutable, misbehaving, and fundamentally insecure information technology infrastructure. Our personal safety as well as public utilities infrastructure and democratic society itself are at severe risk of disruption due to pervasive design faults of computers.

Krali Computing is a research project developing a cyber-system-of-systems architecture using model-based systems engineering that radically minimizes the Trusted Computing Base; that is end-to-end formally specified and verified; and that synthesizes scientific advancements in decentralized identity, content-centric networking, object capabilities, dependently-typed and effectful functional programming languages with the LISP microprocessors of yesteryear.

Inspired by great thinkers who believed computers can work for us and not against us, information appliances like Alan Kay's famous Dynabook can be built as personal computing device-nodes in a spontaneously global and consent-based meshnet. This project is still early stages but its overall architecture has been sketched out, and preliminary work of developing a LISP-native Systems Modeling Language and incorporating system requirements has begun.

194   Bayes'd and Confused: The Role of Uncertainty in Sensorimotor Control

TYLER WHITTIER

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  COLLEGE: HEALTH AND HUMAN SCIENCES

Our brains rely on sensory information from our feet and legs to control the way we balance and walk. However, even in healthy individuals this sensory information is inherently variable and clouded with uncertainty. How the central nervous system (CNS) controls motor function amid the uncertainty of sensory signals is poorly understood. Researchers have suggested that the brain may account for this sensory uncertainty in a way that can be explained by Bayesian decision theory (BDT). BDT posits that the brain accounts for variability in sensory data by combining it with learned expectations built from previous movement attempts. In this manner, the optimal estimate is achieved by considering both the incoming sensory data as well as learned expectations. While initial findings on this topic

are promising, they have neglected to study full-body movements such as gait and balance. The purpose of this research is to determine if the CNS controls balance-related stepping tasks in a way that fits a BDT framework. To address this purpose, we created a virtual reality protocol to identify what sensory information the brain relies upon when making balance related decisions. Initial findings from this ongoing study suggest that dynamic balance tasks are controlled in a way that fits the BDT framework. These results provide further evidence that the CNS is aware of the variability in sensory information and is proficient at compensating for the resultant uncertainty. We aim to apply these findings as a method for measuring the efficacy of interventions targeting sensory function.

195   Energy Transactions at the Limits of Life

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Extremophiles employ unique metabolic mechanisms that allow them to live in radical environments. Thermococcus kodakarensis is a genetically-tractable, shallow-dwelling, hyperthermophilic anaerobe. While capable of glycolysis, this archaeon gains most of its energy in the catalysis of amino acids. Typically, NAD(P)+/H functions as the electron carrier in metabolism, indiscriminately moving electrons from donor to acceptor. However, these molecules are subject to thermal degradation in the environments where Thermococcales reside. Instead, proteinaceous electron carriers have a range of midpoint electrical potentials and can act as functional shuttles in thermodynamic environments. It is proposed that electro-negative proteins shuttle electrons to membrane-bound complexes which transfer the electrons to protons or elemental sulfur   while translocating protons across the membrane, building up an ion gradient, and ultimately driving the production of ATP.

196   Patterning parental messages guides development in the Caenorhabditis elegans embryo

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Embryos rely on delivery of cellular messages inherited from the mother to guide early development. It is important for these genetic messages, messenger RNA (mRNA), to reach their cellular destination in the embryo to specify cell fate. The instructions carried by mRNA are translated into proteins, the machines doing work in the cell. Devastating developmental consequences can occur if messages are not delivered and the instructions carried in the message are not read and translated into proteins.

In the early Caenorhabditis elegans embryo, we identified almost 300 mRNAs with cellular destination preferences. Of these, we identified a subset with not only increased abundance in a preferred cell, but with specific patterning within that cell. One mRNA, erm-1 (Ezrin/Radixin/Moesin), can be found at the cell membrane. Disrupting the patterning of erm-1 can result in malformation of the intestine and death of the embryo. Interestingly, the cell

membrane is the same subcellular location as where the ERM-1 protein is found. How are these patterned messages delivered? Is the address somewhere on the mRNA itself, or is the address within the instructions and the mRNA requires translation prior to delivery?

Through disrupting translation by various measures, we found the patterning of erm-1 and other mRNAs like it is translationally dependent. The address appears to be in the instructions carried by the message. How delivery of inherited messages can diversify the original template of information passed on from the parents is paramount for ensuring proper embryonic development and understanding the basis for developmental disabilities.

197 Cerenkov Imaging: An Alternative for Radiopharmaceutical Imaging of Positron Emitters

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Cerenkov luminescence imaging (CLI) is an emerging means of in vivo characterization of radiopharmaceutical biodistribution in small animals. Traditional radiopharmaceutical imaging involving Position Emission Tomography (PET) imaging is limited in the number of subjects which can be scanned in a given time and by the high associated cost of the imaging system. CLI offers a less expensive alternative that can scan up to five small animal subjects simultaneously. Cerenkov radiation is produced when a charged particle passes through a dielectric medium faster than the speed of light traveling in that medium. Radionuclides 18F (half-life, 109.8 min) and 64Cu (half-life, 12.7 hours) decay via positron emissions which satisfies the conditions for Cerenkov radiation production in water and tissue. This study will investigate the use of the IVIS® Spectrum (in vivo imaging system) at the Colorado State University (CSU) Veterinary Teaching Hospital (VTH) for detecting Cerenkov radiation associated with the decay of 18F and 64Cu in small animal phantoms. We will also investigate the relationship between the measured intensity of Cerenkov emission to radionuclide activity and the associated radiation dose the small animal phantom receives. The development of radiation detection and quantification processes used in this study will aid in the development of a procedure for cheaper and quicker biodistribution analysis and dose estimation at target sites for radionuclides used for PET imaging. Cerenkov imaging using the IVIS® Spectrum has great potential in becoming a cost-effective imaging modality for radiopharmaceuticals used in small animal translational research.

198 Military Environmentalism in the U.K., Canada, New Zealand, and Australia

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The research project asks under what conditions do military organizations become environmental stewards. It examines four Western industrialized states military

organizations, the United Kingdom, Canada, Australia, and New Zealand. I examine why these defense organizations want to implement an environmental stewardship program and what influences its success or failure. To implement a stewardship program, these military organizations attempt to engage in the policymaking process to create environmental policies and direct government attention to their stewardship needs. They accomplish this by creating a coalition where they work with other groups of stakeholders to achieve their goals. Therefore, I apply an advocacy coalition framework to capture and organize the data and determine what groups and factors contribute to these stewardship programs' outcomes. I use the most similar systems design with process tracing to examine the development of military environmentalism in these organizations. This project's findings illustrate that while military organizations desire to engage in environmental stewardship efforts, the results of these stewardship practices are complicated by various factors. These factors include the strength of an opposing coalition, government legislation, funding, and international events that focus the military organization's attention away from environmental issues. Overall, the United Kingdom and Australian militaries implemented their environmental stewardship program. In contrast, the Canadian and New Zealand militaries were heavily impacted by these various factors and failed to implement their stewardship programs.

199   Exploring blueberry consumption on endothelial dysfunction: a mechanistic insight

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Cardiovascular disease (CVD) is the leading cause of death in the United States (US), with aging and endothelial dysfunction being significant risk factors. The endothelium is the inner cell lining of blood vessels crucial for endothelial function largely due to its production of nitric oxide (NO). As we age, excessive oxidative stress and inflammation occur, contributing to decrease in NO production and endothelial dysfunction. Foods high in phytochemicals have shown to alleviate endothelial dysfunction by activating molecular pathways involved in NO production. Clinically, blueberries have shown positive effects endothelial function; however, little research has aimed to understand mechanisms associated with endothelial dysfunction. Therefore, one aim of a larger clinical trial was to uncover mechanisms which blueberries may exert beneficial effects on the endothelium. Quantitative immunofluorescence microscopy was performed to detect protein markers associated endothelial dysfunction in human venous endothelial cells. Out of the 47 postmenopausal women with elevated blood pressure or stage 1-hypertension that participated in the study, 24 partook in venous endothelial cell biopsy. Participants consumed 22g of either placebo or freeze-dried blueberry powder for 12 weeks and biopsies were performed at baseline and after the 12-week treatment period. Endothelial cells were transferred to disassociation buffer, rinsed, centrifuged, mounted on microscopy slides, and stored at -80 degrees Celsius until analysis. Slides were then stained with various antibodies, then placed under fluorescent microscopy to detect possible proteins associated with endothelial dysfunction. With this, we hope to undercover potential mechanisms associated with endothelial dysfunction and responses to treatment.

200 Human vs Animal Agriculture: Comparison of Escherichia coli Antimicrobial Resistance

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Antimicrobial resistance is on the rise worldwide. The CDC estimates that per year at least two million people will become infected by a drug-resistant bacteria and at least 23,000 will die as a result. The World Health Organization recently reported that during the COVID-19 pandemic 72% of hospitalized patients received antibiotics while only 8% demonstrated overlying bacterial or fungal co-infections. Additionally, the pandemic is causing disruptions to treatments, for example patients with tuberculosis, which leads to a potential increase in drug-resistant pathogens. There is an urgent need to better understand the spread of antimicrobial resistance in human populations, how resistance-conferring genes are shared among bacterial pathogens and how prevalent these are within human and agricultural settings. Agricultural use of antimicrobial agents is known to impact the treatment of human disease. Increased prevalence in the food-borne pathogens Salmonella, Escherichia coli and Campylobacter has led to limitations in therapeutic agents and has resulted in an increase in treatment failures and unfavorable clinical outcomes. To understand the relationship between antimicrobial resistance elements in agricultural and human pathogens we have surveyed over 700 isolates taken from both poultry agriculture and human clinical isolates in the United States. Through our study we have identified antimicrobial resistance elements common to both poultry agricultural and human clinical isolates, determined their distribution within the United States and speculate if transfer of antimicrobial resistance elements is likely between these two populations.

201 The Effects of Climate Change on Smallholder Farmers Crop Choice

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This project attempts to analyze the effects on changing mean temperatures and precipitation on farmers crop choice decisions, specifically those of smallholder farmers in tropical countries. This is an important area of research as these farmers will be particularly hit by the effects of climate change and shifting the varieties of crops grown is one method of mitigation. A multinomial logit regression model will be used to find out the effects of historical climate on farmers choices, and then the IPCC climate change projections will be mapped to the farmer data to see the impact on their future decisions. Prior literature is somewhat limited but has been done for areas such as parts of South America and Bangladesh and it has been shown that, in these areas, climate does indeed impact crop choice. My data will come from a mix of surveys and agricultural censuses for the countries of Panama, Costa Rica, Cambodia, Ethiopia, Colombia, French Guiana, and Nicaragua. The underlying choice model is a Ricardian Profit Maximization Framework which assumes that farmers choose crops that will maximize their profits, and that multiple crops can be chosen.

For some countries I have access to repeated categorical data, while for some countries I have solely one year. For countries with repeated data, I will also do the analysis for particular years to see if there is a statistically significant difference in the crop choice results and provide some evidence for the validity of single year analysis.

203   Climate change, mountain landscapes, and Andean agropastoral communities

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COLLEGE: INTRA-UNIVERSITY

Mountain ecosystems cover approximately 22% of the worlds land surface, with more than 60% of them located in developing countries. People in these areas have developed livelihood strategies to adapt to fluctuating environmental conditions. However, emerging climatic pressures as well as social and economic stresses represent new challenges mountain people are facing. This research aims to (i) analyze the effects of landscape heterogeneity on land-use dynamics of agropastoral systems, (ii) study the role of social factors in the decision-making processes of agropastoral communities, and (iii) explore the effects of climate change and management scenarios on the socio-ecosystem. The study area comprises three communities settled in the boundaries of Huascarán National Park in the Andes of Peru. Since this research is in the planning stage, an explanation of the methodology for data collection and analysis will be provided. The socio-ecological system will be studied through a coupled system approach. An agent-based model will be built to analyze land-use dynamics at the community and household level. This model will be linked to an ecosystem model that estimates primary production of rangelands. A spatio-temporal analysis of landscape patterns will provide complementary information to the models. Field assessments will be conducted to validate the estimations of the ecosystem model. Social information will be collected through interviews and workshops. The development of the coupled model will provide insights into the role of natural and human drivers on the ecosystem and explore the impacts of short vs. long-term climatic and land-use scenarios.

204   Geodetic Calculation Of Seasonal Mass Changes On Wolverine Glacier, Alaska

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Glaciers are a key feature in mountainous environments where both humans and natural ecosystems rely on them as a source of fresh water. Having accurate measurements of glacier mass changes is a necessity to understand the effects of climate change on both regional and global scales. Repeat high-resolution digital elevation models (DEMs) offer a promising approach for measuring the mass balance of mountain glaciers from airborne or satellite platforms. A single glacier-wide density can be used to equate the observed volume change to mass change when the elapsed time between surveys is on a multi-annual to decadal scale. However, surface mass balance, firn densification, and ice dynamics have

variable effects on the surface elevation of glaciers on shorter time frames, complicating the calculation of mass change. In this study I use repeat fall/winter lidar and Structure-from-Motion derived DEMs, end-of-winter snow depths derived from ground-penetrating radar surveys, and a firn densification model to examine the distribution and magnitude of winter surface elevation changes on Wolverine Glacier over three accumulation seasons (2015-2016, 2016-2017, 2019-2020). The calculated seasonal and annual mass balances show good agreement with in-situ mass balance measurements. The results highlight the importance of distinguishing between surface mass balance, firn densification, and emergence velocity when converting between volume and mass changes on seasonal to annual scales. This study represents the first published attempt to measure distributed mass balance of glaciers using geodetic methods on such short time scales and will facilitate future mass balance measurements over larger regions.

205   TMT labeling to identify proteome changes in early postmortem beef

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  COLLEGE: AGRICULTURAL SCIENCES

Previous research has indicated that variation in the proteome profile of longissimus lumborum (LL) and psoas major (PM) post-rigor influences meat quality attributes such as tenderness and color stability during retail display. Tandem mass tag (TMT) labeling is a chemical labeling approach using isobaric mass tags for accurate mass spectrometry-based quantification and identification of biological macromolecules. The objective of this study was to use TMT labeling to examine proteome profile variation between beef LL and PM during the early postmortem period (45min, 12h, and 36h). We identified a total of 629 proteins, of which 71 were differentially abundant (fold change > 1.5, $P < 0.05$) from three comparisons between the muscles (PM vs. LL at 45 min, 12h and 36h). These proteins were mainly involved in oxidative phosphorylation and ATP-related transport, tricarboxylic acid cycle, NADPH regeneration, fatty acid degradation, muscle contraction, calcium signaling, chaperone activity, oxygen transport, as well as degradation of the extracellular matrix. At early postmortem, more abundant antiapoptotic proteins in LL could cause high metabolic stability, enhanced autophagy, and delayed apoptosis, while overabundant metabolic enzymes and pro-apoptotic proteins in PM could accelerate the generation of reactive oxygen species and initiation of cell death. We characterized the proteomic change of these two muscles at early postmortem using TMT labeling for the first time, which highlighted the potential relationships between metabolism, cell death, and color stability. Our work provides a new perspective on muscle-to-meat conversion, especially on the potential effect of muscle-specific cell death on meat color stability.

206   Advanced manufacturing of fiber-reinforced polymer composites

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Fiber-reinforced polymer composites (FRPCs) based on thermoset resins are lightweight and high-performance structural materials that have attracted a great deal of attention in industrial sectors. The present technologies for fabricating FRPCs rely on using large, expensive autoclaves or oven that scale in size with the component. Another major challenge with composite manufacturing is the design and fabrication of tooling for every new part and geometry, which is a costly and time-consuming process. These requirements have limited the economical applications of FRPCs.

Here, we develop a new digital manufacturing approach to overcome the limitations of conventional processing techniques. We use a new liquid resin system that transforms to a solid polymer in a fraction of second through applying a thermal stimulus. Using this stimuli-responsive resin, we develop a processing technique, where continuous carbon fibers impregnated with resin or resin filled with discontinuous carbon fibers are fed through the nozzle of a printing robot. Upon extrusion, the resin is polymerized immediately by a local heat source. This technique enables us to create free-form and complex parts rapidly, which is hard to achieve using traditional manufacturing approaches. In addition, our new technology will cut the manufacturing cost by more than half through eliminating tooling, resources and post curing step. We envision this technique will pave the way for digital manufacturing of FRPCs in a wide range of industrial applications.

207 Salt Mobilization and Transport in Upland Catchments, Arkansas River Basin

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Salt loading can significantly alter water quality in large river basins. The mobilization and transport of salt in semi-arid and arid regions under irrigation hinder the sustainability of crop production. The objective of this study is to identify the major environmental factors that control the mobilization or salts in upland catchments to nearby streams, which then discharge to large river basins that are utilized heavily for irrigation purposes. Field measurements and statistical analysis will be used to perform this assessment. Electrical conductivity data loggers and rain gauges have been placed along the Purgatoire River, a primary tributary of the Arkansas River located in southeastern Colorado, to quantify in-stream salt loading at different points along the river. Soil samples will be collected from within the catchments that feed into the main tributary to better understand salt location, in addition to water samples that will be taken frequently at the field sites. Salt concentrations from the water samples will be compared to the continuous electric conductivity probe data and linearly regressed to confirm or deny a relationship between total dissolved solids and electric conductivity. This relationship will be utilized to compute daily, monthly, and yearly loadings of salt (kilograms) that are contributed to the Arkansas River from the Purgatoire River. Results can be used in the Arkansas River Basin and other semi-arid and arid basins worldwide to assess salt contributions from upland catchments to irrigated river valleys.