Colorado State University
GRADUATE STUDENT SHOWCASE
CELEBRATING RESEARCH AND CREATIVITY

2019 ABSTRACTS

Performing Arts

Elemental

COURTNEY ELLISON

DEPARTMENT: ENGLISH
COLLEGE: LIBERAL ARTS

Although many believe that life is experienced in a linear way, conceptually it is a series of moments from which we make meaning by finding connections. I will explore the significance of fragmentation as a writing tool, finding an alternate way to process and think of life experiences. Discovering the value of fragmented writing will reveal that it can be just as effective as a linear narrative. This, by using fragmentation to write about life, memory, trauma, healing, thinking and learning, there is perhaps a chance to discover alternated ways to experience the world, art and memory.

What I Could Have Given

ESTHER HAYES

DEPARTMENT: ENGLISH
COLLEGE: LIBERAL ARTS

I wish to present a 1,500-word flash fiction piece titled What I Could Have Given. This piece will be included in the collection of short stories I am producing for my thesis. These stories investigate issues of fertility and rural America. Fertility in these pieces refer to both biological fertility: puberty, genealogy, mothering, as well as ecological fertility: land-use, drought, changing farming techniques, urbanization.

A Student Performance of James Davids Zephyrus for Chamber Ensemble

SHERIDAN LOYD

DEPARTMENT: SCHOOL MUSIC, THEATRE, & DANCE
COLLEGE: LIBERAL ARTS

Colorado State University associate professor Dr. James David is a contemporary American composer whose works have gained acclaim on the international stage. Despite being an important composer of wind band repertoire, with compositions performed at over fifty national and international conferences, no formal research on his output yet exists. This research project will consist of a masters thesis document and performances of Davids works with the CSU Wind Symphony. The thesis will include a series of interviews with David outlining his musical training, approach to composition, and compositional voice. In addition, the document will offer a conductors analysis of his new Symphony no. 1: Codex Gigas for wind band, serving as a reference document for performers, conductors, and composers in the future.

In February 2020, I will be conducting the American premiere of Davids Zephyrus for chamber winds and percussion, a recent addition to the chamber wind repertoire. In April, I will collaborate with the CSU Wind Symphony to present the consortium premiere of Symphony no. 1: Codex Gigas, Davids first symphony for any medium. Rehearsing and performing these works will provide insight into how David constructs and orchestrates his music, as well as his approach to composing for unique instrumentation. Research can be expanded in the future as David writes new works and his compositional style continues to develop and evolve.

For the graduate showcase, I propose to present a live performance of Zephyrus, performed by student members of the CSU Wind Symphony under my direction.

Visual Arts

1 If Objects Could Speak, What Would They Say?

SAMUEL DONG SAUL

DEPARTMENT: ART AND ART HISTORY
COLLEGE: LIBERAL ARTS

As a artist and graphic designer, I have always been interested in the relationship on how the products/objects we consume communicate to us. Why are we attracted to specific forms and colors. Are they talking to us in a language we don't understand? These objects I am presenting are an opportunity to interpret what they might be saying when they are being observed in a more intimate and scientific manner. Using the data sheet as a way to write down the observations from the interactions between the art object and whoever is interacting with them, will aid me with finding commonalities on how these specific objects might be communicating with us.

2 Resilient Impairments

LAUREN FAHERTY

DEPARTMENT: ART AND ART HISTORY
COLLEGE: LIBERAL ARTS

My studio practice investigates the deterioration of the human body and memory systems through the process of disease, aging, and other biological effects. Soft sculpture is prevalent in my work as it becomes a means to affront the viewer with their relationship to their own temporal and malleable body. The repetitious binding and mending techniques used in the fiber forms contemplate the constant state of proliferation juxtaposed with disrepair while the work desperately attempts to hold on to stability. Stability is fleeting in the visual form of off-balance, impermanent wood sculptures that the fiber works desperately cling too. The abject qualities of these sculptures evoke the uncomfortable state of dilapidation when our bodies begin to break down and live outside of our control. The wood structures have begun to be replaced with the physical presence of the actual human body in my practice. In the construction of wearable forms, the integration of the human body with soft sculpture is actualized. How these visual manifestations of faulty biological systems can limit the body and force change of movement through each design. With this investigation, I seek to find a balance between these inevitable internal human impairments with the resilience biological systems are capable of through the language of performance art.

3 What is Non-Representation Art?

SPENCER GILLESPIE

DEPARTMENT: ART AND ART HISTORY
COLLEGE: LIBERAL ARTS

I am a graduate student in the visual arts with a focus on painting. A lot of non-representation art is classified by the general public as abstract, but I would like to educate people on how my practice is very process based and explores material, editing, and creation. My poster will include images of my work and other artists from different time periods who also focused on process and the act of making. I plan to bring small sheets of paper with tape and collage materials for a very quick and brief exercise that others can use to create and take home with them. Many people misdiagnose non-representation art as abstract and I would love to educate them on the difference, how that applies to my own practice, and emphasize the importance of this type of artwork.

4 Custom Paralympic Shooting Jacket: A Single-Case Product Development Project

KAYNA HOBBS

DEPARTMENT: DESIGN AND MERCHANDISING
COLLEGE: HEALTH AND HUMAN SCIENCES

This research project is being done to investigate the sportswear product development needs of a disabled Paralympic Shooting athlete who uses a wheelchair in daily life through a single-case study method. This project is being done to address the major discrepancies in clothing availability between the able-bodied and disabled population, especially in the category of sportswear. Sportswear or sports apparel for disabled athletes is a very small industry, leaving many disabled athletes without proper clothing options for athletic involvement and performance. This research project will incorporate interviews, 3D body scanning, and virtual garment prototyping to create the best product for the Paralympic Shooting athlete, based specifically on her needs and desires for her competition shooting jacket. There are several positive outcomes and implications of this research, including a model example of effective product development processes, in which the athlete is heavily involved, for industry leaders working in sports apparel for disabled athletes. Future directions for this work include involving more disabled athlete participants of whom participate in a diverse collection of athletics (basketball, rugby, etc.) as well as diverse levels of competition (professional, semi-professional, and casual athletic participation).

5 Material Narratives: Manifesting and Managing Memory

JACOB JASO

DEPARTMENT: ART AND ART HISTORY
COLLEGE: LIBERAL ARTS

Throughout my material studies, I work with personal memories to create stories and give them a new life. Working with fiber and mixed media, I create quilts to house and tell these stories. Using quilting as a story-telling tradition passed down in my family, I can not only work out what a memory says, but to allow what can't rise to the surface.

Freud says, " What cannot speak still speaks, and does so irresistibly." Through exploring memory, I can free repressed memories and relate the deeper emotional content that may be

clouding my waking mind.

6 Goat Value Chains Development in India

PRATYOOSH KASHYAP

DEPARTMENT: AGRICULTURAL AND RESOURCE ECON
COLLEGE: AGRICULTURAL SCIENCES

Goat rearing is a major livelihood activity for the resource poor farmers in India who happen to be among the poorest agricultural communities and also largely women. However, the sector faces numerous challenges in the form small scale traditional production methods, lacking input support and inefficient marketing practices. A consistently growing market and massive scope of improvement in production makes developing the value chain an effective tool of combating low farm income and falling rural employment in India. It is also a strong means of women empowerment as the sector largely employs women, though in an informal manner. With the necessary input and extension support, market linkages and developing on community based models, the goat value chain can be strengthened manifold. These photographs are from various states in India and include farmers involved in goat rearing. I had worked with Creative Agri Solutions, an agricultural research company in Delhi, India. We worked on multiple studies involving value chains development of the goat sector in different states in India as well as at the national level. These photographs are from my visits to these states during the duration of these research projects. They represent an intimate connection between the farmers and the goats and also the different stages in the value chains.

7 Girl Powder- The Collection

KATE SCHMIDT

DEPARTMENT: DESIGN AND MERCHANDISING
COLLEGE: HEALTH AND HUMAN SCIENCES

My Plan B project is a portfolio of twenty womens snowboarding garments in a capsule collection based on the premise that there exists a gap in the outdoor apparel industry in regards to womens snowboarding apparel. The portfolio includes prints, fashion illustrations, and computer aided designs with technical features and construction guidelines for each garment. Most of the options are simply menswear garments that have been slightly modified to fit the female body/ preferences. My objective is to design a collection with femininity at the center while still embracing athleticism and functionality. I will be presenting the working portfolio to a panel of industry professionals, including those who work at Spyder and Smartwool and using their feedback and input, I will design and prototype two complete looks. At the showcase, I will be presenting my fully-developed portfolio and the research that informs it and identifies the need in the outdoor apparel market for snowboarding apparel designed, constructed, and produced with the female form, preferences, and consumption attitudes in mind.

8 Agents of Change - Textile Designs for Environmental Awareness

JESSICA SHAVER

DEPARTMENT: DESIGN AND MERCHANDISING
COLLEGE: HEALTH AND HUMAN SCIENCES

This collection of textile designs draw inspiration from H. Boschs 1939 triptych, The Garden of Earthly Delights, which depicts scenes of man and creatures in three stages of existence: the idealized (or heavenly); the reality, which is chaotic and crowded; and the horrors of a hell-like environment. Viewing these three panels together we are forced to confront the duality of how our human existence is both beneficial and harmful to the surrounding environment was with this notion in mind that the concept for this series of prints was derived and designed. Each textile design spotlights a species whose existence is affected by the ongoing interaction of humans and our environment. The goal of the series is to engage and provoke critical thinking without scolding the consumer. My graduate studies are interested in developing ways to effectively communicate environmental issues to consumers, and coming from a professional background in textile design these prints were created for commercial use in apparel or home décor and are meant to spark conversations around the ongoing climate crisis and the human impact on the environment. The California Condor, American Pika, and Cyanobacteria (blue-green algae) were selected for the debut series for the unique and varied perspective they can provide to such conversations. Future series could expand on this concept by diving deeper into flora or fauna species and sub-groups currently being affected by human-caused climate change, or could be used to memorialize species already lost to extinction due to human interaction and harm.

9 Sitting With Divinity - Works by Clark Valentine

CLARK VALENTINE

DEPARTMENT: ART AND ART HISTORY
COLLEGE: LIBERAL ARTS

Throughout my life, I have been greatly influenced by religion. Growing up in Protestant Christianity and still practicing it today, I have been inspired to seek a relationship with the divine. I have also studied Eastern Philosophy, Yogic Traditions, and Buddhism and have found a deep interest with the concept of ritual in religious practice. While my faith does not have rituals in the same way that many other religions do, I have found a beauty in seeking moments of connection with the divine through ritualistic practices. In my spiritual life, I seek the experience of ritual while maintaining intimacy with the divine. Subsequently, this body of work has not only been inspired by these practices, but has become a spiritual practice itself. My work is inspired by artists such as Agnes Martin, Ad Reinhardt, Sol Lewitt, Richard Long and Frank Stella. My work has also found inspiration from traditional art forms such as Buddhist

Mandalas, Catholic and Protestant iconography and Eastern Asian paintings. The materiality of drawing excites me. I am interested in the extreme vibrational contrast that can come from processes that are so simple and immediate. My work is driven by the processive element of its creation. Each line functions as a prayer or mantra as it is drawn. The
collection of these countless elements creates a whole that is greater than the sum of its parts. I
continue to explore these themes within Drawing, Sculpture, Printmaking and Painting.

10 After The Gold Rush

ZANE WHITE

DEPARTMENT: ART AND ART HISTORY
COLLEGE: LIBERAL ARTS

The work I will present represents the culmination of past and current research examining the changing landscape and ecology of the Southwest resulting from increasing land development, oil extraction, and large scale mining operations. The works are intended to challenge common cultural relationships with the land through the construction of imaginary narratives that reveal potential consequences of current actions within the broader society. The dreamlike quality of the images and objects elicit a sense of suspended disbelief that challenges our perceptions of reality and brings attention to the fleeting nature of existence.

The current paintings I am making are derived from multiple site visits to areas of northwestern New Mexico that were historically used for uranium mining, and are currently being developed for the oil and gas industry. The paintings appropriate motifs common in western landscape painting to generate a dialogue between how our society commonly consumes landscapes, and the reality of the condition they are in. These surreal scenes shift between optimistic and solemn depending on the color palettes employed. All of these works feature a disaster, the origin of which is unknown to the viewer. This creates an unsettling feeling that is lacking context, adding a mysterious quality to the work. The viewer is left with questions, rather than given an answer. The exclusion of human beings from the scenes leaves the viewer to experience the aftermath of an unknown event in solitary contemplation.

11 Shedding Youth: Analyzing Social Traditions Relating to Adolescent Development

AMY YOUNG

DEPARTMENT: ART AND ART HISTORY
COLLEGE: LIBERAL ARTS

Across cultures, adolescent development has a powerful connection with social events, life lessons, and economic pressures. This pivotal moment in an individual's growth is often publicly celebrated and privately toiled over. My current work explores 'coming-of-age' traditions through the medium of fibers. Change and transition are represented in my work through the use of color gradations and contrasting materials. My color palette and visual aesthetic incorporates fluorescent tones as a reference to 1980's American films (as the

decade popularized the coming-of-age genre) and to youthfulness which is associated with bright hues. My current path of research is focused towards the unspoken lesson of carefully choosing relationships to reinforce personal growth.

Research, Scholarship, and Entrepreneurship

12 An Integrated Uncertainty-Based Bridge Inspection Decision Framework

ABDELRAHMAN ABDALLAH

DEPARTMENT: CIVIL AND ENVIRONMENTAL ENGR
COLLEGE: WALTER SCOTT, JR. COLLEGE OF ENGINEERING

The limitations of the standard two-year interval for the visual inspection of bridges required by the U.S. National Bridge Inspection Standards have been well documented, and alternative approaches to bridge inspection planning have been presented in recent literature. This framework explores a different strategy for determining the interval between inspections and the type of inspection technique to use for bridges. The foundational premise of the proposed approach is that bridge inspections are conducted to increase knowledge about the bridges current condition, and therefore, are only required when uncertainty about the knowledge of the bridge condition is too high. An example case of a reinforced concrete bridge deck was used to demonstrate how this approach would work. The method utilized deterioration models for predicting corrosion and crack initiation time, considering the uncertainty in the models parameters. Bridge inspections were used to update the current condition information and model parameters through Bayesian updating. As this research presents a new idea for inspection planning, not all the data or models necessary to fully develop and validate the approach currently exist. Nonetheless, the method was applied to a simulated example which demonstrates how the timing and means of bridge inspection can be tailored to provide the required data about individual bridges needed for effective bridge management decision making

13 Exploring Phytoremediation Potential of Hemp (Cannabis sativa)

SUSAN ABERNATHY

DEPARTMENT: BIOLOGY
COLLEGE: NATURAL SCIENCES

Hemp (Cannabis sativa) is a plant in the Cannabaceae family that has many uses. The shoot can be used for making materials, medicine and has nutritional value. Phytoremediation is a process of using plants for cleaning up high levels of elements in the environment that are spilled, dumped, leached or accumulated. Plants can remediate pollutants through uptake into their tissue or containment in their root zone. C. sativa may be able to phytoremediate different toxins while the biomass can be harvested for other uses. I tested C. sativa for its capacity for arsenic phytoremediation. C. sativa was grown in different conditions of arsenic acid (Na2HAsO4) and photosynthetic measurements were collected to investigate the health of the plants. Biomass was also quantified as a measure of As tolerance, and elemental analysis performed to determine the levels of As in different organs. The plants were extremely tolerant to As. Accumulation of As was found mostly in the roots, while the shoots

remained photosynthetically healthy and the levels of the valuable hemp product CBD was unaffected. Thus, C. sativa may be grown on marginal, As polluted soil, while still producing valuable hemp products. Further studies using other toxic elements, and follow-up field studies are planned to better understand C. sativas breadth of potential for use in phytoremediation.

14 Identification of Soybean Aphid Amino Acid Transporters at Aphid-Bunchera Interface

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DEPARTMENT: BIOAGRICULTURAL SCI & PEST MGT
COLLEGE: AGRICULTURAL SCIENCES

Soybean aphid (Aphis glycines) is one of the most important hemipteran pests of soybean and the current consensus management include cultural, chemical and genetic controls which aphids have combated overtime suggesting that unique management strategies are necessary to control them. Our study targets the endo-symbiotic relationship between soybean aphid and the bacteria (Buchnera aphidicola) it harbors in a specialized aphid bacteriocyte cells. Soybean aphid compensates for essential amino acids, that are usually low in the phloem, from their endosymbionts as these bacteria converts non-essential amino acid supplied by aphids to essential amino acids. Studies on pea aphid have shown that a glutamine transporter ApGLTN1 transports glutamine from aphid hemolymph into bacteriocyte cell and this transport is feedback inhibited by competitive arginine. Our preliminary study using arginine supplemented artificial diet in soybean aphid have shown that arginine inhibits glutamine transport. As soybean aphid shares multiple sequence orthologues with pea aphid, it is plausible that a similar transport mechanism exists in the soybean aphid. We have identified two putative amino acid transporters, AG6005571-RA and AG6005572-RA, that are differentially expressed in the bacteriocyte cells, based on the RNA sequencing analysis of 2121 differentially upregulated genes. The functions of these transporters in-vivo however are yet to be characterized.

15 Grow With the Flow: Blood Flow Regulates Cardiac Valve Development

NEHA AHUJA

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

The incidence of congenital heart disease (CHD) is estimated to be 1% of all human births. CHD of the heart valves occurs in over 50% of CHD cases. Often, the only treatment option available is valve replacement surgery, which carries an extremely high mortality rateestimated to be 28% for neonates. Mechanisms that control valve formation are of significant clinical interest. Recent work has shown that valve cells read and respond to cues exerted by blood flow. One such cue is afterload, defined as the resistance the ventricle must overcome in order to pump blood through the body. In adults, increases in afterload often trigger pathology. However, the influence of afterload during development is relatively uninvestigated. We present a zebrafish model in which afterload has been increased using

vasopressin, a vasoconstrictive drug. We first show that application of vasopressin reliably produces an increase in afterload without directly acting on cardiac tissue in zebrafish embryos. We show that increased afterload alters the development of the cardiac chambers and causes remodeling of the cardiomyocytes. Consistent with pathology seen in patients with clinically high afterload, we see defects in both form and function of the valve leaflets. Our results suggest that this valve defect is due to changes in atrioventricular myocyte signaling. Our results identify afterload as a regulator of atrioventricular myocyte development and identifies key signaling components in the afterload pathway. Our work can be leveraged to further elucidate the mechanisms that regulate valve development and thereby increase our understanding of CHD.

16 Existential Concerns and Risky Behavior in College Students

MARISSA ALLIEGRO

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COLLEGE: NATURAL SCIENCES

Most, if not all of college students experience anxiety. Their anxiety concerns may range anywhere from test anxiety, to choosing a major, to anxiety about their entire career path as a whole. Rarely do we assess for existential anxiety concerns in this population. Existential anxiety is concerned with existence as a whole (i.e. death anxiety, meaninglessness and purpose, social isolation). Students may engage in risky externalizing behaviors (unprotected sex, binge drinking, substance use) in order to alleviate some of their existential concerns. By administering validated measures, this study will look at the relationship between existential concerns and the prevalence of certain externalizing and internalizing behaviors in college students. This dissertation project has been approved for IRB and is collecting data.

17 Screening for Fungal Infections Using LC/MS

CHRIS ALLISON

DEPARTMENT: CHEMISTRY
COLLEGE: NATURAL SCIENCES

Fungal infections are a significant problem among individuals using medical devices, those with pulmonary conditions, and patients that are otherwise immunocompromised. Current screening methods to detect fungal infections display limited accuracy, and while more accurate results can be obtained through cultures, these take up to several weeks to provide results. Given that infected patients usually have suppressed immune systems, shortcomings in diagnostic methods make accurate, straightforward alternatives desirable. Chitin and chitosan are polysaccharides that confer rigidity to fungis cell walls. Given their ubiquity in pathogenic fungal species and absence from endogenous sources, these compounds hold the potential to serve as biomarkers for fungal infections. High performance liquid chromatography can be used in tandem with mass spectrometry to detect the degradation products of these polymers, which include glucosamine, N-acetylglucosamine and oligomers comprised of both. This poster discusses degradation methods for chitin and chitosan and the identification of subsequent products in the context of creating unique chemical fingerprints that can be related back to the polymers presence. Detecting these products by LC/MS potentially facilitates its use to nonspecifically screen for and to presymptomatically detect

fungal infections.

18 Role of FLNC in Heart Contractility and Retrograde Flow

AREEJ ALI ALSHAHRANI

DEPARTMENT: BIOLOGY
COLLEGE: NATURAL SCIENCES

Dilated Cardiomyopathy is the most common type of cardiomyopathy disease that causes heart muscle defects. In the United States, it is estimated that 750,000 people have dilated cardiomyopathy. DCM is characterized by a dilated left ventricular chamber and systolic dysfunction that results in congestive heart failure. Although the cause of DCM is not fully understood, evidence supports the hypothesis that costameric proteins contribute to muscle dysfunction linked to cardiomyopathy. In addition, we hypothesize that costamere structure indirectly modulates normal retrograde flow which in turn impacts atrioventricular valve development. Here, we use 5 novel nonsense alleles in zebrafish FLNCa and FLNCb (two paralogous genes mainly expressed in heart and skeletal muscle) to disrupt the components of the costamere. We evaluate how retrograde flow impacts heart valve function in these mutant backgrounds. First, we utilized high-speed videos of live hearts of homozygous mutant FLNCa and FLNCb embryos. From these videos we conclude that costamere disruption results in a significant decrease in stroke volume and cardiac output with normal blood flow patterns in . Interestingly, immunohistochemistry with ALCM antibody showed that flncb exon 35(-/-) exhibited defects in valve development which appeared as decreased the number of expressed ALCM endocardial cells and the area of these cells. Whereas in flncb exon 14 (-/-) there was defects in the number of endocardial cells. These results suggest that disruption of costamere components affect biomechanical properties of the heart.

19 SMYD3 Inhibitor as a Novel Therapeutic for Cancer

ILHAM ALSHIRAIHI

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

We have characterized a lysine methyltransferase, SMYD3, that is required for proliferation of most breast, colorectal, and hepatocellular carcinomas. When aberrantly expressed, the SMYD3 lysine methyltransferase upregulates over 80 genes including oncogenes involved in cell cycle regulation and cell proliferation. We have shown that elimination of SMYD3 restores normal expression patterns of these genes and halts aberrant cell proliferation. Thus, we have developed and begun testing inhibitors that target the catalytic substrate site of SMYD3 and confirmed the ability of these inhibitors to reduce or eliminate its methyltransferase activity. Using cell lines, we have confirmed the ability of one of these inhibitors to restore normal rates of cell proliferation in cells over-expressing SMYD3. We further plan to characterize the downstream impacts of SMYD3 catalytic inhibition to better understand its role in tumorigenesis and to characterize potential adverse effects associated with the elimination of SMYD3 activity. Ultimately, we hope to optimize SMYD3 inhibitors as potential therapeutics in the clinical management of cancer.

20 Youth CAN:
Cultivating Community Change Through Youth-Driven Health Initiatives

ANA ALTARES

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Purpose:

The Youth CAN (Change.Activity.Nutrition.) project engages and empowers adolescents to become agents of change for health promotion within their community. Youth represent a population that are often unheard. However, empowered youth bring a fresh and novel approach to existing policies that may foster sociopolitical change in their community.

Description:

Youth-led participatory action research (YPAR) is an innovative approach to youth-driven community assessment and project development. Youth take on an active researcher role to assess their community, identify facilitators and barriers to healthy eating and physical activity, and design and implement a project to promote health.

As part of Youth CAN, high school students from the Globeville-Elyria-Swansea neighborhood in Denver explored different applications of YPAR to share their lived experiences. Students selected from three mediums; Photovoice (photography), Spoken Word (poetry), and Street Art (graffiti-style artwork). Student projects will be compiled and used to facilitate discussions between youth and community stakeholders using the World Café method to generate ideas for potential community-based projects.

Outcomes:

Youth CAN will engage Denver youth to identify an issue; connect with community stakeholders; and propose, develop and implement a community-based project to promote healthy eating and active living. Empowered youth will also benefit from increased self-efficacy, knowledge and awareness of sociopolitical and healthy lifestyle factors.

Future Directions:

Youth empowerment is fundamental in building connections within the community and yielding physical projects to promote health. Research efforts should shift towards utilizing multiple applications of YPAR in order to attract a broader youth audience and engage community agencies.

21 Studying Luteinizing Hormone Receptor Expression Levels Affect

DUAA ALTHUMAIRY

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Luteinizing hormone receptors (LHR) are G protein-coupled receptors (GPCR) found in female and male reproductive organs where they play a critical role in ovulation and sperm maturation, respectively. The role of oligomerization in LHR function is of considerable interest and not well understood. In this project, we have used polarized homo-transfer fluorescence resonance energy transfer (homo-transfer ¬FRET) to evaluate the aggregation state of LHRs that stably expressing in CHO cell line with different range of receptors number per cell. At lower receptor numbers per cell, LHR appeared in membranes as receptor dimers or small oligomers. At higher receptor numbers per cell, LHR appeared in significantly larger clusters. We also measured basal cAMP levels in these cell lines as well as intracellular cAMP levels in response to hCG using the cAMP sensor, ICUE3, which was transiently expressed in these CHO cell lines. Cells expressing small LHR clusters also had low basal cAMP activity and a robust response to hCG. When LHR were expressed at higher numbers of LHR per cells and LHR were present in larger oligomers in the absence of hormone, basal levels of cAMP per cell were high and cells were comparatively unresponsive to hCG. These results suggest that there is a strong relationship between the number of LH receptors expressed per cell, the size of LHR clusters and LHR receptor responsiveness to hCG. These results provide to a better understanding of the relationship between LHR clustering and signaling as well as LHR-related diseases that involve mis-oligomerization events.

22 Incorporating Halogen Bonds in Eukaryotic Systems

DEREK ANDERSON

DEPARTMENT: BIOCHEMISTRY & MOLECULAR BIOL
COLLEGE: NATURAL SCIENCES

Noncovalent interactions are crucial to the structure and interactions of biomolecules such as proteins, and can be manipulated for drug design, determination of dynamics within the cell, and folding pathways. Halogen bonds (XBs) represent a recently rediscovered category of these noncovalent interactions, showing high directionality, specificity, and variable polarizability. Our lab has pioneered engineering XBs into proteins such as T4-Lysozyme and the Gal11p KIX domain thereby significantly increasing thermodynamic stability of biologically relevant proteins in solution. However, there is no known literature showing the incorporation of XBs in eukaryotic organisms and their altered genotypic and phenotypic profiles. With my promising in vitro results through calorimetry and circular dichromism, the halogenated KIX domain will be introduced into S. cerevisiae and its downstream transcriptional shifts in the genome determined. Such findings will open avenues to pursue specific binding interactions that are altered to help us better understand the importance of KIXs partially unfolded structure in vivo and its stabilized binding preferences. More broadly, shifting dynamics of this natively unfolded protein in yeast could reveal novel interactions including nuclear granule inclusion or transcription factor specificity.

23 Exercise Hyperemia and Oxygen Extraction During Elevated Resting Flow States

JAKE ANNA

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

Changes in blood flow during exercise are intimately coupled to skeletal muscle metabolic demand. Feedback from pathways involved in oxygen delivery contribute to the regulation of these responses, but recent evidence suggests the presence of a feedforward mechanism capable of augmenting blood flow upon the initiation of exercise. We hypothesized that the change in blood flow following the initiation of exercise is preserved independent of the level of baseline oxygen delivery, and reciprocal reductions in oxygen extraction would occur during elevations in resting blood flow. We quantified forearm blood flow (FBF; Doppler ultrasound) and oxygen extraction (O2 EXT; based on venous O2 content) at rest and during 5 minutes of handgrip exercise under control conditions and during infusion of a vasodilator to artificially increase oxygen delivery. We elevated resting blood flow to levels that matched (MAT), and exceeded (EXC) steady-state hyperemia during control (CON) exercise trials. Despite significant elevations in resting flow, changes in FBF during MAT (FBF; 84 ± 3 ml · min-1) and EXC (FBF; 112 ± 14 ml · min-1) remained unaffected compared to CON (FBF; 97 ± 14 ml · min-1; all P = NS). O2 EXT decreased during steady-state exercise in the MAT (44 ± 10 %) and EXC (34 ± 9 %) conditions compared to CON (65 ± 4 %; P < 0.05). We conclude that changes in exercise hyperemia and oxygen extraction remain intact when oxygen delivery is artificially elevated prior to exercise.

24 Effects of Two Polyoxovanadate Complexes on Mycobacteria Smegmatis Growth

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Polyoxometalates (POV) have been found to be inhibitor of some isolated enzymes, however, little information is available on the effects of POV on the intact bacterial systems. In this study, we measured the inhibitory activity of two pseudospherical POV, K(NH4)4[H6VIV2VV12O38(PO4)]-11H2O (V14) and (Me4N)6[VIV8VV7O36(Cl)] (V15), on the growth of Mycobacterium smegmatis, with IC50 values of 17±0.00740 and 1.9±0.000900uM, respectively. These values are 10-100 fold lower than those reported for metavanadate (190uM) and closer to decavanadate value, [HnV10O28[(6-n)(V10) of 3.7uM. Spectroscopic studies were performed to evaluate the species formed in solutions of V14 and V15 during the bacterial growth. 51V NMR and EPR spectroscopy showed that V14 undergo some hydrolysis and a more extensive oxidation of vanadium(IV), than V15. Speciation were characterized in the Middlebrook 7H9 media and supernatant, both which contains citrate and phosphate. 51V NMR spectra of V14 showing signals of simple oxometalates and vanadium-complexes formed with media components, include citratevanadate complex (-547 ppm) and phosphate-vanadate complex (-564 ppm). The V15 spectra showed lower intensity monovanadate signals, indicating a higher stability of the V15 structure. The combined spectroscopic and growth data show that there is some effect of the structure on the growth inhibition, favoring the V15 structure as a 2-fold (compared to V10) or a 10-fold (compared to V14) more potent inhibitor of growth. These differences can be attributed to the subtle difference in the polyoxo surface charge or shape and may link to the ability of some vanadium compounds to impact

membrane proteins and cause cell signaling.

25 Coinage-Metal Thiolate Supramolecular Assemblies

JAMES ARMSTRONG

DEPARTMENT: CHEMISTRY
COLLEGE: NATURAL SCIENCES

Synthetic precursors for nanoclusters and nanostructures determine product. Coinage metal-thiolate oligomers are common precursors to nanoclusters. These metal-thiolates also assemble into supramolecular hydrogels. The introduction of a coordinating antisolvent to the synthesis of metal-thiolate hydrogels dramatically changes the hydrogel. This results in as amorphous supramolecular assembly of short metal-thiolate oligomers. The resultant amorphous metal-thiolate assemblies show unique rheological properties comparative to structured systems. Current research is investigating the usage of the supramolecular assemblies as a precursor to nanomaterials. Initial studies have shown the ability of the assembly to be reduced post-synthetically into nanoclusters and nanoparticles. In situ reduction leads to a supramolecular assembly infused with nanoparticles. We anticipate this as a new method for templated nanoparticle synthesis, as well as nanoparticle assemblies. Future research will focus on the usage of this material for potentially interesting properties in antimicrobial work.

26 How Sustainable is a Universal Definition of Sustainability?

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Since the Industrial Revolution, humankind passed from the Holocene to the Anthropocene, an epoch in which human action is the driver of global environmental change. Since the 1980s, the buzzword sustainability has been used globally to acknowledge efforts to combat climate change. Along with sustainability, the notion of sustainable development arose as a counter to progress as integral to development and grew side-by-side with modernization theory. There is no universal definition of sustainability, but the 1987 Brundtland Report definition is widely used. This definition is vague and allows for ambiguity in the interpretation/implementation of sustainability. How sustainable is an ambiguous definition? Using a political ecology and social ecological systems framework, this research explores the history of the terms sustainability and sustainable development, compares varying definitions, interpretations, and potential impacts of varying definitions. Findings suggest sustainability is context-driven and no universal definition can be created because the definition of sustainability depends on the goals of the definer. Based on this idea, a comprehensive list of five basic key components of sustainability are outlined based on a literature review. This research aims to strengthen the idea of no one-size-fits all solution to creating a sustainable world, and hopes to inspire a shift in the way we perceive and interact with nature to protect and ensure our common future. Sustainability is not about preserving sections of the natural world and calling it wilderness. Sustainability is about re-establishing a symbiotic relationship with nature and changing the ideology that humans and the environment are separate.

27 Examining How Mixed Reality Mobile Apps Enhance Sense of Place

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Growing concerns regarding declining community and civic engagement as a result of increased access to new technologies calls for research seeking to understand ways that purposeful design could have a reverse impact. Location-aware mixed reality mobile apps may be one such technology that, with purposeful design, have the potential to engage users in their communities. Examining these technologies in the context of sense of place theory will provide insights to how these technologies may impact user engagement in their community. Sense of place theory posits that individuals experiences in a place contribute to their sense of what that place is like and increase their sense of place. An increased sense of place increases a persons likelihood of becoming engaged in that place and of taking an active role in preserving or improving that place. This exploratory study considers the potential of location-aware mixed reality mobile apps to positively impact users sense of place, making them more likely to engage in and participate in their community. Twelve users (four for each of the three mixed reality apps under consideration) were interviewed about their experience of place while using the app. Interview transcripts were coded and analyzed for sense of place topics.

28 Can Wildfires Influence Ice Formation in Clouds?

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Ice nucleating particle (INP) measurements are necessary in order to better understand their influence on clouds and precipitation processes, but there are limited measurements from wildfires. Previous measurements found modest enhancements of INP concentrations in ground-based studies of wildfire smoke, but no prior measurements have been reported of in-situ INP concentrations in elevated, free-tropospheric smoke plumes. In July-August 2018, the Western Wildfire Experiment for Cloud Chemistry, Aerosol Absorption, and Nitrogen (WE-CAN) sampled aerosol particle and gas phase properties in several Western U.S. smoke plumes and out-of-plume background air from the NSF/NCAR C-130 based out of Boise, Idaho. The INP results are from the online CSU Continuous Flow Diffusion Chamber (CFDC) and for aerosol filters that were exposed during the flight and later analyzed offline using the CSU Ice Spectrometer (IS). Both the CFDC and IS measurements show a general enhancement in plumes over background INP concentrations. However, there are some variances among fires and in the level of enhancement. To account for plume dilution, INP data are presented as normalized excess mixing ratios (with respect to CO) as functions of plume distance. Additional treatments were done on select filter liquid suspensions, including 95 °C heating to denature biological INPs and digestion with hydrogen peroxide to remove organic carbon present. These temperature spectra, compared to the untreated sample, show a predominant organic INP population in many sampled fires, while only some have a large

biological influence.

29 Bioelectrochemical Characterization of S. cerevisiae for Cathodic Electrofermentation

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In electrofermentation (e-ferm), electrodes deliver electrons directly to microorganisms to alter metabolic processes, potentially increasing production of industrially valuable metabolites. While some microorganisms are known have conductive pili or periplasmic cytochromes capable of direct electron transfer into the cell, others may require redox mediators to shuttle electrons. Saccharomyces cerevisiae has not yet been shown to have electroactive properties, and previous e-ferm studies have neglected to account for important redox conditions. Using cyclic voltammetry (CV), we have probed the electrochemical behavior of S. cerevisiae with a variety of redox mediators. This electrochemical analysis will help us to optimize the e-ferm process for maximum ethanol production.

Our initial CV experiments have provided unprecedented evidence that S. cerevisiae may be capable of direct electron uptake, making it a viable and industrially relevant organism for e-ferm. Future work will focus on optimizing e-ferm for ethanol production as well as investigating the effects of electrochemical conditions on the metabolome and proteome of S. cerevisiae to develop an understanding of the biochemical mechanisms involved.

30 Destination Recovery: Leveraging Tourism for Long-Term Economic Recover Post-Natural Disaster

KELSEY BAUN

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COLLEGE: BUSINESS

In the wake of climate change, potential for natural disasters is only increasing. When destinations such as Puerto Rico and The Bahamas are hit, they not only lose infrastructure and lives, but their main source of income tourism. Tourists are inherently risk-averse, and as the narrative of such disasters hit the media, destinations experience immense trip cancellations. Tourism is proven to be a quick way to inject money into economies; following natural disasters it is badly needed in order to help restore destinations. Here, we see a gleaming opportunity creating a niche sector in the tourism industry, by which tourism is a means of destination recovery.

Our tourism company, GeoVia, specializes in curating culturally immersive and purposeful vacation packages to destinations impacted by natural disasters leveraging tourism as a means to lift communities up. We differentiate ourselves by striking a balance between drawing tourists to desired destinations while acknowledging and supporting communities in need, playing a meaningful part in recovery. Our triple bottom line business provides responsible, ethical and memorable experiences for both givers (tourists) and receivers (local community).

To achieve this, we will create a portfolio of partnerships with local businesses with which

weve already established relationships who have displayed commitment to ethical tourism practices. We have also established a strong network of nonprofits and NGOs that are responding to the named community needs and have requested tourist support.

31 Deliberating Environmental Justice: News Analysis of Minnesotas Proposed Copper-Nickel Mines

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While the state of Minnesota debates the controversial risks and economic value of its first proposed copper-nickel mines, it has also committed to a transition from the use of fossil fuels to 100% clean energy sources by 2050. Though environmentally damaging, copper-nickel mining operations produce elements required of the clean energy transition to produce commodities such as solar panels and electric batteries. Studies show that news coverage of this controversy brings liberal conservationists at odds with both pro-mining conservatives and their marginalized Native American neighbors.

This proposed analysis of digital news coverage produced by journalists, governments, and corporate communicators will study the influence their various treatments may have on the states provision of an environmentally just transition for all its diverse stakeholders through the copper-nickel quagmire to meet its clean energy commitment. Up to 150 articles and news videos will be selected with respect to published qualitative critical discourse analyses and coded in a hermeneutic process supported by an actor-network theory mindset. Themes from the data may emerge to trace associations between the actors through time to describe the conversation as it exists online. These findings will then inform the design of a digital database/resource for use in a deliberative forum in which participating communicators will meet to draft a statement of best ethical and professional practices that their industries may adopt to improve their coverage of Minnesotas proposed copper-nickel mines and help provide a democratic, environmentally and socially just transition to clean energy for all.

32 Environmental and Economic Analyses of Renewable Products from Cyanobacteria

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As the world faces the effects of climate change, research and development of alternative fuels and lower impact products becomes more important and time-sensitive. This project, funded by the Department of Energy and in collaboration with Arizona State University, considers a variety of processes that use cyanobacteria, a type of microalgae, to produce drop-in transportation fuels and/or algal oil for use in the oil-based chemical industry (associated with products including soaps, food, and cosmetics). Both products are potential substitutes for ones that currently have unfavorable environmental impact. The detrimental effects of fossil fuels on the earth are widely known, and biofuel offers a much lower impact

alternative to traditional diesel and gasoline. Similarly, algal oil would serve as a replacement for palm oil, which is the most widely consumed vegetable oil worldwide, and is generally produced irresponsibly, threatening rainforests and their ecosystems. An important aspect for developing alternative fuels and products is feasibility modeling, which allows for investigation of economic and environmental impact. This type of modeling work is based on a foundational mass and energy engineering model that is ultimately used to find a final minimum fuel (or other product) selling price, as well as for an accounting of environmental impact. The modeling work reviewed here simulates several scenarios for producing drop-in biofuel and pure algal oil in different quantities and via varying processes, giving a comprehensive overview of both financial opportunity and environmental impact.

33 Hearing and Seeing Emotion: A Magnetoencephalography Study

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Emotion is vital to communication as it instantaneously connects us through subtle changes in facial movements and vocal expressions, with perception occurring via the simultaneous integration of affective vocal and facial information. These expressions activate a constellation of brain areas known to be sensitive to emotional facial expressions, which are distinct from those devoted to prosody recognition. While much is known about the independent contributions of these channels to emotion perception, less research has focused on multimodal affect perception. The current study used magnetoencephalography (MEG) to quantify the neural underpinnings of this dynamic process. MEG is similar to electroencephalography, but it measures the minute magnetic fields emanating from the scalp. Videos of happy and angry faces saying the vowel a in a happy or angry tone were used to examine how vocal and facial information is combined in the brain. Subjects were instructed to indicate if the emotion they perceived was happy or not happy via button press. Responses were analyzed for reaction times and frequency of responses. Brain responses for the angry conditions were primarily lateralized to anterior areas of the right hemisphere, with angry faces and angry voices exhibiting greater activity than angry faces paired with a happy voice. Happy face stimuli exhibited bilateral activity in language related areas associated with prosocial behavior. These data may indicate that the multimodal perception of emotion is complex and represented via a constellation of cortical areas.

34 Assessing a Novel Therapeutic on Drug-Seeking Behavior in Mice

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Opioid drugs exert their rewarding properties by acting at the mu opioid receptor (MOR) and mice lacking the MOR fail to exhibit conditioned place preference (CPP), a well-established assay of drug seeking behavior. Despite the known roles for the MOR, the possibility of

targeting MORs to therapeutically interfere with opioid use has not been heavily explored. Here, we set out to test the hypothesis that inhibiting the expression of MORs will reduce the acquisition of drug-seeking behavior and lessen reinstatement of drug seeking after abstinence. To test this hypothesis, we first established CPP for morphine in mice. CPP is performed in a cage with two chambers that have different contextual cues and a removable divider between them. After determining that the mice to did not naturally have a preference for either side, mice received daily injections of either saline or morphine and were selectively placed in one side of the divided cage for 30 minutes. This went on for 10 days and then mice were placed in the cage with the divider removed. In general, mice spend about 20% more time in the morphine-paired environment following conditioning. Subsequent cohorts of mice will be injected with an antisense oligonucleotide (ASO) designed to decrease MOR expression or a control oligonucleotide. If the hypothesis is correct, ASO-injected mice will fail to acquire preference for the morphine-paired context. Our studies may indicate the utility in using ASO-mediated knock down of MORs as a potential therapeutic for opioid use disorder in people.

35 Defining TPC2's Role in Melanosome Homeostasis and Trafficking

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Melanosomes are lysosome related organelles in melanocytes that are responsible for melanin synthesis in the eyes, hair and skin. Enzymes directly involved in melanin synthesis are sensitive to luminal pH, which is regulated by various ion channels, Na+/H+ exchangers, and V-type ATPases at the melanosome membrane. We previously reported that Two Pore Channel Two (TPC2), a cation channel, localizes to melanosomes and plays a major role in maintaining their pH and size. Interestingly, the polymorphisms M484L and G734E are highly associated with the shift from brown to blonde hair. The M484L polymorphism is thought to directly influence the conformation of the TPC2 pore. TPC2 residue 734, on the other hand, resides in the cytosolic domain and it is unclear how it could regulate TPC2 function. Here, we explore whether TPC2 polymorphisms differentially regulate melanosome size, pH, and calcium conductivity utilizing fluorescent probes in live cell confocal fluorescence microscopy and find that the C terminal domain regulates TPC2 function. We hypothesize that the cytosolic C terminus of TPC2 interacts with another protein or complex that is responsible for the variations in melanosome size and pH that we have observed. We used BioID2 proximity labeling to identify proteins that interact with TPC2 in live melanocytes and performed functional assays to determine which candidates regulate pigmentation. We are testing their interactions with TPC2 and designing assays that will test whether they are involved in melanosome biogenesis, homeostasis, or melanosome transfer to keratinocytes.

36 Study of Bacterial Factors Activating Colorimetric Transitions in Polydiacetylene Nanofiber

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The bacterial infection is an enormous problem for human health and a major cause of death around the world. Rapid identification and monitoring of bacterial infection in the wound are not possible with conventional wound dressings. A conjugated polymer- polydiacetylene (PDA) - changes color from blue to red when bacteria are detected making it a potential material to be used in conventional wound dressing for detecting bacterial infection. As bacteria is a complex organism, it is necessary to understand how bacteria induces the color change in PDA for producing a prototype of smart wound dressing capable of identifying bacterial infection rapidly. Although conformational changes in the conjugated backbone of the PDA polymer have been reported, the factors in a bacterial culture responsible for the color change in PDA has not been intensively studied. Therefore, in this research, different factors in a bacterial culture will be investigated and the responsible factor for color change will be identified. This research will be helpful to understand how bacteria induce a color change in PDA that can pave the way to prepare smart wound dressing which can be useful for millions of wound patients to detect infection rapidly without expensive pathological tests.

37 HOMEChem: A Spatial Odyssey

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Globally, air pollution accounts for approximately 6.5 million deaths every year. A large fraction of these deaths can be attributed to indoor air quality, were people typically spend much of their time. Understanding the indoor dynamics that impact these aerosols is crucial in order to assess overall human exposure. This work aims to further characterize aerosol emissions from cooking, investigate the spatial and temporal gradients caused by the mechanisms of aerosol transport indoors, and determine the major loss mechanisms for particles indoors. In order to probe these different elements of indoor aerosol sources a variety of cooking experiments were conducted during the House Observations of Microbial and Environmental Chemistry (HOMEChem) campaign. The emissions from these experiments were measured using size resolved optical instruments at four points throughout the house simultaneously. During background periods, aerosol concentration indoors was 50 ± 10% lower than the observed outdoor concentration, however, during cooking events the concentration indoors was measured to be up to 180 ± 20% higher than outdoors. Most of the particles emitted during these events were less than 100 nm in diameter. After emission, the particles took approximately 0.7 ± 0.1 minutes to reach the living room, with a 50% decrease in concentration, and they took 2.4 ± 0.9 minutes to reach the bedroom, with an 80% reduction in concentration. Deposition was found to be the dominate loss process in the rooms with loss rates ranging from 0.25 to 1.25 h-1 and deposition velocities ranging from 0.1 to 0.6 m/h.

38 Shear Wave Splitting Across the Mackenzie Mountains, Canada

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The Mackenzie Mountains (MM) of northwest Canada are an actively uplifting, seismogenic salient of the northern Canadian Cordillera that lie about 800 km NE of the plate boundary. We present new shear wave splitting measurements for the region featuring results from the recent NSF-funded Mackenzie Mountain Earthscope Project seismometer deployment, a linear array which transects the MM and the Northern Canadian Cordillera to characterize upper mantle anisotropy in this region. These measurements can provide constraints on fossilized strain in the lithosphere and/or the directionality and degree of lateral asthenospheric flow. Our splitting measurements used the newly developed Whittle Likelihood Estimation Method (Corbalan et al., in review). This is a robust method that better characterizes the effects of pre-event noise on parameter uncertainties. We note a gradual rotation in anisotropy across the Canadian Cordillera, with stations nearest to the craton yielding fast axis orientations that are subparallel to North America absolute plate motion of (~NE-SW). Moving SW from craton, across the MM, and towards the plate boundary, fast-axis orientations gradually rotate to become subparallel to the strike of the Denali and Tintina faults (NW-SE). This, along with recent body wave tomography results, suggests that these large offset fault zones are associated with narrow lithosphere-scale shear zones. Further to the SW, shear wave splitting is dominated by the effects of subduction under the Gulf of Alaska, which divert asthenosphere flow about the slab. (Hanna and Long, 2012; Wang and Becker, 2019).

39 Spatiotemporal Variations of Liquid Water Content in a Continental Snowpack

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Seasonal snow provides water resources for an estimated 1.2 billion people, yet there are no current satellite remote sensing methods capable of measuring snow water equivalent (SWE) on global scales. The planned 2021 launch of the NASA-ISRO NISAR satellite mission includes a L-band (1-2 GHz) Synthetic Aperture Radar (SAR) instrument, a promising approach for measuring SWE at high spatial resolution in complex topography. However, key methodological details remain unresolved, particularly in wet snow conditions. We use 1 GHz ground-penetrating radar (GPR) to study the spatiotemporal variability and influence of terrain and vegetation on liquid water content (LWC) in a continental seasonal snowpack. We collected weekly to biweekly GPR surveys from April to June 2019 at Cameron Pass, CO, a high-elevation site (>3500 m). Transects (~1 km distance) contained 0-70% canopy cover on south, flat, and north facing aspects and were surveyed three times per survey date with ~2 hours separating each survey. GPS locations of GPR traces were post-processed (0.5-2 m accuracy) to ensure high quality comparisons between repeated surveys. We derive radar velocities from GPR travel times and coincident snow depth measurements from snow probes and repeat terrestrial LiDAR scans. Radar velocities are used to invert for LWC, and subsequently compared to snow pit-observed LWC observations. We evaluate the impact of the observed spatial heterogeneity of LWC along our study transects in the context of the

upcoming NISAR satellite mission.

40 Clonable Metal 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 fluorescence microscopy is inherently hindered by the diffraction limit of light, electron microscopy unveils details of cellular ultrastructure with atomic level resolution. The primary barrier preventing biological electron microscopy from overtaking fluorescence microscopy as the main imaging technique is creating target specific contrast. While methods have been developed to generate more specific contrast agents, none have achieved the specificity of an encodable tag. Our lab initiated the development of encodable contrast agents for electron microscopy by isolating 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 tag in a proof of concept study that involved tracking filamenting protein FtsZ, our model system, 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-fused FtsZ in vivo. Ongoing work not only includes collaborating with experts in the field of 3D biological electron microscopy to reveal punctate nanoparticles decorating filaments, but also expanding our clonable nanoparticle toolbox through the discovery of other metal reducing enzymes.

41 Synaptotagmin: If It's a Switch, How do We Flip It?

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Proper nervous system function relies on efficient communication between neurons via synaptic transmission. The Ca2+-binding protein synaptotagmin is critical for this synaptic transmission. Synaptotagmin has been shown to act as a Ca2+-dependent switch that coordinates the synchronous release of neurotransmitter at the synapse. There are several hypotheses for the mechanism underlying this switching. One hypothesis is that Ca2+ changes the electrostatic charge of synaptotagmin and allows it to interact with membranes. This electrostatic switching activity has never been investigated independent of Ca2+ binding. Here we use single point mutations to alter the electrostatic charge of synaptotagmin to determine if synaptotagmin can act as an electrostatic switch in the absence of Ca2+ binding. This sheds valuable light on the mechanistic underpinnings of the function of this critical

protein.

42 Towards the Total Synthesis of Versiquinazoline B

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In the constant battle against cancer, treatments have increasingly become more selective. Cancer cells overexpress a wide range of cellular machinery to help them grow and divide rapidly. Targeted drug therapy takes advantage of these overexpressed proteins and finds drugs to inhibit them. Thioredoxin reductase (TrxR), an enzyme involved in cell proliferation, has been found to be overexpressed in aggressive cancers such as breast, thyroid, and prostate. Inhibition of this enzyme leads to apoptosis, making it a desirable candidate for drug development. Versiquinazoline B (VQB) is a natural product isolated from Aspergillus versicolor LZD-14-1 in very low amounts. When analyzed for inhibitory effects against TrxR, an IC50 value of 12±2 M was determined. Overall, this IC50 value is relatively high, making it a poor drug candidate alone. It does, however, open the door for the development analogs. These analogs could be used to probe the activity of TrxR and create a highly selective and potent drug. Combined with the low bioavailability of this molecule and desirable biological activity, VQB is an excellent candidate for total synthesis. Starting with a retrosynthetic analysis of the molecule, key intermediates were identified for synthesis. A forward route was then proposed to build the molecule from commercially available starting materials. Currently, this project is in the early stages of the total synthesis, having faced several interesting synthetic barriers. With an established, high yielding synthetic route, Versiquinazoline B could be made in appreciable amounts and allow access to numerous analogs for selective drug development.

43 Genetic Parameter Estimates for Efficiency and Pulmonary Arterial Pressure

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Feed intake data was collected on 533 Black Angus steers segregated over a total of a five-year test period. With each year representing a different group of animals with the average yearly sample size being 110 observations. Steers entered a feed intake test, data was then used to estimate the phenotypic and genetic parameters related to feed efficiency traits and pulmonary arterial pressure (PAP). Steers were segregated into pens upon arrival and feed efficiency traits were measured on an individual basis with the use of a Growsafe monitoring system. Test length varied per year with an average test length of 67 ± 9.2 d. Average daily gain (ADG) was more heritable (0.35 ± 0.1) than average dry matter intake (ADMI; 0.16 ± 0.09). A moderate genetic correlation (0.40 ± 0.25) between PAP and ADMI was calculated. Genetic correlations between PAP and ADG were less strong (0.04 ± 0.18).

44 The More the Merrier?: The Impact of Two Biocontrol Agents

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Russian knapweed (Acroptilon repens) is a non-native perennial species in the western United States that causes environmental and economic harm by forming clonal patches through asexual growth, thereby out-competing native plants. Additionally, Russian knapweed can reproduce sexually and spread to distant areas through seed dispersal. To manage this invasive plant, two host-specific biological control agents have been approved for use in the US: the gall midge, Jaapiella ivannikovi (Diptera: Cecidomyiidae), and the gall wasp, Aulacidea acroptilonica (Hymenoptera: Cynipidae). These two insects may offer a cost effective and long-term solution to controlling this invasive plant since chemical herbicides are often not an environmentally or economically favorable management option. We conducted a field experiment over the summer of 2019 that examined (1) how the midge and the wasp, when acting separately and together, impact Russian knapweed growth and (2) whether the presence of one insect could facilitate the establishment of the other insect. These questions were addressed using a 2x2 factorial design with wasp and midge presence and absence at 16 field sites throughout Colorado. Each site consisted of 21 1m2 plots from which data was collected regarding the number of galls formed by midges and wasps, and plant morphology characteristics. Both wasps and midges were able to establish at multiple sites. The results of this study could have pragmatic significance for land managers and biological control practitioners in limiting the spread of Russian knapweed while also contributing to a deeper understanding of how species interactions between herbivores shape ecological communities.

45 Addressing Discovery Bias in Landscape Archaeology

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Archaeologists have long used the distribution of sites over landscapes to infer how humans have interacted with their environments through time. While this research has contributed many valuable insights into ancient lifeways and practices, archaeologists have struggled to address discovery and visibility bias in these datasets. Discovery of archaeological sites is often an imperfect practice, and is dependent on complex factors like elevation, vegetation, and erosion. Given these difficulties, how can archaeologists determine if site distributions are the result of human behavior or visibility conditions which allow certain sites to be more easily discovered? Using a case study from the Medicine Bow Mountains of Northern Colorado, my research proposes a new methodology to estimate the role of visibility in landscape-level archaeological datasets. Through application of ecological niche modeling techniques adapted from ecology, it is possible to analyze archaeological datasets to evaluate the relative contribution of visibility in predicting site distributions. Critically, this method will allow archaeologists to estimate the influence of visibility in spatial datasets and to better understand the effectiveness of conventional archaeological survey.

46 Accuracy of Carbon-Ion Cancer Radiotherapy to Induce Double-Stranded DNA Damage

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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 leaving the normal cells relatively unharmed. However, the precise range in which it distributes dosages that significantly induce double-stranded DNA breaks causing cell death surrounding its Bragg peak remains enigmatic. We have developed a technique utilizing -H2AX allowing us to examine DNA double-stranded breaks throughout the full beam length in a single system to address carbon-ion nuclear fragmentation, as well as, at three different time points to address cellular capability for DNA repair at different beam depths.
Prior cell survival results indicated the carbon-ion beams biological Bragg peak depth was at 14.0 cm for the monoenergetic beam and from 8.0-14.0 cm for the SOBP technique. Our observed track structures support this finding as we observed more tracks within this range. Foci were still present throughout these areas 24 hrs post irradiation, suggesting this damage to be severe. Tracks were also found past the Bragg peak, possibly indicating DNA damage potential of nuclear fragmentation.
As of now carbon-ion treatment facilities are only in developmental proposal in the USA. Therefore, portraying the precision of the carbon-ion beam will help push the decision to move forward on building these facilities. Furthermore, defining the DNA damage potential surrounding the carbon-ion Bragg peak will aid medical professionals to more accurately target tumor tissues to spare unwanted cellular damage to the surrounding normal healthy tissue.

47 Puff, Puff, Policy? Environmental Implications of Cannabis Legalization in Colorado

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Forgotten pizza orders, big high-deas, bloodshot eyes were all familiar with these quintessential side-effects of cannabis usage. But with Peter Toshs reggae, earworm hit Legalize It fading slowly from our brains following the state of Colorados implementation of his chorus, one might start to ponder what other effects are associated with the controversial plant. Its easy to forget that cannabis is, at its root, an agricultural product, despite its status as a recreational and medicinal commodity. As a result, some of the social, political, and environmental issues that have grown out of its legalization have fallen by the wayside. Using a mixed-method, qualitative approach, I plan to continue to capture and highlight the voices of stakeholders from all sides of this issue in order to get a full picture of whats going on at each level. By examining these social-ecological systems that exist around and within this policy change, I believe its possible to create sustainable action plans that meet the needs of our local society, environment, and law in other words: reduce stigma, mitigate environmental damage associated with legal/illegal growing, and construct clearer growing and selling

boundaries with incentives in order to avoid black market transactions to ensure better long-health of consumers. Cannabis legalization is a hot, divisive topic that could carry regional, national, and global implications if not properly researched and from every angle possible.

48 Systemic Iron Chelation Reduces Cartilage Lesions Characteristic of Osteoarthritis

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Iron is required for several biological processes, including oxygen transport, DNA synthesis, and ATP production. While crucial for life, iron can also directly promote tissue damage by participating in redox reactions that generate deleterious reactive oxygen species and free radicals. Despite this, there are no direct iron excretion mechanisms present in mammals beyond normal turnover of skin and gastrointestinal epithelial cells. As such, progressive iron accumulation within tissues inevitably occurs over time. Cellular iron accumulation has been implicated in several chronic diseases, including atherosclerosis, neurodegenerative disorders, and various cancers. While the role of excess iron has been characterized in the aforementioned conditions, its involvement in age-related/primary osteoarthritis (OA) remains unexplored. OA is the most prevalent arthropathy worldwide and is characterized by the progressive loss of cartilage within joints, causing pain, joint stiffness, and decreased mobility of affected individuals. Unfortunately, the mechanisms driving disease pathogenesis are poorly understood and there are currently no treatments available to restore degraded cartilage. We hypothesize that age-related iron accumulation in joint tissues may contribute to the development of primary OA. Here, we demonstrate that systemic iron reductionachieved by administration of an iron chelator, deferoxamine (DFO)reduces the development of OA cartilage lesions in an animal model. Overhead enclosure monitoring revealed that movement of control animals declined significantly by study termination, while animals treated with DFO were able to maintain mobility throughout the study. Collectively, our results indicate that decreasing systemic iron levels via pharmacologic iron chelation may prevent cartilage deterioration attributed to OA.

49 Cyclin-Dependent Kinase 8 is a Transcriptional Regulator During Dengue Infection

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Dengue viruses, among the most aggressive arthropod-borne diseases worldwide, induce metabolic changes within infected cells. This upregulation of metabolic pathways is necessary to meet the demands of viral replication. These metabolic changes, including increased glucose metabolism and autophagy, ultimately promote viral genome replication as well as infectious particle formation and maturation. The mechanisms by which these changes occur are known to be, at least in part, virally directed through complex interactions between host and viral nonstructural proteins. We were interested in the transcriptional regulation of these

metabolic changes. We investigated the role of a host transcriptional regulator, cyclin-dependent kinase 8 (CDK8), during dengue infection as a mediator of virally induced metabolic changes. Here we show that CDK8 is not only a transcriptional regulator of select metabolic gene expression but also the type I interferon response. This surprising contradiction demonstrates that in the context of dengue infection, CDK8 is a transcriptional regulator of both pro-viral and anti-viral processes. Further, we show that manipulation of CDK8 activity by chemical inhibition, and CDK8 expression by lentivirus-mediated shRNA knockdown, changes the outcome of dengue infection by influencing viral genome replication and ultimately infectious particle production. CDK8 is therefore a transcriptional hub for induced gene expression during dengue infection and can be manipulated to alter the course of viral infection.

50 A Culturally Responsive Mindset: Meaningfully Incorporating Spanish Language Music

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COLLEGE: LIBERAL ARTS

U.S. public elementary schools have recently seen a large increase in English Language Learners, most of whom are native Spanish-speakers. Educational practices have had to shift in order to better serve these students. My literature review found that incorporating a culturally responsive mindset allows elementary general music teachers to incorporate Spanish language music in a meaningful way, so as to provide equal access to quality music learning for all students. Teachers must recognize that change begins with them, by first acknowledging Western European dominance in the education system. They must build relationships/care with their students, and educate themselves on the cultures of the students in their classrooms. Content taught should be culturally valid and contextualized. As a result of teaching with a culturally relevant mindset, students will be able to see themselves as musicians in and out of the music room, build a stronger musical identity, and have greater success accessing musical content. These culturally responsive strategies are seemingly small steps toward greater diversity and acceptance in music education, but may finally be the beginning of systematic change.

51 Pump-Free Magnetophoretic Cell Separation

ZACH CALL

DEPARTMENT: CHEMISTRY
COLLEGE: NATURAL SCIENCES

Infectious diseases cause approximately 15 million deaths each year globally. To improve global health we must develop simple but reliable testing methods for infectious diseases. Magnetophoretic separations are a popular technique used to separate and concentrate analytes from complex samples. Current magnetophoresis assays use external pumps to drive flow, which limits their portability and simplicity. In this work we demonstrate the first pump-free microfluidic paper-based device (µPAD) capable of magnetophoresis. µPADs are generally not used for magnetophoresis because particles can get trapped in the paper fibers

lowering the signal of the assay and the flow is not fast enough for continuous separation. We solve both issues by creating fast flow in a modified multi-layer paper device. Our devices achieve a 145x increase over traditional 1-layer µPADs and allow for continuous pumping necessary for magnetophoresis. To separate magnetic particles from a complex sample, we created an H-cell device commonly used in traditional microfluidics, and employ a perpendicular external field to the device After optimization we achieved manipulations of magnetic particles of various sizes across a flow barrier in a pump-free µPAD utilizing only one permanent magnet. We are currently optimizing a 1-step assay to detect analytes ranging from small molecules to complex proteins in real samples. Future work will consist of detection of E. Coli in urine and blood. Our one-step, pump-free magnetophoresis µPAD is a novel POC device that will advance the rapid detection of analytes.

52 Low-Frequency EPR Study of Isomeric Broadening in a Cr(III) System

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COLLEGE: NATURAL SCIENCES

An electron spin-probing analogue to MRI stands to greatly improve upon the capabilities of this non-invasive diagnostic tool. Using the principles of electron paramagnetic resonance (EPR), the high sensitivity of electronic spins can be harnessed to create a detailed map of the physiology of the human body. Existing probes for EPR imaging (EPRI) take advantage of the paramagnetism of organic radicals, which require high-power microwave radiation to probe the spectroscopic transitions at the high magnetic fields used in MRI. To integrate EPRI into conventional MRI, low-frequency/high-field EPR transitions must be realized. Paramagnetic metal complexes with S > ½ hold the key to implementation due to their unique and tunable electronic structure, which can be leveraged to gain desired low-frequency/high-field transitions. However, current technologies cannot take advantage of the benefits of transition metal complexes due to their broad linewidths, arising from structural variations across a population of molecules. One such source of this inhomogeneous broadening is the presence of multiple isomers. A series of Cr(III) tris-diamine complexes with the number of isomers ranging from 2 to 24 was studied with low frequency (L-band) EPR to directly assess linewidths. It was found that the Cr(III) complex formed with the ligand (1R,2R)-1,2-diphenylethylenediamine, having only two possible isomers, produced the sharpest spectral lines. This study serves as the first examination of the Cr(III) ion with L-band EPR, as well as illustrates an aspect of ligand choice important for mitigating controllable broadness.

53 Integrating Occupational Therapy and Yoga for Clients with Multiple Sclerosis

HAYLEE CANDRAY

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COLLEGE: HEALTH AND HUMAN SCIENCES

While it appears that therapists are using yoga for people with multiple sclerosis (PwMS), there is no research regarding combined occupational therapy (OT) and yoga for PwMS. Our

purpose is to complete an exploratory qualitative study to gain initial insight into why and how occupational therapists (OTs) use yoga for PwMS. Beginning in October, I will conduct semi-structured interviews with OTs who completed an online survey and indicated they use yoga in treatment for PwMS. Interviews will be approximately 20 minutes and transcribed verbatim. Data analyses will occur through inductive open coding and thematic analysis to identify, analyze, and report patterns in codes and themes. Interviews will continue until the data is considered saturated. Data collection and analysis are scheduled to be complete prior to the beginning of the spring 2020 semester. I expect the OTs to speak about the feasibility of using yoga as an intervention to increase clients performance and participation in meaningful activities, as well as improve clients balance, mind-body connection, and quality of life. The OTs will likely also share logistical supports and hindrances that influence the use of yoga as an intervention in different practice settings. Since OT aims to use engagement in occupations as both a means and ends to rehabilitation, I believe the implications of my research will be positive and well received. Once my research is finalized and published, OT practitioners will have evidence to support their use of the occupation of yoga as an intervention for PwMS.

54 Measuring Crop Water Use With a Novel Internet-of-Things Sap-Flow System

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COLLEGE: AGRICULTURAL SCIENCES

About Seventy percent of the worlds freshwater is used to irrigate crops, with a similar percentage used for agriculture within Colorado. Finding ways to more efficiently irrigate crops is crucial for long term agricultural sustainability around the globe. Assessing plant water consumption using sap flow gauges can help to identify irrigation water requirements and different pathways to improve its efficiency.

In this study, a new type of sensor was developed to measure the flow of water through plant stems just like one might measure water flow through a pipe. These do-it-yourself sap flow gauges were made using a desktop 3D printer and low-cost open-source electronics. The cost of building these instruments was approximately ten times less than commercial instruments.

Data from the sensors were transferred instantly to the cloud using Internet of Things (IoT) technology. Thus, all the information can be seeing in real time from any device, computer or cellphone, from any place in the world.

Sensors were tested in a well irrigated corn field near Greeley, Colorado, in cooperation with USDA and Northern Water.

The data collected allowed calculation of crop water use every 15 minutes and showed how plant transpiration was affected by weather and irrigation events. Results will improve our ability to predict corn water use, better manage irrigation and water resources.

55 Estimating Black Bear Population Connectivity in Glacier National Park

SARAH CARROLL

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COLLEGE: INTRA-UNIVERSITY

Connectivity and corridor science is increasingly applied in conservation and land management decisions, highlighting the need to evaluate, refine, and advance methods used to estimate connectivity. Typical connectivity estimation methods often do not incorporate local population abundance (density) information, though density influences dispersal processes and thus the spatial structure and connectivity of populations. We applied recently developed spatial capture-recapture models to estimate density-weighted connectivity of black bears (Ursus americanus) in the northern Crown of the Continent ecosystem in northwest Montana. Using genetic spatial capture-recapture data of 598 individuals, we estimated landscape resistance to individual movement and subsequently density-weighted population connectivity. We found that forest cover facilitates black bear movement, whereas areas with greater road density and high relief mountain ranges increase landscape resistance to movement. Female and male bears differed in their movement response to landscape variables. We compare these resistance estimates with estimates derived from landscape genetics approaches. This study contributes to methods development in the growing field of landscape connectivity research. The resulting connectivity maps can be applied to support landscape management and prioritize future highway mitigation efforts in Glacier National Park and the greater Crown of the Continent ecosystem.

56 Voluntary Euthanasia for Prisoners: A Question of Policy and Opinion

EMMA CASEY

DEPARTMENT: SOCIOLOGY
COLLEGE: LIBERAL ARTS

This research intends to explore current policies and opinions on inmate suicide, and seeks to understand if a voluntary euthanasia policy would be a suitable response to the phenomenon. The policies of other countries will be compared, and the inequitable application of the United States Constitution between inmates and the public will be analyzed. The results of this mixed method research endeavor will either support or oppose the enactment of a policy allowing prisoners to participate in voluntary euthanasia. Quantitative data will be gathered from incarceration facilities on the demographics and circumstances of suicide victims, and the reporting policies and medical services used by each facility will be examined. Semistructured interview with inmates, facility staff, judges, district attorneys, and law enforcement officers will provide the greatest amount of data for this study. Public focus groups will also be held in order to gauge public opinions and concerns surrounding the idea of voluntary euthanasia for prisoners. This project is still in the beginning stages, but a literature review and an IRB application will soon be completed.

57 An Autism-Associated Mutation Impairs the Surface Trafficking of Human Neuroligin-4

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COLLEGE: NATURAL SCIENCES

Neuroligins (NLGNs) are a family of post-synaptic cell-adhesion molecules that interact with presynaptic Neurexins. Different NLGN genes (NLGN1-4) differentially regulate the functional properties of neurons by promoting post-synaptic clustering of neurotransmitter receptors. Human NLGN4 (hNLGN4) is known to have multiple distinct mutations that lead with high penetrance to Autism Spectrum Disorder (ASD). hNLGN4 is evolutionarily divergent in humans, making its study in rodent model organisms difficult. Here, we analyzed a missense mutation in hNLGN4 derived from an ASD-diagnosed patient, from conserved residue Arg101 to Gln (R101Q). We found that the R101Q mutation significantly reduces the trafficking of hNLGN4 to the cell surface in HEK293 cells and increases the relative abundance of the protein in the Endoplasmic Reticulum. As a potential mechanism, we found that the R101Q mutation increases the relative abundance of immaturely-glycosylated hNLGN4, which may arise as a result of impaired glycosylation at an adjacent Asn102 residue. Using embryonic stem cell-derived human neurons, we investigated the effect of endogenous hNLGN4 knockdown and rescue with either WT or R101Q hNLGN4 on the functional properties of excitatory vs. inhibitory synapses. This results of this project shed light on how human-specific hNLGN4 regulates the maturation and maintenance of synapses in a developing human brain.

58 Beyond Distilling-A Sustainable Solution to Food Waste

CHRIS CASTELLS

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COLLEGE: BUSINESS

We are creating a vodka product using 100% baked goods from the food bank instead of the traditional inputs of grain. On average, 400 pounds of food is wasted per person per year in America. 20% of landfill waste is food that will release harmful greenhouse gases when it decomposes. Our venture wants to harness the value of food that is literally being thrown away. Our business would divert food waste in Colorado and turn it into a high quality craft spirit.

This is a mass market product that can be enjoyed by all craft spirit lovers. This is an innovative product in the craft spirits industry. Those that enjoy new and different craft spirits will enjoy this product due to its superior quality and affordability. An emphasis on sustainable sourcing and overall environmental impacts provides an obvious spirit choice for the green consumer.

We are working with CopperMuse Distillery, and their master distiller Jason Hevelone, in Fort Collins to create an MVP. Tony Alexis, COO at the Food Bank of the Rockies, has agreed to let us use their bread waste to create this product. On September 27th we will begin fermentation of our bread vodka.

59 Carbon Sequestration Through Char Production With Hydrothermal Liquefaction of Algae

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Hydrothermal liquefaction (HTL) is a thermochemical conversion technology that can be applied to whole, wet algal biomass for the production of biocrude. Continuous operation of HTL is conducted in a reactor at moderately high temperatures (250 400 °C) and pressures (20 22 MPa) to keep the feedstock in a reactive subcritical (liquid) state. Products emerge from HTL in multiple phases, including a biocrude product, an aqueous phase, a gaseous phase, and biochar residue. Final yields depend on a multitude of conditions such as feed composition, temperature, and reactor residence time. Experimental work has shown that algal HTL can achieve a 30 60 % yield of biomass to biocrude. There is a major trade-off at lower temperatures; less energy input is required, but final yields favor biochar, which is considered to have significantly less value than algal biocrude. This study seeks to apply life-cycle carbon accounting to investigate the sequestration potential of algae HTL-derived biochar. Life-cycle greenhouse gas emissions and credits are compared between varying HTL conditions and scenarios that result in economic incentives for carbon sequestration. Results are integrated with economic modeling to understand the trade-offs of carbon sequestration through the proposed methods.

60 The Changing Human Exposure to Hail Storms Across Eastern Colorado

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Eastern Colorado is one of the most active hail regions of the U.S. In fact, two of the countrys fourteen billion dollar disasters in 2018 were Colorado hail storms. The extent of future human exposure from hail storms depends on both meteorology and population dynamics. This study explores the relative contributions of these two factors in end-of-century human exposure from hail storms over eastern Colorado through development and use of a Hail Monte Carlo (HailMC) model. HailMC uses probabilistic distributions of severe (1.0+) hail reports in control and future climate scenarios to repeatedly create hail swaths over the domain, and then counts the number of people underneath the swaths according to different population projections. The future probabilistic hail surface is computed using atmospheric parameters generated from dynamically-downscaled climate model output. An increase of up to three days annually of severe hail is found, maximized across northeastern Colorado. Population projections are taken from the Shared Socioeconomic Pathways (SSPs) and clipped to the eastern Colorado domain. HailMC reveals a wide range of change in human exposure from +177% to -78% depending on the combination of population, hail frequency, and hail spatial distribution chosen. Integrations of HailMC that show decreasing human exposure are due to projected hail storm frequency increasing most in northeastern Colorado, an area with relatively few people but prime agricultural production. A recently completed interview study of Colorado farmers and ranchers will apply this finding by investigating how the agricultural community perceives and responds to hail storm risks.

61 Regeneration in Contemporary Cottonwood (Populus deltoides) Dominated Riparian Forest Systems

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COLLEGE: AGRICULTURAL SCIENCES

Riparian forests are biologically diverse systems, that provide essential ecological services for the arid, western U.S. The present-day South Platte River riparian forest is dominated by native phreatophytes (Populus and Salix species) which require hydrologic disturbance to reproduce. With changed water-use and hydrology in the South Platte basin of Colorado, the future riparian forest status is unknown. This study describes the contemporary forest species and the forests age structure to describe historic and contemporary recruitment dynamics. Tree cores were collected from cottonwood, green ash, and Siberian elm (later successional species) at seven randomly selected sites along the stream. Tree cores and forest data were collected, and the cores were dated and measured, using standard dendrochronological methods.

Preliminary analysis shows variability in tree establishment. Furthest upstream sites had the oldest trees, with establishment as early as the 1890s, and a significant pulse of establishment around 1920. At sites further downstream, tree establishment was not identified until the 1930s. Comprehensively, recruitment has been continuous for this forest-- though establishment patterns are varied among sites. Ring width analysis showed increased tree biomass during three separate time periods, it is hypothesized that these coincide with increased water levels and decreased competition. Common pulses of recruitment coincide with varied stream discharge indicating that both high-flow and low-flow periods create opportunities for forest recruitment. The findings of this study indicate that hydrologic-geomorphic-ecologic patterns are important to recruitment. Further understanding of these can provide insight into how the forest responds when these factors are altered.

62 Plasticity May Not Save a Cold-Adapted Frog From Climate Change

AMANDA CICCHINO

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COLLEGE: INTRA-UNIVERSITY

In the face of rapid environmental change, phenotypic plasticity is often an individuals first line of defense. Phenotypic plasticity occurs when the same genotype produces different phenotypes in response to the environment. Plastic responses are often fast, and thus can offer a short-term solution for organisms trying to cope with changing environments. For example, some salamander species increase blood vessel development near the skin surface to increase heat dissipation when temperatures increase. Understanding how thermal tolerance plasticity evolves can help us identify trends in coping ability, which can inform conservation action. In this study, we quantified thermal tolerance plasticity in populations of a cold-adapted, stream frog (Ascaphus spp.) along elevation gradients. We also investigated drivers of this plasticity, such as stream temperature variability and the availability of thermal

refugia. We found that these frogs have low levels of plasticity in their thermal tolerance, and that the amount of plasticity is related to temperature variability at a site. We found few thermal refugia among sites, suggesting that there is little opportunity for behavioral thermoregulation, and thus populations that cannot cope plastically may not persist. Temperature variability and refugia availability did not follow the common paradigm associated with elevation, where high elevation populations experience less temperature variability and have more refugia. Therefore, generalizations to other montane systems will need to consider underlying thermal trends to identify vulnerable populations. For these species of cold-adapted frogs, it seems as though plasticity in thermal tolerance will not buffer them against the effects of climate change.

63 Adaptation of Diapause Induction Cue Enables Range Expansion

ELIZA CLARK

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COLLEGE: INTRA-UNIVERSITY

Theory predicts that species undergoing range expansions will evolve in novel environments. For hibernating and diapausing species, adapting to environmental cues that indicate seasonal change is crucial. The northern tamarisk leaf beetle, biological control agent of the invasive plant tamarisk, has rapidly adapted to different daylengths across latitudes that signal to the beetle to prepare for winter. Understanding evolution of these cues will help us study the impacts of local adaptation during range expansions across heterogeneous environments.

We define a new trait, days until diapause at one daylength, to study adaptation to daylength at an individual level. We measured the genetic variation in days until diapause in one northern population in both home and away environments and the responses of eight populations from varying latitudes to both northern and southern environments.

We found that days until diapause was highly variable for the population in its home environment and not significantly variable in a novel environment. When comparing populations across the range, we found significant differences in the diapause behaviors of northern core beetles and southern edge beetles in each environment.

The variation in the trait days until diapause indicates that adaptive evolution is possible, but only when populations are near their home environment. The range expansion must proceed slowly enough that genetic variation on which selection can act is maintained. These results can be used in conjunction with genomic studies to better predict the rate of range expansion and inform research on ecological factors important to range expansions.

64 Enzymatic Sensors From Carbon Composite Electrodes

KAYLEE CLARK

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COLLEGE: NATURAL SCIENCES

Reduced nicotinamide adenine dinucleotide (NADH) and hydrogen peroxide (H2O2) are

important redox molecules for the transfer of electrons in redox reactions present in nearly all living organisms. NADH oxidation is catalyzed by a class of enzymes called dehydrogenases and H_2O_2 is produced by oxidases, which each encompass 200+ enzymes. Therefore, the quantification of NADH and H_2O_2 can be used in many applications including glucose, lactate, and glutamate sensing. Carbon composite electrodes are an attractive option for electrochemical detection due to their low cost, easy fabrication, and ability to be patterned. However, the electrochemistry of these electrodes is lacking relative to other carbon-based electrodes such as glassy carbon. Furthermore, it is difficult to create intricate patterns of small features using easy to make composite carbon electrodes. The electrodes presented here combine graphite with a thermopolymer called polycaprolactone (PCL) to enable easy intricate patterning. PCL has a melting point of approximately 60 °C, so the electrode material can be easily patterned into templates with a heat press without extensive use of organic solvents. The electrochemistry of these PCL electrodes can also be easily altered by changing the type of carbon mixed into the PCL as well as the ratio of PCL:carbon. The simple fabrication also allows catalysts to be mixed into the material for better detection of enzymatically relevant molecules. By tuning these characteristics, sensitive detection of NADH and H_2O_2 has been demonstrated with these PCL thermoplastic electrodes. Electrodes have also been fabricated with enzymes to allow for the detection of glucose.

65 Saving Face: Medicine, Art, and Expectations of the Mutilated Face

MEGAN CLEVENGER

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COLLEGE: LIBERAL ARTS

The purpose of this research is to demonstrate that the facial mutilation of soldiers in the First World War led to the intersection of art and medicine through advancements in reconstructive surgery and the production of portrait-masks. These advancements preserved social expectations and standards of masculinity, as well as helped to shape collective war memory following the First World War. While scholarship on the post-war male body and masculinity increased at the turn of the twenty-first century, research specifically on the post-war male face is limited. The examination of post-war male facial mutilation and its impact on war memorialization is often unmentioned in any study of the post-war male body. The procedure for this study included the development of a research question and thesis. To prove that facial reconstruction and portrait masks influenced post-war masculinity and collective war memory, I analyzed primary sources in French and English from the American National Red Cross Photograph Collection and the Archives of American Art, as well as period newspaper articles, procedural notes, and personal notes of surgeons and artists. Secondary sources contributed to the historiography of post-First World War masculinity and body studies, as well as foundational works on collective memorialization of the war. Implications of this research indicate that facial mutilation heavily influenced memory and masculinity in post-war society. This research is replicable for future direction to study facial mutilation in other modern conflicts, including the Second World War, Cold War hot spots, and the present War against Terror.

66 Tidally Induced Icequake Swarms on The Ross Ice Shelf, Antarctica

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COLLEGE: WARNER COLLEGE OF NATURAL RESOURCES

Repeating icequake swarms near the grounding line of the Ross Ice Shelf (RIS) were recorded by broadband seismometers deployed from late 2014 to early 2017. Swarms occur diurnally and in phase with falling ocean tides. Most swarms consist of 1000's of individual events triggering over the course of a few hours. During a swarm progression, there is a steady increase in the rate of events and their amplitude until the activity abruptly ends. The total energy released in a swarm is primarily correlated to the tidal range and slope. However, non-diurnal tide components, seasonal effects, and environmental conditions all affect the swarm expression and our detection threshold. We use several digital signal processing methods to analyze the seismic data and employ a custom detection algorithm to create a catalog of icequakes with relevant metrics. Examining our catalog shows that events are dominated by surface wave energy and reveals that families of events exist that trigger repeatedly within and between swarms. We also observe curious azimuthal clustering and migration during swarms. Based on our results, we hypothesize these swarms are sourced from brittle failure of surface crevasse driven by increased tensile stress at the RIS surface during falling tide. We anticipate this research will provide insight into the workings of the RIS system and that it will guide efforts to passively monitor ice shelf stability with seismic instrumentation. This is important because we need to track ice shelf response to climate change in order to improve predictions of sea level rise.

67 Corporate Giving for Climate Adaptation and Mitigation on National Forests

NATASHA COLLINS

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COLLEGE: WARNER COLLEGE OF NATURAL RESOURCES

Climate change is having critical consequences on forest ecosystems and ecosystem services, as increasing temperatures drive wildfire, tree mortality, and regime shifts. The U.S. Forest Service struggles to address its impacts and turns to external partners for financial resources and capacity to help manage for climate change effects. Private actors, specifically companies, are a promising new partner for climate change adaptation and mitigation projects because they can provide capital up front to accelerate the pace and scale at which these projects can be undertaken. My research investigates the engagement of private companies in funding climate related projects on national forests. These companies often work through a third party non-profit, who conducts the forestry work on National Forest Systems Lands. Through semi-structured interviews, I strive to identify the major companies engaging in these projects, their motivations for engagement, the range of investment mechanisms used, and corporate interests related to measurements and accountability. I focus on three primary groups to accomplish this: 1) Forest Service Partnership Coordinators; 2) third party non-profit organizations who often serve as intermediaries; and 3) company representatives. The objective of this research is to inform the Forest Service on its current and potential private sector partners, as well as to improve and expand these types of efforts moving forward.

68 Interagency Collaborations in Environmental Sustainability: Reflections, Barriers, and Opportunities

CAROLYN CONANT

DEPARTMENT: SOCIOLOGY
COLLEGE: LIBERAL ARTS

This poster will present the preliminary findings from a social network analysis research project conducted among those working on issues pertaining to environmental sustainability (ES) in Fort Collins, Colorado. ES is a field that permeates many sectors and often involves highly collaborative processes. Our current rate of drastic planetary climate change means that there is an urgent need to efficiently implement environmental initiatives and restructure existing systems to be more sustainable. To that end, it is imperative that organizations and individuals working on ES projects are able to complete their work as efficiently as possible through collaboration and alignment.

This research uses Fort Collins as a case study to explore how the structure of social networks enables or inhibits efficient collaborations in ES work. Using qualitative and quantitative data from 200 survey responses, seven in-depth interviews, and a participatory workshop, I examine patterns in interactions that emerge from the resulting network maps and tropes from the qualitative data pertaining to the barriers and opportunities in collaboration that respondents have experienced.

While preliminary, the data already reveal interesting insights, barriers, and opportunities for improvement for ES collaborations in Fort Collins. The findings from this research will serve as a guiding model for other medium-sized cities that host universities and a variety of ES practitioners, and lessons from Fort Collins can be applied to other sites that are interested in improving their interagency collaborative efficiency.

69 Investigation of Deactivation in Organocatalyzed Atom Transfer Radical Polymerization

DANIEL CORBIN

DEPARTMENT: CHEMISTRY
COLLEGE: NATURAL SCIENCES

Roughly half of all plastics produced today are polymers synthesized through radical polymerization methods due to their operational simplicity and chemical scope. A subset of radical polymerizations, termed controlled radical polymerizations, preserves many of these benefits while also enabling the precision synthesis of polymers with targeted structures. However, many such methods often require harsh reaction conditions, necessitating more sustainable approaches to synthesizing these desirable materials. Organocatalyzed atom transfer radical polymerization (O-ATRP) is a recently developed controlled radical polymerization method that employs visible light absorbing photoredox catalysts (PCs) to synthesize precision polymers in a more sustainable fashion under mild reaction conditions. In this method, a PC mediates the reversible activation and deactivation of polymer chains, effectively turning their reactivity on and off to control their growth over time. One key

mechanistic step in this process deactivation is especially important for controlling polymer structure; however, this step also remains poorly understood, making it challenging to design better PCs for O-ATRP.

In this work, we study deactivation in O-ATRP through two synergistic approaches. First, we employ synthetic techniques to isolate the species responsible for deactivation in O-ATRP (deactivators) paired with computational methods to investigate deactivator structures and properties. In addition, new polymerization methods are developed, in which strategies to control deactivator concentrations in-situ are explored. Combined, these efforts will allow us to rationally design better O-ATRP PCs, which will ultimately widen the scope of precision-polymers accessible through this sustainable, light-driven polymerization method.

70 Assessing Maize Crop Water Stress Using an Aerodynamic Temperature Approach

EDSON COSTA FILHO

DEPARTMENT: CIVIL AND ENVIRONMENTAL ENGR
COLLEGE: WALTER SCOTT, JR. COLLEGE OF ENGINEERING

This poster evaluates two methods for determining maize crop water stress index (CWSI) using a surface energy balance coupled with an aerodynamic temperature approach. Data were collected on an irrigated maize field, at a research farm located near Greeley, Colorado, USA, in 2018. The irrigation treatment was subsurface drip. Weather data were measured on-site at 3.3 m above ground level. Remote sensed red (RED) and Near infrared (NIR) surface reflectance data were obtained on-site through radiometry measurements done twice a week. Nadir surface temperature was measured using infrared thermometers kept at 1 m above canopy height. Aerodynamic temperature models developed by Chavez et al. (2005) and Costa-Filho (2019) were used to independently estimate CWSI based on the surface energy balance approach. Independent CWSI from measured surface heat fluxes were used as reference for model performance assessment. Results indicated that estimated CWSI based on Costa-Filho (2019) model had mean bias error (MBE) of -0.01 and root mean square error (RMSE) of 0.08, while model from Chavez et al. (2005) resulted on MBE of -0.24 and RMSE of 0.27. Both models underestimated CWSI values due to negative values of MBE, but Costa-Filho (2019) model improved CWSI estimation by reducing the magnitude of RMSE in 30 % when compared to CWSI estimated using Chavez et al. (2005) aerodynamic model. Therefore, research results indicate that there is evidence that the CWSI approach based on Costa-Filho (2019) model for aerodynamic temperature seems to improve estimation of maize CWSI for semi-arid conditions.

71 Clinical Significance and Effects of Cancer Rehabilitation for Older Adults

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COLLEGE: HEALTH AND HUMAN SCIENCES

Evaluate the clinical significance and effects of outpatient CAncer REhabilitation (CARE) for

older adults with at least one rehabilitation need.

We retrospectively analyzed outcome data from a two-arm, randomized control trial of CARE (physical and occupational therapy); hypothesis tests previously reported. We calculated effect size (d) for mean pre- to post change and mean between-groups difference for each outcome. When applicable, clinical significance was indicated if mean pre-post change or between-groups difference exceeded the established minimally important clinical difference (MICD).

Participants (N=45) self-reported functional status (Nottingham Extended Activities of Daily Living scale; NEADL); PROMIS global mental health (GMH), physical health (GPH), physical function (PF) and ability to participate in social roles (SR); and activity expectations and self-efficacy (Possibility for Activity Scale; PActS) prior to, and 2-3 months post-intervention. In the CARE group, MICD was achieved for SR, PF, and GMH. CARE (N=19) had small-to-moderate effects on all outcomes (d = -0.31 0.47) via attenuated decline or improvement. Between groups, small-to-moderate effects were seen for all outcomes (d = 0.23 0.64), except NEADL (d = 0.05).

CARE resulted in clinically significant improvements in physical function, mental health, participation in social roles. Compared to usual care, small-to-moderate effects were seen for all outcomes except functional status. This study provides preliminary evidence of the positive effects of CARE for older adults. Future studies should utilize a larger sample size and seek to understand personal and environmental factors that influence clinical effectiveness in order to replicate results in clinical practice.

72 Assessing Influence of UAS Data Acquisition Parameters for Forest Photogrammetry

MATTHEW CREASY

DEPARTMENT: FOREST & RANGELAND STEWARDSHIP
COLLEGE: WARNER COLLEGE OF NATURAL RESOURCES

Characterization of forest structure is important for management-related decision making, especially in the wake of disturbance. Increasingly, observations of forest structure are needed at both finer resolution and across greater extents in order to support managers in meeting spatially explicit management objectives. Current methods of acquiring forest measurements can be limited by a combination of time, expense, and either extent or temporal resolution. In situ measurements can be time consuming and often limited in extent, while airborne methods of data acquisition (e.g. LiDAR and aerial imagery) are often costly enough to limit temporal resolution. Drones provide an airborne method of data acquisition at significantly lower cost and time commitment. Acquiring aerial imagery in a systematic fashion with a drone allows for photogrammetric reconstruction of 3D forest observations using only photos. Recent literature confirms these products can be as detailed as conventional LiDAR models, however, there exists a knowledge gap in best practice for data acquisition parameters for forest photogrammetry. Our study seeks to help fill that knowledge gap by systematically testing speed and altitude as they influence the quality of models produced by photogrammetry. Preliminary results indicate the potential to produce highly detailed 3D models of various forest measurements from the point clouds. These results indicate that UAS systems can provide high-resolution, accurate forest data for a fraction of the time and money needed for conventional methods and potentially become a much-needed tool for monitoring forest

structure and pattern as they relate to forest health and disturbance response.

73 Applying Metal-Organic Frameworks as Molecular Nets for Dialysis Applications

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Chronic Kidney Disease effects approximately 14% of Americans, eventually necessitating routine dialysis treatments to remove uremic toxins from the bloodstream. On average, each treatment costs hundreds of dollars per four-hour session. This life-saving treatment can be cost-prohibitive given the clinical and materials costs, as well as time required per session. Metal-organic frameworks (MOFs) are a promising class of material for filtration applications and show potential as next-generation materials for dialysis applications. MOFs have some of the highest surface areas per volume of any known materials, and the chemical and physical properties can be fine-tuned based on the metal and organic linker molecules used. This work investigates the removal of the uremic toxin p-cresyl sulfate from water with the commercially available metal-organic framework iron trimesate, and quantification using High Pressure Liquid Chromatography. Our data indicate removal of uremic toxins in three hours and approximately four grams of iron trimesate is sufficient to remove enough p-cresyl sulfate from solution to be useful for clinical application. We will also discuss ongoing filtration experiments using flow-based systems, feasibility of using other MOFs, and removal of additional uremic toxins indoxyl sulfate, urea, and creatinine.

74 Sustainable Development of Polymers for a Circular Plastics Economy

ROBIN CYWAR

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Over the past five years, the Chen research group has made significant strides in the development of infinitely recyclable plastic materials (polymers). Virgin-quality plastic is regenerated with every chemical recycle, as opposed to the severely compromised materials returned by common mechanical recycling which contribute to the accumulation of plastic waste. This work describes the environmentally friendly, metal-free polymerization and depolymerization of monomer/polymer systems with the gene for full chemical recyclability. The sustainable methods developed in this work enabled multi-gram scale preparation of materials and their subsequent characterization. Polymers made with organic catalysts showed advantages such as higher yields, reduced purification requirements, and greater thermal stability than those made with metal catalysts. The strong and tunable plastics showed potential as packaging and membrane materials and are under current evaluation for such applications via two international collaborations.

75 Role of EndonucleaseG With Respect to the 5-hydroxymethylcytosine Epigenetic Marker

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Endonuclease G is a mitochondrial localized protein involved in cleaving DNA both in duplex and Holliday Junction forms. It has also been shown to be involved with recognizing the 5-hydroxymethylcytosine epigenetic marker. In this work, we look at how the protein-DNA interaction occurs and determine what within the protein is responsible for localizing to 5hmC. Additionally, we use two model, mice and C elegans. Lower eukaryotes lack 5hmC so they provide an interesting model to determine what has occurred with this highly conserved protein throughout evolution. New work in the lab has been able to determine the affinity of the protein-DNA interaction as well as the catalytic rate in order to show how the 5hmC marker plays a role in the cellular interactions. Furthermore, we show how the rates of the protein changes with respect to the species and ultimately leads to a loss in differentiation between Holliday Junction and 5hmC modified Holliday Junction. This differentiation is believed to be a result of a Hydrogen Bond forming between a conserved cysteine and the hydroxyl group of the 5hmC modification which positions the DNA in order for it to be cleaved at certain sites.

76 Microbial Clues in Decomposing Human Bones: A New Forensic Tool

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In crime scene investigations, estimating the postmortem interval (PMI), or time since death, can be extremely helpful in death investigations. Currently, there are few tools for estimating PMI that are accurate after the first two weeks of decomposition. Microbes are consistently present throughout decomposition and change in a predictable, clock-like manner, and thus could be applied as a forensic tool for estimating PMI. We hypothesize that the invasion of microbes into bone is likely a slow process, and tracking the succession of microbes into bones after death may provide accurate estimates of PMI for long timeframes of decomposition.
To test this hypothesis, rib bones from human bodies placed at an anthropological research facility were collected beginning at approximately three months after death. For each body, one rib was collected every three weeks for a total of 48 sampled ribs. The samples were processed by excising a portion of the bone, cleaning the excised piece with bleach and UV irradiation, then pulverizing into a powder. Each of the powders were demineralized, then DNA was extracted. The bacterial microbiome in each sample was then characterized using amplicon sequencing. Data analysis revealed that similar microbes invade the rib bones during decomposition. Constructing a Random Forest regression model using these data then provided PMI estimates within approximately one month over a decomposition period of nine months. These promising results demonstrate that utilizing the invasion of microbes into bone

may be useful for estimating PMI on a long timescale.

77 The Effect of Resins in the Flocculation of Asphaltenes

MORTAZA DERAKHSHANI MOLAYOUSEFI

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Asphaltenes are molecules in crude oil that cause petroleum industry equipment to clog. Shutting down each oil well due to the clogging can cost millions of dollars. We studied the effect of resin molecules in the flocculation of asphaltenes. In flocculation, small nanoaggregates form larger macroscopic aggregates. Resins, which also are indigenous to crude oil, affect the further aggregation of asphaltenes. Studying the atomistic resolution and dynamics of aggregation is not available for most common experimental methods. Using molecular dynamics as a computational tool, we were able to achieve these goals. We studied the aggregation of asphaltene on a large scale where small nanoaggregates of asphaltene come together and form large clusters. Also, we studied the effect of select resins in the aggregation behavior of asphaltenes. We had shown in a previous study that resin prevents aggregation of asphaltenes in nanoaggregate scale. In this study, we show that resin can prevent aggregation of asphaltenes in large scales. Utilizing the right type and sufficient concentration of resins, we can prevent clogging problem in the oil industry and reduce its adverse economic and environmental effects.

78 Computational Incorporation of Proteinaceous Materials Into Metal Organic Frameworks

JACOB DEROO

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Computational Incorporation of Proteinaceous Materials Into Metal Organic Frameworks

Metal Organic Frameworks (MOFs) are regular lattice structures, with the vertices being metal ions, and organic molecules as ligands providing framework. MOFs have many desirable functions in a myriad of differing fields. In this project we lay down groundwork for directed incorporation of proteinaceous material into MOF lattices via computational modeling with the Python package SHARPEN. Computationally, we successfully incorporated 57 small proteins into a Cu-BTC MOF system using our pipeline. From this, an optimized peptide motif was established. With this peptide appended, proteins or enzymes of interest can be more readily encapsulated in Cu-BTC or fixed to the MOF surface. This opens up a world of functional materials possibilities by combining the myriad catalytic or biorecognition capabilities of protein with the catalytic functionality, as well as the thermal, pH, and mechanical stability of Cu-BTC. Notably, the entire pipeline can be repeated to derive binding tags for alternative MOF lattices. The computationally derived peptide motif also provides a starting point for the subsequent optimization of the sequence by phage display for MOF integration.

79 Evaluation of Taxpayer Costs/Benefits of Pro-Active Algae Bloom Prevention

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Harmful algae blooms have been identified as a major environmental problem in all 50 states leading to water impairment in some of the United States major water bodies such as the Great Lakes and large aquatic dead zones in the Gulf of Mexico and the Chesapeake Bay. Harmful algae blooms have been shown to negatively impact tourism, aquaculture, recreation, and real estate markets. Taken together, harmful algae blooms cost tax payers millions of dollars each year between water restoration costs and lost revenue. One major contributor to harmful algae blooms is nutrient pollution, or excess nutrients in the water, specifically nitrogen and phosphorus. This study evaluates the costs of pro-active nutrient management through wastewater treatment and controlled algae growth using an attached algae growth system to target non-point source waters. This study uses a model to predict algae bloom frequency based on nutrient loadings before and after nutrient removal treatment. Then, based on nutrient removal and social costs, we estimate the costs and benefits to tax payers for pro-active algae bloom prevention over a 30 year time frame.

80 Incorporating Evolutionary and Ecological Genomics Into Annual Cycle Avian Research

MATT DESAIX

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COLLEGE: NATURAL SCIENCES

Most populations of migratory birds are currently in decline and the rates of decline are likely to be exacerbated by climate change. To identify the specific factors driving declines in migratory species, researchers need to identify the migratory connectivity between stages of the annual cycle, as well as the disturbances and selection pressures at these stages. While there is numerous research on the migratory connectivity of different species and carry-over effects of disturbances, little is known of the interdependence of local adaptation throughout the annual cycle. However, recent advances in genomics are making it feasible to investigate local adaptation at different annual stages and predict future adaptive potential. Here, we describe preliminary results of a conservation genomics study of the American Redstart (Setophaga ruticilla): a model species for full annual cycle research of migratory songbirds. Our preliminary results reveal finer-resolution geographic genetic clustering on the breeding grounds than previously reported for American Redstarts and we explore the influence of environmental variables on local adaptation. We highlight the importance of building on these results from the breeding ground and incorporating genomic data into a full annual cycle framework. Specifically, integrating research of migratory connectivity and local adaptation will allow us to tease apart the influence of selection pressures, throughout the annual cycle, on different avian populations. Ultimately, these conservation genomic models will help us predict how migratory species will respond to climate change and provide an understanding

of the underlying genomic mechanisms behind a species response.

81 Peter Village and the Production of Space

CARLY DESANTO

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COLLEGE: LIBERAL ARTS

Peter Village (15Fa166) is a large irregularly shaped earthen enclosure that has intrigued antiquarians and modern archaeologists since the 1800s. Most recent interpretations of the site have suggested it represents a diverse range of late-Early and early-Middle Woodland activities. Historically, this enclosure has been viewed as different from smaller Adena-Hopewell geometric enclosures because of its shape and arrangement of the ditch to the embankment. Recent archaeological investigations at Peter Village have included LiDAR visualizations, geophysical survey, and soil coring. These datasets allow us to revisit the monuments construction and organization. Doing so create an opportunity to reconsider the production of space among early complex societies in the Middle Ohio Valley.

82 System Identification of Non-Stationary Systems Under Non-White Excitations

YUE DONG

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A time-frequency domain approach is presented for the system identification (SI) of structures under non-stationary non-white excitation. The availability of this approach is vital for monitoring of civil engineering structures under wind excitation, which is typically non-stationary and non-white. In practice, extreme wind load always lasts a very short time and will cause amplification in the bandwidth of response spectrum. Hence, many spectral-based methods may fail in identifying the structural properties in this case. To address this problem, this approach introduces a modified frequency response function (FRF) to model the effect of short signal explicitly. Previous works by the authors, which focused on white noise excitation, are extended to handle the non-white excitation.

83 Cyclin Dependent Kinase 8 in Zika Virus Control of Metabolism

JASMINE DONKOH

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COLLEGE: VETERINARY MEDICINE AND BIOMEDICAL SCIENCES

Zika virus (ZIKV) is a mosquito borne flavivirus that is associated with outbreaks of microcephaly in South America in 2016-2017. ZIKV is linked to cases of Guillain-Barre

syndrome, fatal encephalitis and myelitis as well as other neurological complications. DENV, a close relative of ZIKV, has been shown to alter cellular metabolism, resulting in an alteration in metabolites and host proteins. We have found that ZIKV infection leads to induced expression of the host mediator complex protein, cyclin dependent kinase 8 (CDK8) and that CDK8 promotes virus replication. CDK8 is a transcriptional co-factor that regulates gene expression in multiple metabolic pathways. We show that CDK8, as well as the glycolytic enzyme hexokinase 2 (HK2), are increased during ZIKV infection. Using the CDK8 kinase inhibitor, Senexin A, we demonstrate that CDK8 is required for increased expression of HK2. We also show that ZIKV genomic RNA and particles decrease. The attenuated ZIKV replication may be due to decreased availability of metabolites necessary for nucleic acid and fatty acid synthesis.

84 Changes in Future Flash Flood-Producing Storms in the U.S.

ERIN DOUGHERTY

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COLLEGE: WALTER SCOTT, JR. COLLEGE OF ENGINEERING

Floods are one of the deadliest natural disasters in the continental United States (CONUS), with the Mississippi River Valley floods of 2019 resulting in an estimated $12.5 billion in damage. Given their highly destructive nature, it is important to understand how floods will change in a future, warmer climate. Previous studies using global climate models have examined this topic and find that flood risk increases in the future, but these models are too coarse to accurately simulate precipitation timing, structure, and intensity. While high-resolution convection-permitting climate models improve simulations of current and future rainfall, they have not yet been explicitly used to understand changes to future floods. Thus, the goal of this research is to fill this knowledge gap by using high-resolution convection-permitting simulations that apply a pseudo-global warming approach to analyze how flash flood-producing storms will change in a future climate over the CONUS. Changes in historical flash flood-producing storm rainfall characteristics are examined in current and future simulations, using a large number of cases from a flood-producing storm database. Flash flood rainfall increases over most of the CONUS in a future climate, with increases in maximum rain rates exceeding that predicted by a well-known theory. To understand why future flash flood-producing storms intensify, we perform a regional analysis in the Mississippi River Valleya flash flood hotspot in the CONUSand examine how the storm characteristics change in a future climate. These results are useful for stakeholders seeking a better understanding of climate change impacts at a region level.

85 Accelerating Statistical Corrections to Neutrino Measurements With High Performance Computing

DEREK DOYLE

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COLLEGE: NATURAL SCIENCES

Neutrinos are one of the most abundant, yet elusive particles in the universe; trillions pass through the human body every second. Experiments like Neutrinos at the Main Injector Off-

axis electron Neutrino Appearance (NOVA) are designed to measure the properties of these elementary particles, requiring huge detectors and lots of neutrinos. Even with an intense beam of neutrinos and kiloton detectors, NOvA has collected data on only a few neutrino interactions. Such a small dataset requires an advanced stochastic approach called the Feldman-Cousins (FC) procedure to correct for low statistics. The FC procedure involves simulating millions of possible experimental measurements, making for an incredibly computationally demanding task, and is often the bottleneck of neutrino measurements. Such a task requires the massive amount of computing resources available at High Performance Computing (HPC) facilities like National Energy Research Scientific Computing center (NERSC). I, together with NOvA and Scientific Discover through Advanced Computing (SciDAC) collaborators, have demonstrated a speedup factor of over 50 compared to previously employed methods using HPC implementation and NERSC facilities. This work has and will continue to dramatically decrease NOvAs time-to-results, and marks one of the first interdisciplinary and collaborative efforts between NOvA and SciDAC to improve the computational efficiency of High Energy Physics analyses.

86 Identifying Candidates for Customized Probiotics as Treatment for Cardiovascular Disease

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COLLEGE: HEALTH AND HUMAN SCIENCES

The gut microbiota has emerged as a critical regulator of human health. As a result, commercial probiotics have become a multi-billion dollar industry. However, data regarding the efficacy of probiotics in the treatment and prevention of chronic diseases are mixed, with some studies reporting no positive effects. One possible reason for these disappointing data is that the microbes included in commercial probiotics are chosen indiscriminately, without regard to the bacterial make-up of the gut microbiota of patients. Thus, its reasonable to speculate that efficacy may be enhanced if the probiotics are customized to the specific bacterial deficiencies of the target population.

The general goal of this project is to identify potential candidates for novel customized probiotics for the treatment of obesity-related cardiovascular abnormalities. To this end, we examined the composition of the gut microbiota across several studies in obese and lean mice. Our goal was to determine if certain bacterial deficiencies were consistently present in obese mice across studies. We found that the abundance of certain bacteria were significantly reduced in obese mice compared to lean mice across 5 independent studies. Decreases in certain species across 5 studies were related to the development of CVD abnormalities and intestinal pathology.

These data suggest that the development of obesity-related CVD pathologies is associated with consistent bacterial deficiencies or surplus, which may represent targets for novel customized probiotics. Future studies will examine whether a customized probiotic containing specific species of bacteria may offer protection in the prevention or treatment of obesity-related cardiovascular diseases.

87 The Science Behind Multilingualism

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COLLEGE: LIBERAL ARTS

Much research has been done regarding how humans learn their second language, and only recently has it become relevant to study how they learn a third or additional language, thanks to accelerated globalization. What studies have not investigated, however, is what happens when a bilingual person is presented with both a language similar to their first language as well as one that is similar to their second language. Will the learner apply the rules of their first language to both languages presented to them? Will they apply the rules of their second language to both? Or will they apply the rules of the corresponding type of language (Germanic, Romance, for example) for each language? Currently, I have completed my proposal and started on my literature review and I plan to recruit 15-20 international students whose first language is English and second language is a Romance language, and 15-20 students whose first language is a Romance language and second is English. I will present them with a syntactical activity in 2 languages, one in a new (to them) Romance language and one in German. The results will be analyzed based on the patterns demonstrated between the speakers first and second languages and their presuppositions about the two target languages. I expect the speakers to use their corresponding base language knowledge to direct them to differentiating between the two additional languages so that their syntax will be the same for both Romance languages and both Germanic languages.

88 Microbes in the Mucosa: Probiotic-Based Vaccine and the Gut Microbiome

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The gut microbiome is a collection of microbes found along the gastrointestinal tract. However, the impact that the immune response has on the microbiome is not well characterized, especially when the immune system is activated during vaccination. Understanding this relationship is important as the gut microbiome influences many aspects of an individuals health, including maintenance of intestinal homeostasis, nutrient processing, and maturation of the mucosal immune system. We are investigating two changes within the host after vaccination with a Lactobacillus acidophilus vector: the host immune response to the vaccine and shifts in the microbiome bacterial community. This study uses a murine model to show the ability of this probiotic bacterium to deliver an HIV antigen (MPER) to relevant mucosal immune sites. The immune response to the vaccine and longitudinal shifts in microbiome are shown. We demonstrate antibody-specific induction of the immune response after vaccination, thus validating the bacterium Lactobacillus acidophilus is a suitable vector for delivering target antigens to mucosal effector sites. The microbiome will be analyzed further by sorting bacteria that are bound with mucosal antibodies to further define the relationship between the microbiome and the mucosal immune system during oral vaccination.

89 Anthropogenic Landscapes of Ancient Amazonia

GRACE ELLIS

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COLLEGE: LIBERAL ARTS

Traditional views of Amazonian habitation in the deep past revolve around environmental limitations on cultural development. This research challenges traditional perceptions of Amazonian societies as environmentally determined and adds to our understanding of ancient human occupation and modification of Amazonian landscapes. Anthropogenic landscapes are the product of complex human-environment processes that form distinct features in the landscape, which materially preserve and reflect human behavior. Since human colonization of Amazonia around 16,000 BP, humans have been modifying the landscape resulting in a mosaic of anthropogenic landscape features across Amazonia, which reflects the cultural heterogeneity that existed in the past. This research explores the complex human-environmental processes that form distinct features on the landscape and what these features can illuminate about past human behavior in Amazonia. Data for this research was collected at the pre-Columbian site, Macurany, located along the Middle Amazon River in Parintins, Brazil. Survey and topography revealed four distinct classes of anthropogenic landscape features at the site, including ports, middens, terra preta, and cultural forests. These features represent a range of subsistence, settlement, and infrastructure-building activities pointing to a society that was actively modifying the surrounding landscape. Geospatial analysis of the patterning of landscape features evidenced at Macurany suggest social organization was decentralized. The notion of a permanent, extensive, continuously settled, and decentralized society practicing intensive landscape engineering in pre-Columbian Amazonia challenges traditional perceptions of habitation density and early urbanization in Amazonia. This research contributes towards an understanding of human-environment interaction, landscape formation processes and urbanization in pre-Columbian Amazonia.

90 Energy Storage/Saving Materials: New Tools For A Fresh Look

COLBY EVANS

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COLLEGE: NATURAL SCIENCES

The development of next generation batteries and smart devices is instrumental to meeting the energy demands of our future. Nanostructuring materials has drastically improved performance of energy storage and energy saving devices in the last few decades. Now, the major issue is understanding how the differences in all the nanoparticles impacts their operation. We developed a correlated optical / scanning electron microscopy technique that allows us to study the fundamental chemical reactions of individual nanoparticles used for energy applications. So far we have found that individual isolated tungsten oxide nanoparitcles perform 4x better and last up to 20x as long as a nanoparticle film. The resolution of our method has allowed us to predict that growing the particles differently may allow further device improvements.

91 Soil Aggregates: The Tiny Homes for Soil Organic Matter Protection

REBECCA EVEN

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Soil is the largest terrestrial carbon (C) pool, storing more C than the atmosphere and vegetation combined as soil organic matter (SOM). Years of land use change and unsustainable agricultural practices have reduced SOM by 30-50%. In order to ensure food security and help mitigate climate change, we need to adopt management practices that regenerate SOM. One way is to increase soil structure by preserving and/or stimulating aggregation. Aggregation is a soil structural property thought to both promote SOM formation and its protection from further mineralization. However, little is known regarding the mechanisms by which aggregates perform these important functions. A new paradigm was recently developed in our lab that proposes two different pathways of SOM formation: one pathway contributes distinctly to the formation of particulate organic matter (POM) from the decomposition of structural root inputs (i.e. fibrous plant residues) while the second adds to the mineral associated organic matter (MAOM) from water soluble plant components and their microbial transformations. I aim to explore how aggregation affects these two pathways of SOM formation and its protection. I will track SOM dynamics using isotopically enriched soluble and structural plant components in a yearlong incubation experiment with soils of contrasting aggregation. Results from this research will highlight how important soil structure is for soil productivity and climate change mitigation. My study will also provide mechanistic understanding useful to improve larger scale SOM modeling and inform decisions for sustainable soil management.

92 Exploring Nitride Superconductors Synthesized at Low Temperature

MICHELLE FALLON

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COLLEGE: NATURAL SCIENCES

Superconducting materials have zero resistance and they expel magnetic fields which enables many unique applications such as levitating trains, and high performance electronics. Most known superconductors require low temperatures or high pressures to superconduct which makes designing devices challenging or impossible. Thus, there is a push for novel materials that superconduct at high temperatures without added pressure. Electron doped nitrides have shown promise as superconducting materials, however, nitrides can be challenging to synthesize. The goal of this research is to synthesize known nitride materials using a new low temperature approach and then electron-dope these materials and investigating their properties. This research would both provide a low temperature nitride synthesis as well as potentially discover new higher temperature superconducting materials.

93 Sensory Tradeoff?: Exploring the Effects of tbx2 on Anuran Eyesight

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The middle ear is known to be important for the survival of anurans (frogs and toads). However, the evolutionary loss of middle ear structures is widespread in anurans, with about 38 independent losses in 20 families worldwide and in many different environments. This convergent loss may be explained by antagonistic pleiotropy, which occurs when one gene is responsible for at least one beneficial trait and at least one detrimental trait. Selection for the gene occurs if the beneficial effects outweigh the cost. In this study, we explore a possible trade-off between ear and eye development as a result of tbx2, a strong candidate gene for ear loss. Along with its known role in ear development, tbx2 is highly expressed in the retina and has been shown to be involved in the differentiation of rod and cone photoreceptor cells. In this study, we aim to determine whether closely-related eared and earless toads (Rhinella yunga and Rhinella leptoscelis) possess differing ratios of rods and cones throughout the retina. We speculate that an increase in either rods or cones may result in improved eyesight for earless toads to compensate for ear loss. The results of this project may offer an adaptive explanation for the widespread and perplexing anuran ear loss phenomenon and contribute to our understanding of pleiotropic effects.

94 A Library of Values: Persistent Data Structures Using Explicit Aliasing

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Programming with values has many advantages over programming with places. Where place-oriented constructs struggle: values convey, persist, endure and share with ease. Code using places is by necessity imperative, a source of incidental complexity. Values overcome this problem. Where place-oriented constructs aim to manipulate computing substrate, value constructs aim to manipulate information. Many languages have spotty implementations of values, leaving programmers with a toolbox full of hammers. Languages and runtimes often support numbers and strings as values, but dont have aggregate values. Aggregates are necessary tools.
Aggregate values are implemented with persistent data structures, most notably as trees that can share (alias) their components. Runtime-dynamic aliasing like this requires runtime-dynamic memory recycling. Aliasing and unaliasing can be implicit, where recycling happens in periodic sweeps, or explicit, where recycling happens upon an explicit unaliasing event. Currently, the most complete value implementations are integrated with some particular recycling runtime. I aim to provide values to programmers in many languages, with persistent data structures using explicit aliasing. These structures can be driven by a runtime as rich as C, by exposing an opaque pointer resource model. I believe this will enable people learning to program, as well as practitioners working in the industry.

95 Association of Obstructive Sleep Apnea With Cardiorespiratory Fitness in Firefighters

SEAN GAO

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

Obstructive Sleep Apnea (OSA) is a common risk factor for cardiorespiratory dysfunction. Heart Rate Recovery (HRR) and maximal oxygen uptake (VO2 max) are indicators of cardiorespiratory fitness. We aim to assess association of OSA with HRR and VO2 max in Colorado firefighters who are at high risks of sleep disorders due to shift work outside from 9 a.m. to 5 p.m. The Heart Disease Prevention Program (HDPP) in the Human Performance Clinical and Research Laboratory at Colorado State University is an outreach program having screened cardiorespiratory dysfunction risk factors for Colorado firefighters over 20 years. Previous studies have shown that OSA leads to metabolic syndromes (MetS) resulting in decreasing cardiorespiratory fitness. We will use the available data collected from Colorado firefighters enrolled in the HDPP and test the hypothesis: MetS mediates association between OSA and decreased cardiorespiratory fitness in Colorado firefighters. The mediation effect will be tested using Multiple Linear Regression Analysis by Baron and Kenny (1986) with four steps. First, we will conduct a simple regression analysis with OSA predicting HRR and VO2 max. Second, we will assess a simple regression analysis with OSA predicting MetS. Third, we will present as simple regression analysis with MetS predicting HRR and VO2 max. Fourth, we will run a multiple linear regression analysis with OSA and Mets predicting HRR and VO2 max. The findings of this study will provide new evidence in better understanding the mechanism how sleep deficiency influences cardiorespiratory fitness.

96 Role of Beneficial Phytochemicals on the Honey Bee Gut Microbiome

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Ongoing challenges to honey bee populations have prompted worldwide research efforts to determine the causes and offer mitigation. Recent jurisdictional changes placing honey bees under the surveillance of veterinarians prompt reevaluation of their management and end products of research efforts to parallel those of other animal husbandry fields and provide standardized medical care. Human and veterinary medicine research provides significant evidence for the impact of diet on the gut microbiome in healthy and diseased states. Similar research on the honey bee gut microbiome is gaining momentum. A major concern facing honey bees relates to the depletion of nutritional resources and habitat. Earlier studies confirm increases in longevity and pathogen tolerance when bees consume dietary phytochemicals: caffeine, gallic acid, p-coumaric acid, and kaempferol.

The aim of the present study is to determine the effect of these phytochemicals on the bee gut microbiome and determine how their beneficial properties overlap. 8d-old worker bees (n=550), collected from two foster colonies were allowed to feed on a solution of 20% sucrose + 25ppm of one phytochemical, for 3 and 6 days. GI tract genetic material was extracted. 16S and ITS regions were amplified using Next-Gen sequencing. We found an increased microbial diversity and richness associated with duration and hive, relative to the phytochemical treatment. The compositional shifts observed are consistent with improved host metrics and hive fitness. Future work should further explore the utility of dietary management for gut

microbial health in honey bees as is being used in human and animal medical therapies.

97 Impacts of Forest Restoration Treatments on Colorado Native Bee Communities

RYLEIGH GELLES

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Insect pollinators are an essential component of both agricultural and wild ecosystems through the provision of pollination to the various forms of flowering vegetation, bees being the primary group responsible. However, recent research suggests a large-scale decline in bee populations, compelling the need for further research of the drivers and mechanisms influencing this decline. Within ponderosa pine forest communities, past management in the late 19th and early 20th century has led to unnaturally dense stands with closed canopies and suppressed understory production. Forest restoration goals along the Colorado Front Range align with conservationists goals of creating desirable habitat for bees by combating the lack of resource patch connectivity, herbaceous production, and landscape heterogeneity created by these dense stands. In this study, we examined insect pollinator community response to prescribed fire forest treatments within lower-montane ponderosa pine dominated forest communities in Red Feather Lakes, Colorado. Metrics of Bombus and other taxonomical groups of wild bees collected between May and September within treated plots were compared to that of specimen collected within control plots. It was found that treated plots had higher bee abundance, species richness, and species diversity than samples collected within control plots, although this trend diminishes as the growing season continues.

98 Urban Planning as Protest and Public Engagement: Reimagining Mong Kok

ANDY GILMORE

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COLLEGE: LIBERAL ARTS

I investigate Green Mong Kok (GMK): An Umbrella Revolution-inspired architectural blueprint for an environmentally friendly and democratic space in Hong Kong. Inspired by the citys 2014 protests, architect Vicky Chan created an urban plan for how Mong Kokone of the major sites of mass gatherings during the Umbrella Revolutioncould lead the way in providing a vision for a more democratic and sustainable Hong Kong. While I posit that GMK is a significant artifact for thinking about how to reimagine the role of environmentally friendly public spaces, in the context of Hong Kongs highly contested democratic future, I argue that GMK is problematic.

My rhetorical analysis of GMK suggests that while it does offer a stunning future vision for one part of Hong Kong, it also may be infused with lingering notions of class and social hierarchy, which were two of the key injustices that led to the Umbrella Revolution. Through my analysis, I argue that GMKs use of material, nature, space, movement, and culture acts as a form of governmentality that, while green, also embeds assumptions about class and power relations that might undercut GMKs more radical hopes.

As we face staggering ecological and social justice crises, increasing numbers of people around the world are dreaming of a green future. To this end, despite the flaws I uncover in my analysis, GMK provides a generative site for imagining not only the future of Hong Kong, but the future of environmental communication, urban communication, and interdisciplinary scholarship about space.

99 When It Rains, It Depends: Timing Affects Population Dynamics, Coexistence

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Plant species are well known to have exhibit variable responses to rainfall and some species thrive in saturated soils while others do not. Less often considered is the importance of timing of water availability in determining the success of plant populations, and its consequent role in driving community structure. Big bluestem (Andropogon gerardii) and indiangrass (Sorghastrum nutans) are two codominant grasses of the eastern Great Plains, US. Though they are both competitive and highly abundant, these two concurrently-active species bear many ecological similarities, raising questions about how their coexistence remains stable in the absence of clear physiological niche differentiations. However, the two species differ subtly in their clonal reproduction patterns, which may expose them demographically to temporal environmental variability. To test this, I used water additions to manipulate the timing of precipitation in field and greenhouse experiments, then observed the responses of population densities of the two species, both in competition and in isolation. I observed that both species responded negatively to late-season drought conditions but differed in degree. Both species suffered reductions in the longevity of their clones, but indiangrass also experienced reduced recruitment of new clones. However, indiangrass also showed a far more positive response in recruitment rate to late-season water additions. This suggests that the stability of the relative densities of these two species are tied at least in part to the timing of environmental variability, and as such may be threatened due to changes in interannual rainfall patterns resulting from climate change.

100 Revealing the Age of Malaria Mosquitoes through Wing Scale Counting

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Because the extrinsic incubation period for malaria parasite development is long relative to the lifespan of most mosquitoes, only older female anophelines transmit sporozoites. As such, it is important that researchers have a fast, reliable, and accurate method for estimating the age of wild mosquitoes during field studies. Our research investigates scale loss along posterior wing edges as a means of determining mosquito age on both the individual- and population-level scale. To begin, colony-raised An. gambiae mosquitoes were dissected,

ovaries were examined, and wing scales were counted at various stages of insect development. Linear regression analyses demonstrated that loss of wing scales within four pre-designated zones along the wing edge could be used to predict mosquito age (R2 values: Zone 1 = 0.22, Zone 2 = 0.23, Zone 3 = 0.28, and Zone 4 = 0.28; all p-values <0.01). To further these experiments, images of dissected wings were used to train a mosquito age predicting machine learning model. Results indicated that wing scale analysis predicted mosquito age with 90% accuracy. In addition, An. gambiae were reared in two separate mesocosms to replicate semi-field environments. One mesocosm was exposed to blood meals that contained a sub-lethal concentration of ivermectin, a mosquitocidal drug, to determine if shifts in the mesocosm population age structure could be detected via wing scale counting. Our findings may provide an alternative field method for detecting age shifts in malaria mosquito population structures, as well as opportunities for novel biotechnology development based on mosquito wing scale counting.

101 Food Insecurity in Immigrant and Refugee Communities in Northern Colorado

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COLLEGE: LIBERAL ARTS

Northern Colorado hosts immigrant and refugee families from around the world. These already vulnerable populations face food insecurity in their new homes despite many efforts to integrate into the community. In 2019, I conducted a study with clients and students of the Immigrant and Refugee Center of Northern Colorado in Greeley to assess their experience of food insecurity and strategies they have adopted to face food scarcity. The study follows several ethnographic methods including surveys, focus groups, and interviews with immigrants, refugees, and staff. The study argues for food sovereignty in which immigrants and refugees act as their own representatives in the search for sustainable food security. Finally, the study proposes several steps to ease the financial burdens and health crises surrounding affordable and nutritional food deficits in the community.

102 The Development of Machine Learning Toward the Development of Antidotes

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There are reportedly tons of nerve agents in existence worldwide. These deadly chemicals affect the central nervous system through inhibition an enzyme (acetylcholinesterase), which is vital for normal operation of many processes in the body. Following exposure to these agents, death can ensue without immediate medical intervention. Because these agents currently pose threats to both military and civilian populations through warfare and accidents, there is an urgent need for antidotes.

Our collaborators have developed a series of chemical compounds (substituted phenoxyalkyl

pyridinium oximes) with the objective of discovering a brain-penetrating antidote to these agents (Neurobiol Dis. 2019 May 31:104487. doi: 10.1016/j.nbd.2019.104487). Their set of candidate was developed based on the extensive chemical and biological expertise of the investigators, rather than on a systematic approach. Such approach could couple computational techniques with domain expertise to increase the likelihood of finding a successful antidote.

To this end, we developed a machine learning tool that computes a multitude of molecular descriptors for each chemical, and uses a random forest to predict endpoints of interest from optimized descriptors. Training this tool using the data from our collaborators, we made predictions for a set of compounds, determined important contributory descriptors, and identified several new candidate chemicals not included in the original set. Overall, the tool we are developing has the potential to increase the likelihood of finding compounds that will satisfy the numerous constraints required for their usage as antidotes and potentially reduce the number of fatalities and serious injuries resulting from nerve agent exposure.

103 Using Chew-Track-Cards to Index Rodent Abundance in the Mariana Islands

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The brown treesnake (Boiga irregularis) is a mildly venomous colubrid native to the South Pacific that was accidentally introduced to Guam after World War II. The eruption of the brown treesnake population on Guam caused great economic and ecological damage, including the extirpation of nearly all of Guams native forest birds. Advances in tools available for brown treesnake control suggest that landscape-level suppression may be realistic on Guam; however, data indicate that monitoring and managing invasive prey is crucial for long-term suppression or eradication. Capture-mark-recapture methods are often used to estimate small mammal abundance, where individual rats, mice, and shrews are live-trapped, ear-tagged, released, and potentially re-captured. While robust, this methodology is expensive and labor-intensive, and managers often require quicker, more cost-effective methods to index small mammal populations. We tested the accuracy of a small mammal abundance index chew-track-cards in Mariana Island forests. Chew-track-cards are baited, plastic rectangles with ink and contact paper that are designed to retain small mammal teeth impressions and footprints. We conducted capture-mark-recapture sampling alongside chew-track-cards at forested sites in the Mariana Islands that varied in small mammal abundance. We compared chew-track-card indices to abundance estimates via regression analyses and provide recommendations on their use in this system. Our findings will inform small mammal monitoring and improve understanding of when to control rodents. Rodent control is likely a critical component of a management strategy for long-term snake suppression to allow reintroduction of native vertebrates on Guam.

104 The Influence of Cortical Inhibitory Maintenance on Age-Related Force Control

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COLLEGE: HEALTH AND HUMAN SCIENCES

By 2050, there will be nearly 89 million people over 65 years old in the United States. Aging is accompanied by several neuromuscular adaptions that can adversely impact quality of life, including the loss of muscular force output control.

Purpose: The purpose of this study was to determine the influence of cortical inhibition on age-related force control declines. We hypothesized that older adults with more inhibition would demonstrate better force control as compared to those with less inhibition.

Procedure: Twenty-nine healthy young (YA) and older adults (OA) participated in this study. We used transcranial magnetic stimulation (TMS) to elicit the cortical silent period (cSP) recorded via electromyography. Participants were instructed to maintain 15% of their maximal knee extensor force as steadily as possible throughout the TMS trials. The data were exported to a custom MATLAB script for processing to determine force control capacity.

Results: OA demonstrated more variable force output in the right leg than YA, but there were no other significant differences in force control between groups. OA displayed significantly shorter cSPs (i.e. less cortical inhibition) in the right hemisphere than YA. Inhibition also differed within the OA group, with the left hemisphere showing less inhibition than the right. Linear regressions revealed one significant association: YA with greater inhibition displayed more variable force output.

Implications: This study indicated important differences in cortical inhibition between YA and OA, but those differences did not influence force control differences. Future research should explore additional neural mechanisms for age-related force control changes.

105 Recreational Trails Positively Affect Mammalian Connectivity in an Urban Landscape

ISABELLA HARRIS

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Mammalian populations in habitats across the world require an array of factors in order to grow and thrive. One of the most important factors for these species is corridors; stretches of land that connect ecosystems and allow wildlife to traverse patches of natural habitat. Often, one habitat does not provide sufficient resources for mammalian populations and they must utilize corridors to access resources required for their survival. For populations within urban ecosystems, corridors are a necessary factor that allows for travel between otherwise isolated habitats. My research is looking at safe corridors for urban wildlife in the form of man-made recreational trails. These trails not only allow for mammals to travel between habitats, but foster a positive connection between humans and urban wildlife. My purpose is to determine if mammalian populations are using recreational trails as corridors within the City of Fort Collins. This use will be determined by looking for a correlation between trail density within urban green spaces and species richness in these habitat patches. Species richness will be measured using data from wildlife trap cameras across Fort Collins. I predict that my research

will find a positive correlation between species richness and trail density, and therefore provide supporting evidence to show recreational trails being used as corridors by mammalian populations. This research will help build a foundation for current and future studies in urban ecology, and will help both scientists and city managers collaborate on conservation plans for urban ecosystems.

106 Do We Build a Resilient Healthcare System?

EMAD HASSAN

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COLLEGE: WALTER SCOTT, JR. COLLEGE OF ENGINEERING

Ensuring the continuation of vital community services is critical for minimizing social losses after extreme events such as earthquakes. Shortage of the hospitalization service could have catastrophic short-term and long-term effects on the community. The short-term effects could include an increase in morbidity and mortality as a result of direct injuries that are intensified by the lack of the service being available. The long-term effects could include population outmigration, social instability, and economic losses. Therefore, maintaining hospitalization service is essential community resilience goals and is vital for ensuring the social stability of any modern community. However, to date, no comprehensive models exist for estimating healthcare system functionality and recovery, patient demand on hospitals, and interaction between healthcare facilities after earthquakes. The introduced hospital functionality assessment model encompasses both the quantity and the quality of the hospitalization service. The number of available staffed beds and patient waiting time are utilized as indicators of the hospitalization service quantity and quality, respectively. The demand on the hospitals estimated based on the newly developed patient-driven model, which considering patient constraints, patient-to-hospital connection, hospital availability in addition to the hospital cluster interaction. The hospital's dependency on other infrastructure during the recovery process and the interaction between different hospitals have been modeled. Socioeconomic data related to the hospital operation and recovery after the earthquake have been utilized. The presented framework accounts for limitation in resources within the community, expected economic return for each hospital, and interdependencies between the different lifelines and the investigated hospitals.

107 Stem Cells Replace Neurons and Decrease Neuroinflammation in Prion Disease

ARIELLE HAY

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COLLEGE: VETERINARY MEDICINE AND BIOMEDICAL SCIENCES
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We propose the use of gene edited stem cells as therapy for neurodegenerative diseases. Olfactory neuronal progenitors (ONPs) can differentiate into neurons in adulthood. We hypothesize they will regenerate neurons that have been lost due to aggregation of disease-associated proteins. Mesenchymal stem cells (MSCs) can be derived from adipocytes of adult

mice and further differentiated to neural stem cells (NSCs), which we will use as an alternative to ONPs. These therapies will be modeled by prion infected mice, which display the typical features of neurodegenerative disease. Prion protein (PrP) is highly expressed in neurons, and its misfolding results in disease. PrP knockout mice are resistant to prion diseases. CRISPR/Cas9 gene editing will be used to delete the prnp gene in WT ONPs. CRISPR/Cas9 will also be used to revert a mutation associated with the human prion disease GerstmannSträusslerScheinker syndrome (GSS), modeled by a single point mutation at codon 101 of mouse PrP. Alternatively, we plan to edit the prnp gene in M/NSCs to express a secretable, dominant-negative PrP. Single cell sorting will be used to produce homogenous populations of edited cells, which will be sequenced to identify relevant mutations. We will engraft gene edited ONPs using stereotactic injection and M/NSCs using nasal instillation into the brains of prion infected WT and GSS transgenic mice. We hypothesize that these cells will resist prion infection. ONPs will migrate throughout the brain to restore damaged neurons and M/NSCs will populate the olfactory bulb and secrete dominant negative PrP and anti-inflammatory cytokines.

108 Establishing Pseudo Pelger-Huet Anomalies as Biodosimeters in Japanese Wild Boar

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The Fukushima-Daiichi nuclear disaster in 2011 released a plume of radionuclides into the surrounding environment which included Iodine-131, Cesium-134, and Cesium-137. The contaminated environment continues to provide unique research opportunities related to chronic low-dose radiation exposure, in that it would be similar to doses that human inhabitants of the Fukushima Prefecture and clean-up workers would likely experience. Here, quantitative biomarkers of radiation exposure were evaluated in free-ranging wild boar that now thrive in the region. Frequencies of abnormal neutrophils in peripheral blood, known as pseudo Pelger-Huët anomalies (PPHAs), were determined to be present in exposed wild boar. PPHAs have been shown to be useful biomarkers of radiation exposure in several scenarios, including archived slides from the 1958 Y-12 criticality accident, radium dial painters, and chronically exposed bats in South African caves containing high levels of thorium. We have confirmed the PPHA morphology in exposed wild boars, and in order to perform lifetime dose estimations, a dose response curve is being constructed utilizing blood smears collected in the field from approximately 140. The utility of PPHAs as a biodosimeter will then be validated via comparison to dose estimates obtained with gold standard dicentric chromosome analysis in the same animals. Results have the potential to help inform decisions as to when those in the exclusion zone may return to their homes, as well as 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 exposure.

109 Processing of Branched Ubiquitin Chains by Uch37 and the Proteasome

ZACHARY HAZLETT

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COLLEGE: NATURAL SCIENCES

Many proteins within living cells can be modified by the attachment of a small protein called ubiquitin for the purpose of changing their fate or function. Cellular machinery that modifies proteins with ubiquitin has the ability to link multiple ubiquitin molecules together in chains. These ubiquitin chains can be built onto a protein in a variety of lengths and conformations all having the potential to provide a unique signal. Known ubiquitin signals play important roles in protein degradation, chromatin remodeling, cell cycle regulation, and more. Of interest to us is the branched ubiquitin chain, a signal that has been identified within cells, but whose purpose is not well understood. We have preliminary evidence that the proteasome-associated deubiquitinating enzyme, Uch37, specifically recognizes branched ubiquitin chains. The goal of our study is to understand how Uch37 and its activator Rpn13 recognize and cleave branched ubiquitin chains, and what purpose this serves in protein degradation by the proteasome. We also want to identify which proteins within the cell are modified with branched ubiquitin chains, so that we can connect the function of Uch37 to specific cellular processes. Recent studies have revealed a connection between branched Ub chains and neurological diseases/disorders and have even proposed Uch37 and the proteasome as drug targets for cancer. Our work will reveal important information about these mechanisms of cellular regulation and will be of great importance to the understanding and treatment of various pathologies.

110 Remote Earthquake Identification in the Mackenzie Mountains, Canada

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Seismic activity in the Mackenzie Mountains region is poorly constrained due to a historically sparse seismograph distribution. In this study, new data are analyzed from the 40-station, 875 km-long Mackenzie Mountains temporary network (Baker et al., 2019) in conjunction with Transportable Array and other sparsely distributed stations in the region. Data from approximately August 2016 August 2018 are processed and compared to the sparse-network earthquake catalog records maintained by the U.S. Geological Survey. Combining the algorithms developed by Kushnir et al. (1990), Roecker et al. (2006), and others, signals are identified and subsequently associated across the network to identify small-magnitude earthquake events. Results from this study provide new insight into the regions of active faulting within the Mackenzie Mountains and to activity along large strike-slip features, such as the Tintina Fault. Additionally, the Mackenzie Mountains region is identified as having high seismic hazard, with implications for pipeline manufacturers, commercial developers, and local residents. These results inform a high-level interpretation of the regional geology and seismicity from a hazards and risk perspective for northwestern Canada.

111 Regulation of Neural Differentiation Through mRNA Methylation in Stem Cells

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COLLEGE: INTRA-UNIVERSITY

Stem cells are able to change or differentiate into any cell type in the body, a property known as pluripotency that enables them to initiate early growth and development. In order to maintain a pluripotent state, yet rapidly differentiate in response to external signals, stem cells need to exert tight control over expression of lineage-specific factors. However, the mechanisms by which this occurs are poorly characterized. N6-methyladenosine (m6A) RNA methylation is an abundant post-transcriptional modification that influences RNA structure and association of RNA-binding proteins and miRNAs. RNA methylation is important for the establishment and maintenance of pluripotency, but the role of m6A-binding proteins is less clear. In this study, we show the RNA-binding protein YTHDF2 contributes to pluripotency by targeting a group of mRNAs encoding factors important for neural development. The down-regulation of YTHDF2 during neural differentiation is consistent with increased expression of neural factors during this time. Based on our results, we propose that stem cells are primed for rapid differentiation by transcribing low levels of mRNAs encoding neural factors that are subsequently targeted for degradation, in part by YTHDF2, until differentiation is induced. This model illuminates the role of another factor involved in the complex regulatory pathways utilized to tightly control gene expression in stem cells. Our study expands the knowledge of how stem cells regulate gene expression, and identifies avenues to optimize use of stem cells in personalized medicine.

112 Urban Growth and Community Resilience on Flooding Events

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Economic development and population growth are major causes of urban expansion in flood-prone areas that put more exposure at risk. A comprehensive understanding of the impact of urban growth on flood risk is an essential ingredient of adequate risk management. Considering the effect of urban expansion on risk assessment, the current approaches are mostly limited to scenario-based analysis, where various scenarios are assumed for the city boundaries. While, these methods are convenient to use, they cannot incorporate the physical, environmental and more importantly the social and behavioral aspects associated with urban growth.
The objective of this study is to present an innovative approach for modeling the dynamics of urban growth that entangles the mentioned parameters. This method employs an integrated Cellular Automata and Agent-Based Modeling approach to simulate urban growth dynamics, resulted by socioeconomic changes. Considering the behavior of heterogeneous agents and environmental incentives provides a spatially explicit model that incorporates the interaction between residents and built environment through an adaptive feedback loop. The results of this research demonstrate that flood risk can be assessed more accurately by employing the physical and environmental drivers, as well as, human behavior in urban growth. This method also provides a perspective on potential socially vulnerable areas based on adopted urban planning policies. In addition, these results can be used to assist city planners and stakeholders in examining tradeoffs between costs and benefits of future land

development and performance of the built environment and population growth during the remainder of the 21st century.

113 Synaptic Ultrastructure at the Drosophila Neuromuscular Junction

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Fast and efficient neurotransmission is orchestrated through the release of neurotransmitter from a presynaptic nerve terminal, which travels across the synapse and reaches an adjacent cell. The active zone, a specific presynaptic specialization of the neuromuscular junction (NMJ), is the primary mediator for transmitter release during cell-to-cell communication. Synaptic vesicles dock, prime, and ultimately fuse with the presynaptic membrane at the active zone. Proteins required for each of these steps are highly concentrated and specifically organized into active zone material (AZM).
Previous experimentation has revealed functional roles of several active zone proteins. However, the location of these essential proteins remains unknown. Determining the synaptic ultrastructure of the AZM will help us determine the functional relationships of active zone proteins and decipher the molecular mechanisms mediating the vesicle cycle. However, resolution limitations of standard electron microscopy (~50 nm) has limited our ability to identify the spatial relationships between individual proteins and vesicles. Recently, through the use of electron tomography, the 3D active zone ultrastructure of mouse and frog has been determined at a sufficient level of resolution to begin assessing functional relationships. This technique permits the analysis of 0.5 nm virtual slices through a single 50-70 nm sample, to construct a 3D rendering of the sample. I have started to exploit the fast, cost effective, genetic system of Drosophila and high resolution of electron tomography to further elucidate the ultrastructural makeup at the neuromuscular junction.

114 Associations Between Sedentary Behavior and Blood Lipids in Colorectal Cancer

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Purpose: Dyslipidemia is associated with increased risk of colorectal cancer (CRC), the third leading cancer diagnosis in the United States. Moderate to vigorous physical activity (MVPA) can improve components of dyslipidemia, however the role of sedentary behavior (SB), independent of PA, is not as clear. This study examined associations between SB and blood lipids among individuals at high risk for CRC.

Methods: Participants were 18 years, and had 1 adenomatous polyps removed 3 years. PA and SB were measured continuously for 7 consecutive days using an activPAL accelerometer. Fasted blood was collected and analyzed for total cholesterol, triglycerides, high density lipoprotein (HDL), and low density lipoprotein (LDL) using standard procedures. Pearson

correlations explored associations between lipids and the SB variables of minutes in SB, number of bouts of SB >30 or >60 minutes, and % of waking hours spent in SB. Significant (p<.10) variables were included in hierarchical regression models, along with waist circumference and MVPA.
Results: Participants (N=23) were on average 58.9 ± 9.0 years old (52.2% female). Bouts of SB >30 minutes was associated with total cholesterol (r= .353, p=.099), however the regression model was not significant [F(3,19)= 1.30, p=.310, R2=.196].

Conclusion: Although number of SB bouts per day >30 min were positively associated with total cholesterol, the association did not exist after accounting for MVPA and waist circumference. Additional studies are needed to further explore the benefits of SB reduction in those meeting MVPA guidelines for blood lipid control and CRC prevention.

115 Obesity: Try Not To Get Sick!

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Obesity is a continued epidemic, with ~70% of adults in the United States considered overweight or obese. Pre-clinical and epidemiologic data suggest that obesity is not only a precursor for chronic diseases, such as cardiovascular disease and type 2 diabetes, but also infectious diseases, like influenza virus. As obesity-induced immune dysfunction has emerged as a fundamental driver of disease risk, we seek to better understand how obesity impacts and impairs immunity in humans. Peripheral blood mononuclear cells (PBMCs) are widely used for studying aspects of human immunity. We hypothesize that the adaptive immune response, specifically in cellular immunity, is impaired in obese individuals compared to lean counterparts. We collected PBMCs from 7 normal [18.5-24.9 kg/(m)2] and 7 overweight [25.0-29.9 kg/(m)2] or obese [30 kg/(m)2] individuals. PBMCs were isolated from whole blood using Ficoll gradient centrifugation. Upon isolation, PBMCs were counted and cryopreserved. After acquiring all samples, cryopreserved cells were thawed and prepared for culture. PBMCs were challenged in vitro with 5µg/mL of Concanavalin A (ConA) and incubated for 72hr. Post-incubation, supernatants were removed and saved for downstream cytokine analysis, and cells labeled with fluorescent antibodies and analyzed by flow cytometry. We postulate that ConA stimulated immune cells from obese individuals will show a blunted TH1 cytokine response, including reductions in IL-6, IL-2, LT-, and IFN-, compared to lean controls. Additionally, we postulate that obesity will impair Tregulatory cell expansion and function, seen as a reduction in IL-10, compared with lean counterparts. Supporting and providing insight into obesity-induced immune impairment.

116 Improving Tin(IV) Oxide Gas Sensors With Carbon Dioxide Plasma Treatment

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To compliment air quality data gathered by permanent monitoring stations, people have turned toward citizen science projects utilizing inexpensive, portable gas sensors to monitor harmful gases. Although commonly studied in the laboratory, tin(IV) oxide (SnO_2) is not typically used in these portable devices because it requires operating temperatures of 300 °C to effectively detect gases and often the unmodified material lacks selectivity for a single gas. One method to address these challenges is plasma processing, which allows for material surface modification while maintaining desirable bulk properties. Previous work using this method largely utilized O_2 or O_2/Ar plasma systems because they are thought to form oxygen vacancies in the SnO_2 lattice, resulting in improved gas-SnO_2 interactions at lower temperatures, thus improved device performance. Therefore, exploration of other etching plasma systems is needed to better understand how these changes in surface chemistry impact gas detection.

Here, SnO_2 nanoparticle gas sensors are treated with an inductively coupled CO_2 plasma at various applied rf powers. Plasma treated sensors demonstrated a higher response to ethanol, carbon monoxide, and benzene at lower operating temperatures when compared to the untreated sensor. Treated sensors also performed better than the unmodified sensors when evaluating sensor response and recovery behavior. Finally, optical emission spectroscopy measured during plasma treatment and material characterization post plasma processing will be discussed to evaluate how plasma treatment changes sensor performance. All these data work toward an improved understanding of the gas sensing process, ultimately working toward developing a targeted approach to fabricating better gas sensors.

117 Exploring Maternal Self-Care Practices to Facilitate Intervention Design

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Purpose: Parental health practices are related to child health outcomes, and maternal self-care, or behaviors facilitating healthy eating, physical activity, and stress management practices, may play an important role in child weight status. The overarching purpose of this project is to understand existing beliefs, practices, and supports or barriers surrounding self-care in mothers of preschool-aged children in rural settings via in-depth interviews. These interviews will be used to inform the development and refinement of a self-care intervention.

Procedure/description: Mothers (n = 19) from preschool centers in rural Colorado participated. A semi-structured interview guide was developed using the constructs of Social Cognitive Theory and pilot tested to establish content and face validity. The final interview guide consisted of 22 questions with multiple probes. Telephone interviews were conducted by a trained researcher. Interviews were recorded, transcribed verbatim, coded, and analyzed using an iterative approach.

Results/outcomes: Three themes emerged: 1) Self-care practices; 2) Facilitator and Barriers, and 3) Resources. Mothers had varying definitions of self-care and the contexts in which self-care strategies were used differed. Mothers described infrequent practices of self-care and difficulties prioritizing self-care. Participants identified self-care as important, but barriers, such as time, make it difficult to incorporate. Lastly, desired self-care resources included online information about the benefits of self-care, tips for incorporating self-care in to busy schedules,

and social support.

Implications/future directions: Understanding existing self-care practices in mothers provides information about maternal health behaviors that will be used to inform the development and refinement of a self-care intervention.

118 Investigating Silencing of the Cell Division Checkpoint in Cancer Cells

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When a cell divides, it is essential that its chromosomes are equally divided into the two new daughter cells, thus ensuring that each new cell receives an identical copy of genetic information. The importance of this process is emphasized by the fact that cancer cells often display incorrect segregation of their chromosomes, leading to uncontrolled proliferation. The main cellular structure involved in maintaining this genomic integrity is the kinetochore, a large network of proteins that assembles at the centromere during cell division. Monitoring of kinetochore-microtubule attachments is carried out by the spindle assembly checkpoint (SAC), a surveillance system that delays cell division until every kinetochore has attached to a spindle microtubule. During metazoan mitosis, the minus end-directed motor protein dynein is thought to strip SAC components away from attached kinetochores, allowing for anaphase progression. It remains unknown, however, how kinetochore dynein is activated to evict checkpoint proteins away from the kinetochore upon microtubule attachment. Here, we investigate the role of dynein at the kinetochore, as well as potential regulatory mechanisms governing its activity. By using a cell culture system that prevents dynein recruitment to kinetochores, we have identified a subset of SAC effectors as dynein cargoes. Additionally, we have demonstrated that the fibrous corona, a meshwork of proteins at the kinetochore, may have a role in amplification of the SAC signal at unattached kinetochores. Our current work is focused on purification of these kinetochore proteins for use in reconstituted motility assays to further elucidate the nature of their function.

119 Observing Ghost Particles in Japan

MATT HOGAN

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A neutrino is a nearly massless, electrically neutral elementary particle with unique properties whose properties can potentially explained the matter/anti-matter asymmetry in the universe. They are difficult to detect such that a single one can travel straight through the Earth unimpeded. Even stranger is that they are able to change their type called flavor as they travel through space. The international experiment Tokai to Kamioka (T2K) in Japan produces an intense beam of neutrinos to detect such flavor changing behavior. The experiment uses massive particle detectors to detect individual neutrinos as they travel through the Earth. The experiment is designed to investigate neutrinos as they change flavor through a quantum

mechanical process called flavor oscillation. In order to measure flavor oscillation, detailed knowledge of the neutrino beam must be known before and after flavor oscillations occur. In order to achieve this, T2K hosts a near detector (ND) site to detect the neutrinos before they undergo flavor change and utilizes the Super-Kamiokande (SK) detector to observe the oscillated neutrinos. To better understand flavor oscillations, the collaboration must also study how neutrinos interact with matter inside their detectors. This work describes the work to use the ND data to improve the measurement of oscillation parameters.

120 Beyond Air Quality & Climate: How Will the Planet Smell?

JULIE HOLDER

DEPARTMENT: CHEMISTRY
COLLEGE: NATURAL SCIENCES

Accurate prediction of both climate and air quality under a changing earth system requires a full understanding of the sources, feedbacks, and ultimate fate of all atmospherically relevant chemical species. Volatile organic compounds (VOCs) make up a large portion of the reactive chemical species in the atmosphere and are key components in air quality and climate change. Biogenic VOCs (BVOCs) are the main source of atmospheric VOCs and are naturally produced and emitted from plants in both direct and indirect response to their environment. Thus, if their environment changes, we can expect their BVOC emissions to change. The BVOCs most are familiar with are the fragrant ones, such as those you smell when you sniff a flower, freshly cut grass and that signature scent of a pine forest. They are, in fact, the primary reason our world is so aromatic (or smelly)! Further, it can be inferred that changing the conditions that dictate BVOC emissions will not only change the composition of the atmosphere, but also the aromatic profile of the planet. Yet, despite their importance, the impact of global change on BVOC emissions is poorly understood because measuring and quantifying them is not a trivial task. Therefore, we aim to quantify the relationship between BVOC emissions and environmental change through the combination of ecosystem level real-time measurements with laboratory controlled whole-plant chamber experiments. Our hope is that we can not only fill that knowledge gap, but also explore the intriguing question: will we be able to smell global change?

121 An Interactive Data Quality Test Approach

HAJAR HOMAYOUNI

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COLLEGE: NATURAL SCIENCES

Data quality tests validate heterogeneous data to detect violations of constraints typically specified by domain experts. For example, data quality tests may check for non-numeric value for the Weight attribute and a Pregnancy value for a Male patient in a health data store. Domain experts often specify constraints in an ad hoc manner and may miss important ones. We proposed ADQuaTe, which is an automated data quality test approach that uses an unsupervised technique to (1) discover constraints that may have been missed by experts and (2) label as suspicious those records that violate the constraints. These records are organized

in groups along with explanation and presented to the experts who determine whether or not the groups are actually faulty. ADQuaTe uses an interactive technique that incorporates expert feedback to retrain the learning model and improve the accuracy of the approach. We evaluated the effectiveness of ADQuaTe on real-world applications using a health data warehouse and a plant diagnosis database as well as on some ground truth data from the UCI repository. Our approach discovered new constraints in the attributes of health and plant data that were missed by experts and detected faults that were not previously detected by existing tools. Using the ground truth datasets that contain a set of known faults, we demonstrated that the true positive and false negative rates improved after incorporating the ground truth knowledge. We will extend ADQuaTe to support constraint discovery over multiple records using time series analysis techniques.

122 Understanding Symbiotic Fungal Communities to Increase Plant Community Restoration Success

SHABANA HOOSEIN

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COLLEGE: INTRA-UNIVERSITY

Modifications to plant community structure can lead to disruptions in many ecological processes and belowground interactions. As an obligate plant root symbiont, arbuscular mycorrhizal fungi (AMF) serve as a fundamental role in the rhizosphere microbiome and form intimate, mutualistic associations with the majority of land plants. While AMF communities are important for the survival and persistence of many host plants, many studies have shown that these symbionts response to restoration is context dependent. By understanding AMF community interactions within our target plant communities, we can begin to utilize plant-fungal interactions to increase plant diversity and restoration success.

Our study examines AMF community structure within high, low and monotypic plant communities to better understand how changes in plant diversity influence AMF communities. Soil samples were collected within a tallgrass prairie restoration site in Platte River, Nebraska across a gradient of plant diversity levels (high, low, monotypic). AMF communities were examined using high-throughput sequencing technologies.

We found that high diversity plant treatments had lower AMF diversity relative to low and monotypic plant communities. Additionally, we noted two AMF taxa were highly abundant in the high plant diversity treatments, but present in low abundances within lower plant diversity treatments. This pattern suggests that targeting specific AMF taxa may be more important in achieving restoration goals and re-establishing target high diversity plant communities.

123 Herd: Travel Stronger Together

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Studying abroad is a time of unparalleled growth for students who immerse themselves in a

new place with new people. Currently, study abroad orientations prepare individuals to travel, but dont develop connectedness as a group. Herd will fill the gap by guiding students through team-building initiatives to establish a feeling of home within an unfamiliar place. The app guides members through SWOT analysis to assess the teams strengths, discover cultural differences within and outside of the group, and to build a resource guide. Through this process, students will know who they can reach out to for assistance and have better access to information, all in a centralized place. This service is particularly relevant to study abroad programs as they tend to include more shared activities such as orientations, classes, and excursions. I am currently collecting preliminary data from students who have/planning to study abroad and those who facilitate those trips to identify current methods and their shortcomings. Utilizing communication theories, I am assessing current thoughts regarding how students can develop intercultural, group, and interpersonal skills, regardless of their program of study; when this work is not done, studies have shown that students can develop more severe feelings of disconnectedness and prejudice towards other cultures. Through CSUs Venture Validators I am conducting market validation and developing a business plan with their mentorship program. The web app will be created to test with student groups who are preparing summer abroad programs.

124 Old Electric Vehicle Batteries, Problem or Opportunity?

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Electric vehicle batteries are retired from electric vehicles when they do not meet the required performance metrics, however, these batteries still have remaining life. Upon retirement from electric vehicles, the battery cells state of health (SOH) are typically imbalanced as a result of differences in manufacturing and operating conditions. These imbalances degrade the batterys performance limiting the 2nd life value. Through a reconditioning process these batteries SOHs can be balanced resulting in increased value. The technology required to recondition batteries is under development by University of California San Diego and Utah State University. The role of this project is to evaluate the economics of building and operating an electric vehicle battery reconditioning facility that will sell reconditioned batteries to a second life energy storage market. To determine the minimum sale price of the reconditioned batteries, an economic model was built with the relevant expenditures and revenues along with adjustable reconditioning parameters. Initial modeling results calculated a minimum sales price of $97 per kilowatt-hour after reconditioning. A sensitivity analysis was used to determine how adjusting certain parameters would impact the sales price. After identifying reconditioning parameters that the sales price was sensitive to, scenario analyses were used to determine performance targets. The performance targets were relayed to the technology developers as a path to reduce the sales price of the batteries. Once the technology yields experimental results, the economic models assumptions will be validated or adjusted accordingly.

125 Statistical Methods for Estimating Health Outcomes Associated With Multipollutant Mixtures

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Individuals are exposed to complex mixtures of environmental pollutants on a daily basis. Researching health effects associated with pollutant mixtures is challenging due to small effect sizes, collinearity among multiple exposures, and possible nonlinear or interaction effects. Recently several statistical methods have been proposed to estimate the association between health outcomes and exposure to mixtures, but a formal evaluation among broad-ranging methods is lacking.

We compare the performance of five recently proposed methods and traditional linear models in a simulation study using observed air pollutant and pesticide exposure data. We evaluate methods on their ability to estimate the exposure-response function, identify active mixture components, and identify interactions. We applied all methods in an analysis of forced expiratory volume in the first second (FEV1) in a California children's asthma cohort.

We found Bayesian kernel machine regression and nonparametric Bayes shrinkage were able to estimate complex exposure-response functions and identify active mixture components more precisely and consistently than traditional linear models. Bayesian profile regression techniques performed poorly on observed exposure data. In the FEV1 analysis, we found evidence of an association between nitrogen dioxide and decreased lung function.

Model choice is important when studying exposure to mixtures of pollutants and depends on both the exposure data and research questions. Sophisticated methods have the capability to answer more epidemiological questions of interest in a wider variety of settings than traditional linear models.

126 Investigating the Use of Hydroxyapatite Scaffolds for Assisting Bone Regrowth

NELSON ISAACSON

DEPARTMENT: COLLEGE OF NATURAL SCIENCES
COLLEGE: NATURAL SCIENCES

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.

A material that matches these characteristics was developed by the previous graduate student in this lab. Of significant note is this material 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. 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.

127 Cell Size Evolution Mediates Simplification in Organ Morphology

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Genome size varies extensively across vertebrates, driven by levels of repetitive non-coding DNA. Because genome size is strongly positively correlated with cell size, repetitive DNA sequences impact phenotype, although the sequences themselves lack genetic function. Large cell size also impacts the structure and function of organ systems and whole organisms. Because organ and body sizes are a function of both cell size and cell number, body size can remain unchanged, despite evolutionary increases in cell size. In this case, organs and organisms are composed of fewer cells, producing structurally simplified, pixelated organs that must nonetheless achieve the functional output necessary for organismal survival. Salamanders have enormous cells and small bodies compared to other vertebrates, making them a model system for studying how organs maintain their function in the face of structural simplification. This work aims to identify the morphological changes that allow critical organs to maintain function despite the structural consequences of large cell size. I integrate soft-tissue CT scans and traditional histology to assess how the size and structure of liver and heart change with increasing cell size. I have found that cell size is not strongly correlated with organ size but does have a significant impact on the number of cells, proportions of cell types, and the overall organization of the tissues. These results identify the structural consequences of cell size on organ structure, contributing towards my broader goal of understanding the mechanisms that connect evolutionary changes in cell size to changes in cellular and organismal physiology.

128 Nuclear-Spin-Pattern Control of Electron-Spin Dynamics in V(IV) Complexes

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Achieving control of phase memory relaxation times (Tm) in metal ions is an important goal of molecular spintronics. Herein we provide the first evidence that nuclear-spin patterning in the ligand shell is an important handle to modulate Tm in metal ions. We synthesized and studied a series of five V(IV) complexes with brominated catecholate ligands, [V(C6H4nBrnO2)3]2 (n = 0, 1, 2, and 4), where the 79/81Br and 1H nuclear spins are arranged in different patterns. High-field, high-frequency (120 GHz) pulsed electron paramagnetic resonance spectroscopic analysis of this series reveals a pattern-dependent variation in Tm for the V(IV) ion. Notably, we show that it is possible for two molecules to have starkly different (by 50%) Tm values

despite the same chemical composition. Nuclear magnetic resonance analyses of the protons on the ligand shell suggest that relative chemical shift, controlled by the patterning of nuclear spins, is an important underlying design principle. Here, having multiple ligand-based protons with nearly identical chemical shift values in the ligand shell will, ultimately, engender a short Tm for the bound metal ion.

129 Paper-Based Nuclease Protection Assays for Pathogen Detection

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Nucleic-acid based sensor technology for the detection and quantification of pathogens at the point-of-need has wide ranging applications in medical diagnostics, food safety, crop protection, environmental analysis, biosafety, occupational hygiene and epidemiology. Traditional molecular diagnostic techniques for nucleic acids are expensive and can often only be performed in centralized laboratories by trained personnel. While significant strides have been made in portable nucleic acid assays, there is still a need for alternative methods that are widely applicable in resource-limited settings. Nuclease Protection Assays (NPA) have been employed in molecular biology for sensitive, sequence-specific detection of DNA or RNA in a variety of sample matrices, especially in the presence of abundant non-target DNA or RNA. In traditional NPAs, hybridization of an anti-sense probe to the target sequence is carried out in solution, followed by digestion with a nuclease which selectively cleave single-stranded DNA or RNA. The target-probe hybrids are protected from nuclease digestion, precipitated and visualized using autoradiography or through secondary detection methods. This is a powerful technique for detection of specific sequences but has not been adapted to point-of-need devices. We have developed a low-cost, paper-based platform to perform nuclease protection assays for the detection of pathogens at the point-of-need. Nuclease protection assays are carried out in solution followed by rapid detection of the presence of the target-probe hybrids using a lateral flow strip immunoassay. We have also developed on-chip sample pretreatment method to improve the sensitivity of the assay and eliminate possible interferents from the reaction.

130 The Role of Adaptation and Phenotypic Plasticity on Invasive Species

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Understanding how organisms establish, adapt and invade novel environments is of significant interest in evolutionary ecology and is important in this era of biological invasions, translocations, and global climate change. Phenotypic plasticity, when a genotype can produce multiple phenotypes in response to different environments, may be key to use of novel environments, particularly changes associated with global warming. Thus, understanding the degree of plasticity of traits, and whether plasticity improves performance

(i.e. is adaptive) or not, is important in understanding biological invasions as well as how climate change might affect species distributions. We have found that Drosophila suzukii, a species invasive in many locations around the globe, exhibits decreased wing size in low elevation (warm) locations on Hawaii relative to higher elevation (cooler) sites. We hypothesize that the variation is due to a combination of plastic responses to the environment and genetic differentiation, and further that plasticity is likely to be adaptive. I collected flies from low and high elevation sites on Hawaii island, and used a reciprocal transplant experiment we are examining the effects of warmer and cooler temperatures (representing low and high elevations) on wing size and number of offspring. By using flies collected from low and high elevation, we can distinguish whether these traits are determined by plasticity, genetic differentiation or both. In the face of global change and increasing biological invasions, understanding the underlying strategies that allow species to establish in novel systems is important in creating methods of control and maintaining native ecosystems.

131 Characterizing Bovine Muscle Composition and Pulmonary Health Across Finishing Systems

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High mountain disease (HMD) impacts select cattle grazing at elevations greater than 1,500 m. HMD is characterized as pulmonary hypertension and vascular remodeling culminating in congestive heart failure. Feedlot heart disease (FHD), a condition similar to HMD, has been observed in feedlot cattle never exposed to high altitude. Despite their similar pathology, HMD and FHD are separate conditions. This study investigated the impact of altitude and finishing system on mean pulmonary arterial pressure (PAP) and carcass characteristics. Forty steers born and raised at the Colorado State University Beef Improvement Center were assigned to one of four finishing strategies: stockered and grain finished at moderate altitude (Norm_Mod_Stocker, 1,420 m), stockered at high altitude (2,150 m) and grain finished at moderate altitude (Ext_Mod_Stocker), stockered and grain finished at high altitude (HA_Grain), or stockered and grass finished at high altitude (HA_Grass). PAP measurements were recorded on steers every six to eight weeks. Hot carcass weight (HCW), backfat, and kidney pelvis, and heart fat (KPH) were recorded at harvest. Comparisons across finishing systems was performed through mixed model regressions in R, with significance noted when $P>0.05$. HA_Grass steers had greater pre-harvest PAP measurements than Ext_Mod_Stocker ($P=0.006$) and Norm_Mod_Stocker ($P=0.024$) steers. HA_Grain steers had the heaviest HCW ($P<0.001$) and HA_Grass steers had the lightest HCW ($P<0.001$). However, HA_Grain steers had greater backfat and greater KPH than moderate elevation steers ($P<0.001$). Duration at high altitude negatively impacts some cattle. Research should be conducted to detect which cattle are most likely to succumb to HMD or FHD.

132 Remote Sensing Indicators of Ecological Resilience in the Great Basin

ERIC JENSEN

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COLLEGE: INTRA-UNIVERSITY

Natural resources agencies in the Great Basin rely upon models of ecological resilience to make decisions regarding post-fire stabilization and restoration projects. In order to assess ecological resilience, I propose models of plant diversity that use remote sensing indicators derived from NASAs Landsat to better measure temporal changes in Great Basin plant communities. I use a random forest modeling approach that includes remote sensing indicators like the normalized difference vegetation index (NDVI) and tasseled cap indices, along with biophysical covariates including, climate, soils, and elevation as predictor variables. The random forest models will be trained based on measurements of vegetation diversity at nearly 4000 Bureau of Land Management Assessment, Inventory, and Monitoring (AIM) plots and independently validated based on over 1000 withheld AIM plots. Models will then be applied across a stack of raster images of each predictor variable for each year of the Landsat data from 19842019 to produce annual maps of plant diversity. This project is ongoing, and we believe that the models of plant diversity will prove to be a novel and useful way of approaching ecological resilience. The resulting plant diversity model will be assessed as a predictor for ecological resilience using measurements of post-fire recovery based on the LandTrendr algorithm.

133 Atomic Layer Deposition for Improved Photoelectrochemical Water Oxidation Device Performance

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One of the challenges facing the world is the need to fulfill the growing demand for energy while minimizing CO2 emissions and without relying on nonrenewable resources. Splitting water into hydrogen and oxygen using the power from the sun is one such system capable of renewable solar energy conversion. Previously, we developed a water-oxidation photoanode consisting of nanostructured SnO2 coated with a perylene diimide dye derivative (N,N´-bis(phosphonomethyl)-3,4,9,10-perylenediimide, PMPDI) and a CoOx water oxidation catalyst. However, this device was limited by inefficient electron transfer (due to recombination and trap states) at the CoOx/SnO2 interface, resulting in an approximately 50% decrease in photocurrent with the addition of the CoOx catalyst. We hypothesize the addition of an electronically insulating alumina (Al2O3) coating deposited onto the dye by atomic layer deposition (ALD) would improve injected electron lifetimes, while also physically separating the SnO2 and CoOx, reducing trap states. The addition of an insulating alumina overlayer can increase photoelectrode lifetimes while improving photocurrents, making it a promising method for device improvement. Herein, we demonstrate the impact of the controlled and optimized ALD coating to the systems rate of recombination, device lifetime, photocurrent, and faradaic efficiency. The addition of an alumina layer resulted in an approximately 3-fold improvement in photocurrents and reduced recombination, resulting in a more effective water splitting device. The improvement demonstrated herein offers an approach towards developing organic photoelectrodes that may offer a realistic, long-term approach to produce

storable solar powered energy.

134 Factors Related to Parents' Serving Size Estimations

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Serving size estimation is related to several factors such as hunger levels, health numeracy, and the metric of measurement (Brogden & Almiron-Roig, 2011; Regan et al., 2018). This study used products with Front of Package labels (a 1-4 star healthfulness rating) to test how a public service announcement (PSA) introducing and explaining the labels would impact serving size estimations and how serving size estimations differ by food type. Serving size estimation data from 172 parents (93% female, M age= 38.4, 87% white, 14% Hispanic) for 4 foods 2 cereals (a dense, crunchy wheat and barley cereal, and a rice cereal) and 2 snack foods (potato chips, and pretzels) were analyzed. It was predicted that those who viewed the PSA would estimate smaller portions of less healthful foods (chips, pretzels), relative to foods earning more stars (cereals). Regressions showed seeing the PSA did not predict serving size estimations (All R2 <.01, ps>.05), but food type was a significant predictor of serving size estimation, predicting around 91% of the variance (R2 =.910, F (3, 684)= 2294, p<.001). Parents overestimated serving sizes for the dense cereal and pretzels but underestimated for the rice cereal and potato chips. Findings suggest that while watching a PSA about labeling may not have a significant impact on serving size estimations, the type of food is associated with the degree to which an individual may over/underestimate serving sizes. Highlighting areas of potential bias is useful to those hoping to improve their accuracy in serving-size estimation.

135 Literary Trauma and Masculinity: Gender Expression in "Shell Shocked" Heroes

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Though much literary work has been done with masculinity studies and trauma theory individually, and on masculinity in a military/war context, very little discusses the relationship between gender performance and traumatic expression--the ways in which military experience in general and combat-specific traumas reflect, reinforce, shift, challenge, and/or complicate the expression of masculinity during service and in reintegration into civilian society. This paper explores the intersection of PTSD and hegemonic masculinity performance; focusing on Septimus Smith, Virginia Woolfes shell-shocked WWI veteran in Mrs. Dalloway, I argue that gender norms affect his experiences with and attitudes toward military service, and his resultant PTSD, shaping his behavior and mental state in ways that either reproduce or transgress the tenets of traditional masculinity. This dynamic yields a shift toward toxic masculinity that heightens and is in turn reinforced by his mental deterioration, thereby intensifying his breakdown and suicide. Drawing upon contemporary texts within trauma studies and gender theory, I trace Septimuss downward spiral, paying particular attention to

diction and narrative fragmentation as representative of his internal war--his desperate attempts to reconcile internalized masculine expectations with a rapidly deteriorating brain. Revisiting Woolfes account of postwar trauma in light of contemporary developments in trauma studies and gender theory raises new questions about the potential of literary representation in extending or complicating modern conceptions of gender performance and trauma expression and healing.

136 Development of a Novel Tendon Degeneration Model Enables Orthobiologic Development

JIMMY JOHNSON

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INTRODUCTION: Rotator cuff tendon (RCT) repair surgeries in the US occur frequently (~450,000 annually), have a large direct medical cost ($7B), have a high failure rate, and lengthy recoveries, demonstrating the critical need for the development of orthobiologics and regenerative therapies that can be used to improve post-surgical tendon healing. Unfortunately, the degeneration observed clinically has not been effectively emulated in a large animal model inhibiting research into this disease and treatments. The objective of this study was to validate a translational ovine model of chronic rotator cuff tendon degeneration and understand the
METHODS: Ten sheep were operated on bilaterally and sacrificed at 6, 12, and 18-weeks. A mid substance degeneration model was generated by creating sixteen full thickness striations through the tendon (aligned with the loading axis). At sacrifice, non-destructive biomechanical stress-relaxation tests were performed followed by histologic processing and RNA sequencing. Samples of chronically degenerated human rotator cuff tendons were obtained from patients undergoing reverse total shoulder arthroplasty to use as a positive control. DISCUSSION: Cellular-level and biomechanical changes were noted at all timepoints that indicate a pattern of symptoms similar to what was noticed in the human degenerated tendon cascade. These data indicate that this novel model of chronic tendon degeneration is an accurate histological representation of what occurs pathologically in degenerated human tendons. Future gene expression data will illuminate the pathways involved in tendon degeneration laying the pathway for the development of an orthobiologic aimed to reduce or arrest the degeneration occurring in humans clinically.

137 Lets Talk About Nitrogen Chemistry in Wildfire Smoke Plumes

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The frequency, intensity and burn area of western U.S. wildfires are all expected to increase as the climate changes. The chemistry of wildfire smoke is fundamental to understanding air pollution, nutrient cycles, weather, and climate. While it is widely known that the western U.S. is directly impacted by wildfires, smoke from these wildfires can also travel thousands of

kilometers, impacting areas far downwind from the fire itself. In summer 2018, the WE-CAN field intensive deployed the NSF C-130 research aircraft to fly through more than 20 western US wildfire smoke plumes. The aim is to understand and characterize the emissions and daytime evolution of young wildfire smoke. I will present a summary of the evolution of nitrogen species in wildfire smoke plumes as they evolve with time in the atmosphere. I will focus on peroxyacetyl nitrate (PAN), which is a thermally unstable molecule and plays a critical role in the global redistribution of nitrogen oxides. We find that PAN production is rapid in the first 4 hours of plume aging, and then the dilution corrected PAN abundance remains relatively constant for plumes observed at constant altitudes. Within 4 hours of atmospheric aging, the contribution of PAN reaches an average of 57% in this dataset of wildfire plumes. This result means that smoke has the potential to transport nitrogen oxides and impact ozone chemistry far away from the fire source.

138 Using Lasers To Look Inside Solar Cells

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Photovoltaic (PV) devices, colloquially known as solar cells, have improved dramatically over the last decade due to increased research focus. Time-resolved photoluminescence (TRPL) is a valuable characterization tool for PV devices. Traditionally, this measurement is used to extract what is known as the lifetime, a parameter which describes the overall quality of the material or device structure. However, many individual mechanisms contribute to lifetime in nontrivial ways; identical lifetime measurements in fact could actually represent vastly different internal conditions. This project aims to employ novel advanced TRPL measurement techniques such as 2-photon excitation, back-side injection, and external bias application, all tied together with modeling, to untangle these contributions from each other and obtain a far more specific and detailed picture of what is happening inside a particular PV device. This analysis can more effectively isolate problematic areas within the PV device structure, guiding research and development. If successful, these advanced TRPL techniques could be employed to measure specific, vital device parameters, values of which until this point have proven to be exceedingly difficult if not impossible to accurately attain.

139 Synthesis and Characterization of Layered CuSbSe2-xSx Nanosheets

AMANDA KALE

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Earth-abundant copper chalcogenides have attracted interest as potential thin-film solar cell materials; among these, CuSbSe2 has emerged as a candidate due to its promising band gap and high absorption coefficient. Additionally, sulfur can be substituted onto the selenium site in a solid solution to tune the band gap. Studying carrier transport in CuSbSe2 is of particular interest as it exhibits the 2D layered chalcostibite structure, which contrasts sharply with the 3D connectivity common to most solar absorbers. I have developed a hot-injection synthesis

of CuSbSe2-xSx for x = 0 to x = 1 nanocrystals in oleylamine and 1-dodecanethiol. Transmission electron microscopy shows that products have a nanosheet morphology. Photoluminescence measurements show that the band gap increases with increasing sulfur content. I have thoroughly characterized the crystallographic orientation of anisotropic CuSbSe2 nanosheets and show that sheets have a propensity to stack. Sheets could be assembled into organized structures to direct carrier transport. Investigations of carrier transport in various architectures of CuSbSe2 nanosheets are ongoing.

140 Maternal Stress and Offspring Philopatric Behavior in an Asocial Mammal

RACHEL KANAZIZ

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COLLEGE: INTRA-UNIVERSITY

Stress is a physiological state experienced by all living organisms which can be passed across generations. The purpose of my study is to understand the consequences of maternal nutritional stress on daughter dispersal behavior (i.e. remain philopatric or disperse away from the natal home range). I address this in a population of golden mantled ground squirrels (GMGS), Callospermophilus lateralis, which has been studied for 30 years at Rocky Mountain Biological Research Laboratory in Gothic, Colorado. These hibernating mammals give birth to their young in burrows and offspring suckle from their mothers until emergence. During lactation, the stress hormone corticosterone can be transmitted from mother to offspring where it is eventually uptaken by developing hair follicles. By capturing and collecting hair samples from all mothers and daughters immediately upon emergence, stress data from the hair samples can be paired with philopatric/dispersal behavioral data to determine whether the nutritional stress of mothers determines if daughters remain philopatric or disperse after weaning. Sons tend to disperse regardless of circumstances whereas daughters sometimes remain philopatric to their natal home range. The ultimate goal of my thesis research is to gain insight into the role mother-daughter bonds play in shaping offspring behavior and fitness in light of environmental stress.

141 Cybersecurity Threats for Nuclear Power Plants - Attacks and Mitigation

DIPTENDU KAR

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COLLEGE: NATURAL SCIENCES

With the increased implementation of digital systems for instrumentation and control, nuclear power plants have become more prone to cyber-attacks. Keeping in mind the magnitude of the consequences of cyber-attacks on nuclear power plants, it is important that research be focused towards distinguishing such cyber-attacks from fault induced safety events for a correct response in a timely manner. In this research, an event classifier to differentiate abnormal events in nuclear power plants as either fault induced safety events or cyber-attacks in is investigated. Both the physical and network behaviors of a nuclear power plant during abnormal events are used to infer the probabilities of the hidden state of the plant. The nature

of the abnormal event in question is then determined based on these probabilities. The Dynamic Bayesian Networks (DBNs) methodology, is an appropriate framework for inferring the hidden state of the system from the observed variables through probabilistic reasoning. An experimental environment with a two tank system in conjunction with a nuclear power plant simulator and a PLC is designed. A variety of cyber-attacks and safety events for the experimental system are systematically devised. These scenarios are implemented and measurements from a set of sensors and real-time network traffic data are used to test and validate the presented classifier.

142 What is Eating My Potatoes?

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Potato is the fourth most consumed food globally and leading non-grain crop worldwide. In the United States, potato has nearly a $4 billion production annually. Every year, up to 50% of seed rejection and crop losses is caused by bacterial ring rot of potato (BRR), if it is detected. The Gram-positive bacterium Clavibacter michiganensis subsp. sepedonicus (Cms) causes BRR. Bacterial ring rot of potatoes is considered as a zero tolerance and quarantine disease because the presence of this disease can result in large yield and financial losses for potato growers and industry. Furthermore, the presence of a single infected plant may disqualify an entire farm from seed production. Effective management of Cms is aided by accurate and sensitive molecular detection methods. Ambiguous test results have led to costly delays and occasionally to both financial and yield losses for farmers in subsequent growing seasons. In this study, we developed a droplet digital PCR (ddPCR) assay for accurate and sensitive detection of Cms. The assay was compared empirically to existing methods for detection including conventional PCR, real-time PCR (RT-PCR), and ELISA, using field samples from a previous outbreak. We found ddPCR assay improved detection capacity by 100-fold using serial dilution of genomic DNA compared to RT-PCR. Our results demonstrate that Cms is still present in the potatoes sold for consumption in grocery stores, which was unable to detect using previous methods. This discovery highlights the improved detection capabilities of ddPCR and the need for expanded Cms monitoring in the United States.

143 The Influence of Moisture Enhancement on Solid Waste Biodegradation

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COLLEGE: WALTER SCOTT, JR. COLLEGE OF ENGINEERING

Moisture addition to solid waste landfills via leachate recirculation and liquid waste addition are methods used to promote in situ anaerobic biodegradation. However, operations for moisture addition are generally ad hoc and controlling the amount of liquid added and frequency of dosing is challenging. The objective of this study was to assess the influence of moisture enhancement strategies on biodegradation of MSW in laboratory-scale reactors. Moisture enhancement strategies were varied with respect to dose volume (40, 80, 160, and

320 L/Mg-MSW) and dose frequency (dosing every ½, 1, 2, and 4 weeks). Biodegradation was evaluated based on methane generation to identify moisture enhancement strategies that can (i) reduce the lag-time between the start of liquid dosing and onset of methane generation and (ii) increase the first-order decay rate for methane generation. In general, the more aggressive liquid dosing strategies (i.e., higher dose volumes and more frequent dosing) yielded leachate chemistry that displayed anticipated hydrolysis, acidogenesis, and methanogenesis phases. The first-order decay rate for methane generation increased with an increase in dose volume for all four of the dose frequencies. Thus, more rapid dosing was advantageous to enhancing methane generation in a shorter amount of time after the first inoculum dose was added. A key conclusion from this study was that reactors with more aggressive moisture enhancement (i.e., higher monthly dosing) attained elevated methane generation (higher decay rate) that initiated at shorter elapsed times following the onset of dosing (reduced lag-time).

144 Impact of Time-Restricted Feeding on Metabolic Homeostasis in Healthy Adults

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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. However, recent evidence 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 fast. Many studies report improved metabolic function due to TRF. However, none have assessed the impact of TRF on overnight circulating factors. Therefore, the aim of the present study is to examine the impact of TRF on overnight free fatty acids (FFA), glucose, insulin, and insulin sensitivity.

Methods. Five healthy adults (4F; 28±3.7y; 22.1±2.4kg/m^2; mean±SD) have 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 SAM Lab for an overnight stay involving hourly blood samples and an oral glucose tolerance test.

Expected results and implications. We hypothesize that TRF will lower overnight FFA, glucose and insulin, and improve insulin sensitivity. The knowledge to be gained offers the potential to support cost-effective programs that may inform our healthcare approach to metabolic disease prevention in populations at risk for these diseases such as shift workers and anyone who eats outside of daytime hours.

145 Consistency of Hill Estimator for Data Observed With Errors

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We investigate the asymptotic and finite sample behavior of the Hill estimator applied to time series contaminated by measurement or other errors. We show that for all discrete time models used in practice, whose non--contaminated marginal distributions are regularly varying, the Hill estimator is consistent. Essentially, the only assumption on the errors is that they have lighter tails than the underlying unobservable process. The asymptotic justification however depends on the specific class of models assumed for the underlying unobservable process. We show by means of a simulation study that the asymptotic robustness of the Hill estimator is clearly manifested in finite samples. We further illustrate this robustness by a numerical study of the interarrival times of anomalies in a backbone internet network, the Internet2 in the United States; the anomalies arrival times are computed with a roundoff error.

146 Correlating Structural Dynamics With 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. Intrinsic broadband white light emission has been observed in layered hybrid organic-inorganic perovskites with the formula A2PbBr4 (A = R-NH3+). This phenomena has been correlated to static lattice distortions. The intensity of the observed excitonic emission is dependent on the lattice dynamics and the organic cation, suggesting these dynamics are coupled. Quasielastic neutron scattering (QENS) is an advanced scattering technique used to probe the dynamics of the A-site cations. Here, QENS and photoluminescence show more intense broadband emission is observed in materials with larger out-of-plane tilt angles and slower cation dynamics in the perovskite family, A2PbBr4 (A = n-butylammonium (nBA), 1,8-diaminooctammonium (ODA), and 4-aminobutyric acid (GABA)). 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.

147 Enhancement of Oncolytic Viruses by Vanadium(V) Dipicolinates

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Oncolytic viruses are nonpathogenic viruses that preferentially infect and kill cancer cells,

leading to long-lasting tumor defenses. This study has explored the combination of oncolytic rhabdovirus with vanadium(V) dipicolinates to see if vanadium compounds are effective in the enhancement of oncolytic viruses. Vanadium(V) dipicolinates were previously in Phase II clinical trials for anti-diabetic drugs and were unfortunately cut due to loss of patent. These compounds were chosen for this study to see if their medicinal properties can be applied to other medical issues, such as cancer. The dipicolinate compounds were tested with collaborators and shown to increase viral potency in the tumor cells. The three vanadium(V) dipicolinate complexes were characterized in model membrane systems using spectroscopy (1H and 51V NMR) and stability studies were carried out at physiological conditions. Stability studies indicate that the complexes are susceptible to hydrolysis at physiological conditions after an extended period of time, resulting in the formation of vanadate and free dipicolinate ligands. All three vanadium(V)-dipicolinate complexes show similar enhancement of virus infection compared to vanadate which confirms that the effects are likely to be caused by the vanadium for these three complexes. The synergy between oncolytic viruses and vanadium complexes has suggested a new direction in the development of novel effective pharmaco-viral oncolytic therapies.

148 ATR-FTIR Study of Weak OH···F Hydrogen Bonds in Ionic Solids

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Relative OH···X hydrogen bond strengths (X = F, O) have been measured by comparing the (OD) peak position(s) in the infrared spectrum of a sample with a single HOD molecules per formula unit to the (OD) peak position of HOD(g) (2720 cm1)1. The magnitude of the redshift a sample exhibits is an indication of the strength of the hydrogen bond; a larger redshift indicating a stronger hydrogen bond. Investigation of a series of metal salt hydrates containing the weakly-coordinating anions: B12F122, PF6, TiF6, Al(OC(CF3)3)4, Ga(C2F5)4, and B(3,5-C6H3(CF3)2)4 show the presence of weak OH···F hydrogen bonding resulting in very sharp (OD) peaks (FWHM 30 cm1), with minimal redshifting (14-84 cm1) from 2720 cm1. The lithium salt hydrates Li(HOD)(H2O)3(Al(OC(CF3)3)4) and Li(HOD)(B(3,5-C6H3(CF3)2)4) have (OD) values (2706 cm1 and 2705 cm1 respectively) that rival HOD absorbed in polyvinylidene difluoride (PVDF(HOD)) (2696 cm1)2 in terms of its redshift from 2720 cm1. PVDF(HOD) was, until now, the compound with the smallest reported redshift from HOD(g) for a HOD···F hydrogen bond studied spectroscopically. These weak OH···F hydrogen bonds have also allowed for the confirmation of the calculated peak-to-peak distance of the E and B fundamentals for the cyclic (H2O)4 water cluster by studying the cyclic (H2O)4 cluster containing salt Li2(H2O)4(B12F12).

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149 Myoglobin Versus Fiber Type Expression in Skeletal Muscle Cells

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Myoglobin is a hemoprotein expressed in vertebrate muscle that has been shown to ameliorate the effects of tissue ischemia experienced by mammalian divers during diving. Typically, myoglobin expression is known to follow an established slow muscle fiber type. These slow muscle fibers contain a protein called myosin heavy chain I and are found in endurance muscles. Interestingly, recent evidence has shown changes in myoglobin expression without a change in fiber type. This indicates that myoglobin expression may not always be fiber type dependent and could be regulated by different stimulatory pathways. Our lab has shown that mixed lipid supplements, and hypoxia coupled with muscle contraction elevate myoglobin levels in cells from terrestrial and marine mammals, but it is unknown how these supplements affect myoglobin expression relative to the fiber type of the cultured tissue. To investigate, we have cultured and differentiated C2C12 myoblasts in the presence and absence of lipid, hypoxia, and/or caffeine to stimulate contraction. Cells were then harvested each day after differentiation initiation. Western blots were conducted to determine the expression of myoglobin and various myosin heavy chains. With these methods, we have found myoglobin expression prior to that of myosin heavy chain I and IIA. This data reveals conditions under which there are pathways to myoglobin expression independent from slow fiber type expression. Examination of alternate routes of myoglobin expression that are independent of fiber type could yield potential therapeutic benefits to combat ischemic diseases seen in humans and animals.

150 Exploring New Frontiers With the Short-Baseline Near Detector

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The Short-Baseline Near Detector (SBND) is expected to be commissioned in 2020 and will be installed 110 meters from the Booster Neutrino Beam target at the Fermi National Accelerator Laboratory where it will be used to study an elusive particle called the neutrino. The neutrino was first theorized by Wolfgang Pauli in 1930 to account for missing energy in nuclear interactions and could hold information about the origin of matter and proof of a reality outside the Standard Model of particle physics. Although Pauli famously believed the neutrino interacted too infrequently to ever be observed, but the first neutrino detection occurred in the 1950s. SBND, containing 112 tons of instrumented liquid argon and employing state-of-the-art detector technology, is designed to observe several million neutrino interactions per year! SBND, as the near detector of the Short-Baseline Neutrino (SBN) program, has the responsibility of recording an unprecedented rate of neutrino interactions to reduce uncertainties on physics measurements which could result in a fundamental shift in how physicists model our world.

151 Impacts of Food Insecurity and Social Isolation on Healthy Aging

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Purpose: To measure if programs like Market Days impact food insecurity and social isolation among low-income older adults.

Procedure/description: Case Series Study
- Participants completed a pre-survey that collects demographic data (age, sex, income), measures of social isolation using Giervalds scale for social loneliness, and current consumption of produce.
- Participants used Produce Bucks (varying between $10 and $20) to spend on fresh fruits and vegetables every week at the Larimer County Farmers Market, with the option of having a student volunteer to accompany them.
- Educational materials from USDA were available at the stand as well as recipes for the educational component
- Participants completed a post-survey that again measures social isolation (Giervalds scale) and current consumption of produce to evaluate if changes occurred throughout the season.
Expectations for next season:
- Participants will have pictures taken of what they buy every week as well as a weekly call to assess how much the participant consumed, preparation methods, and food waste.
- Surveys will expand to Giervalds 11-item survey to assess social loneliness, current/past health disparities, Behavioral Risk Factor Surveillance System (BRFSS) fruit and vegetable dietary intake module

Results/Outcomes: The season ends at the end of October, at which point a preliminary analysis of the pre and post surveys will occur to see if there were any significant changes in social isolation and food insecurity.

Implications/Future directions: To evaluate the efficacy of programs such as Market Days for reducing social isolation and food insecurity among community-dwelling, low-income older adults.

152 Dimension Reduction and Surrogate-Based Topology Optimization of Periodic Structures

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The frequency bandgap of periodic structures has many potential applications. Topology optimization of the unit cell of periodic structures offers great potential to design periodic structures with desirable bandgap characteristics. However, topology optimization typically involves many design variables stemming from discretization of the unit cell. This creates computational challenges for both optimization (i.e., high-dimensional discrete design variables) and the calculation of frequency bandgaps for a given design (i.e., finer discretization requires higher computational effort). To address these challenges, this paper proposes an efficient dimension reduction and surrogate-based approach for topology optimization of periodic structures. Using information from a set of reference topologies with

more desirable bandgap characteristics, dimension reduction technique (i.e., logistic principal component analysis) is used to establish a low-dimensional representation of different topologies in latent design space. To reduce computational effort in calculation of bandgap, Kriging surrogate model is built with respect to the low-dimensional latent continuous design variables, and used within efficient global optimization to efficiently and adaptively identify the optimal topology. The effectiveness and great efficiency of the proposed approach are verified through an example on topology optimization of 2D periodic structures to maximize the in-plane frequency bandgaps.

153 Conductivity Mass Balance for Baseflow Estimation Using Low-Cost Data Loggers

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Quantifying the groundwater contribution to streamflow in Northwest Colorado is of value to support land and water management decisions and add to the active research surrounding baseflow estimation. The conductivity mass balance (CMB) method is often used to estimate groundwater contributions to stream discharge, which requires continuous stream discharge and specific conductance (SC) data. We have produced hourly flow data for seven different streams in the Medicine Bow-Routt National Forest. Stream temperature, intermittency, and conductivity (STIC) loggers were recently designed as a low-cost alternative to higher-cost conventional conductivity loggers (Chapin et al., 2014). STIC loggers were deployed at 10 research sites for water years 2017 and 2018 and have been calibrated. Hourly data were collected with the STIC loggers at each of these sites. Higher-cost conventional Onset HOBO U24 conductivity loggers were installed at three sites for comparison with the STIC loggers. STIC logger calibration curve R-squared values of 0.990 or greater record the same relative SC fluctuations as manually measured conductivity meter data and a higher-cost logger at Silver Creek, making it possible to estimate baseflow for the entire hydrograph. R-squared values between 0.980 and 0.990 have varying results. The Elkhead Creek STIC logger records the same relative SC fluctuations as the higher-cost logger during the falling limb of the hydrograph. Analysis of this falling limb suggests baseflow is 15 percent of stream discharge. STIC loggers with an R-squared value above 0.990 can be used to reliably estimate the groundwater contribution to baseflow with the CMB method.

154 Alternative DNA Replication Strategies in Extreme Environments

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Conventional DNA replication strategies utilize DNA replication origins (ori) to organize formation of replisomes at a specific location(s) in the genome. Under exceptional circumstances origin-independent replication is possible, but alternative replicative strategies are typically repressed in favor of origin-dependent replication. We recently demonstrated that

normal growth of the hyperthermophilic marine archaeon Thermococcus kodakarensis at 85C was not dependent on replication origins or the presumed replicative initiator protein Cdc6, suggesting that alternative mechanisms of DNA replication initiation remain relevant in extant species. More recent evidence suggests that T. kodakarensis reverts to origin-dependent replication when grown under non-optimal conditions, implying a temperature-dependent control of DNA replication strategies. My research is focused on delineating the molecular mechanisms controlling the use of origin-dependent versus origin-independent DNA replication initiation. Temperature-dependent splicing of inteins within critical replication/recombination/repair proteins, changes in ploidy and changes in replisome composition all likely contribute to control of DNA replication mechanisms. A combination of genetic and biochemical assays will be presented to support environmental control of alternative DNA replicative strategies.

155 CS 0: Going Beyond Code

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COLLEGE: NATURAL SCIENCES

In 2018, Colorado State University redesigned their CS-0 course to become a general education requirement for the university within Arts and Humanities, and a guaranteed transfer course across the state for a similar category in other universities. The first CS course in the State to be accepted as a GT-Pathway course. This redesign had to be carefully done due to a need to introduce liberal arts style topics such as CS History, Philosophy and Ethics, and Inclusive Design issues while maintaining current coding and student success standards that were already expected for the CS-0 at the university. We termed this combination as Culture and Coding. In order to add more without reducing retention, the course was redesigned around the psychology of learning and spacing of topics in a "Spiral" manner. Each topic was briefly introduced, and throughout the semester, students would dive deeper into the topics. This allowed for a 50% reduction of time focused on teaching coding topics, with students performing equivalent on exams compared to previous models of the course that focused 100% of the time on coding topics. Furthermore, students taught by the spiral teaching method outperformed students taught using traditional methods in the follow-on course. Our evaluation suggests that the spiral model of teaching computer science may allow for greater retention of topics, allowing classes to either cover additional concepts or go more in depth on current topics.

156 Designing Fe(II) Spin State Switching Complexes Through Post-Synthetic Modification

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The electronic absorption and magnetic properties of iron(II) are vastly different depending on its spin state. Reversible spin state switching can occur through external perturbations (e.g. temperature) or soft environmental changes (e.g. intermolecular interactions, coordination

number). To our knowledge, there are no reports of post-synthetic reactions on the iron(II) bound ligand to promote this spin state switching. By utilizing this post-synthetic reaction, reactive groups can be included on the ligand with more synthetic ease than traditional methods, allowing access to novel spin state switching compounds. Our efforts are focus on using azide-alkyne cycloaddition reactions to modify the coordinated ligand on the iron(II) center, inducing a spin state change. Through this cycloaddition, the iron(II) center with weak-field ligands can be furnish with stronger pi-acceptor ligands, providing access to novel sensors for specific organic functionalities through a visible color change. The structures, analyses of various cycloaddition reaction conditions, and magnetic characterizations of novel iron(II) compounds will be presented.

157 Evaluation of a Multiple Stage Anaerobic Digester

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The arid Great Plains of the central United States is home to numerous high-density, confined animal feeding operations (CAFOs) that utilize outdoor animal pens. These facilities generate a desiccated manure very different from the wastes generated from similar indoor facilities in other parts of the country. These high-solids wastes present challenges to the conventional digestion systems commonly used on wastes with lower solids contents. Therefore, it was determined that there was a need in the industry for a new technological approach to improve the feasibility in the digestion of these challenging wastes.

A first- principle design technique was applied to the conceptual design of an innovative technology better suited to such a challenging substrate. This system, named the CSU multiple-stage anaerobic digester (MSAD) technology, is a promising technical alternative to existing AD technologies. A demonstration-scale CSU MSAD system was constructed and operated for a duration of three months. The demonstration-scale equipment was constructed as a stand-alone mobile pilot lab that could function with various substrates and hydrolysis reactor configurations. Results from column scale experiments indicate that flow rate. The CSU MSAD technology demonstrated the ability to overcome various limitations in previous anaerobic digestion technologies and ultimately demonstrated the ability to be used in the digestion of a wider variety of substrates.

158 Market Dynamics of the Colorado Potato Industry

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This project examines the market dynamics of the Colorado potato industry through econometric analysis of historical price data along several stages of the supply chain. Understanding the market dynamics at play will allow potato growers in Colorado to refine their business strategies effectively, which could strengthen connection between urban and rural parts of the state and constitute a win for economic development in rural Colorado.

159 Assessing Impacts of Spaceflight on Health of Unrelated Astronauts

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COLLEGE: INTRA-UNIVERSITY

Even as long-duration spaceflight missions, lunar bases, and manned ventures to Mars are becoming realities, the impacts of spaceflight on human health, particularly from galactic cosmic rays (GCRs, i.e space radiation), remain relatively unknown. Telomeres are features of chromosomal termini which guard genomic integrity against degradation and inappropriate activation of DNA Damage Responses (DDRs). Telomeres shorten with aging and as a function of lifestyle factors (i.e nutritional) and environmental exposures (pollution, radiation i.e GCRs). Thus, the rate at which telomeres shorten provide an integrative biomarker of overall health that can be linked to aging and age-related diseases, including dementia, cardiovascular disease and cancer - paramount concerns for astronauts as they venture further into space. Here, telomere length and genome integrity were monitored before, during, and after 6-month and 1-year missions aboard the International Space Station. Contrary to predictions, average telomere length increased during space flight, irrespective of mission duration; determined by qPCR and telomere Fluorescence in Situ Hybridization. Telomere functions were preserved (no fusions or fragility), however, evaluation of chromosome aberrations revealed elevated frequencies, particularly inversions (intrachromosomal rearrangements), evidence of ionizing radiation exposure/DDRs which persisted post-flight; determined by Directional Genomic Hybridization. This work profiles damage to human health as a function of spaceflight in terms of telomeres and chromosome rearrangements. Future directions include characterization of the mechanism responsible for telomere lengthening and analysis of astronaut samples taken beyond the International Space Station.

160 Working Towards Higher Energy Density Batteries Through New Architectural Design

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Li-ion battery technology is currently used in many modern day portable applications ranging from cell phones to electric vehicles. Graphite, the current lithium-ion anode used commercially, has reached its theoretical limit in its current use, resulting in a search for newer materials to increase the overall energy density of commercial Li-ion cells. SnSb has been found to be a promising material, allowing for the increase in energy density when compared to traditionally used graphite. Using a quick and scalable method of production through electrodeposition, SnSb is produced as a 3-D architecture electrode. While initial electrochemical testing showed promising results, a newly proposed unique architecture to protect the SnSb is also presented that may help lengthen the lifetime of the material and overall battery.

161 Hemocompatibility and Antibacterial Activity on Titanium With Tanfloc/Heparin Polyelectrolyte Multilayers

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Thrombus formation is still a major concern for cardiovascular implants. Another barrier for successful implementation of medical devices is bacterial infection. Therefore, it is vital to develop multifunctional surfaces, that can prevent both clotting formation and bloodstream infections. A promising technique investigated to enhance compatibility of biomaterials is modifying surfaces with polyelectrolyte multilayers (PEMs), using naturally derived polymers. Heparin is a highly negative charged polymer and a natural glycosaminoglycan, which in the body prevents blood coagulation. Tanfloc is a natural polymer found in plants and is a hydrophilic amino-functionalized tannin. Recently, it has attracted considerable interest due to its antifouling and antithrombogenic properties. In this work, tanfloc/heparin PEMs were developed on titanium. First, the surface topography was modified by making titania nanotubes (NT) via anodization process. Then the surface was coated using tanfloc and chitosan as polycations, and heparin and hyaluronan acid as polyanions. These surfaces were incubated in S. aureus and P. aeruginosa, and bacteria adhesion and morphology on different surfaces were studied. These surfaces were also incubated in blood plasma, and the platelet adhesion and activation were investigated. Clotting time studies were also performed. After 24 hrs, tanfloc/heparin PEMs on NT decreased the adhesion and proliferation of S. aureus and P. aeruginosa bacteria. These surfaces also reduced platelet adhesion and activation, as well as delayed the clotting time on the surfaces. The novel surfaces developed showed enhanced antithrombogenic and anti-microbial activities, thus be a promising approach to improve tissue compatibility on cardiovascular implants.

162 An Interactive Tool to Assist Growers in Selecting Chemical Agents

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Events of food-borne illness related to contaminated fruits and vegetables have been increasing in the past years. The Produce Safety Rule established science-based minimum standards for the safe growing, harvesting, packing, and holding of produce grown for human consumption. The potential for pathogen contamination can occur during any production or handling step on the farm, however, food contact surfaces are frequently sources of contamination across postharvest activities from farm to market. Reducing levels of microorganisms present on these surfaces can help prevent produce-related illness in consumers.
The purpose of this project was to assist growers in addressing postharvest practices and sanitation by creating a resource for selecting an appropriate chemical agent for a food contact surface. The goal was to create a tool using information compiled by assessing existing materials, technical information, and evidenced- based literatures on effective options of

detergent and sanitizer agents focusing on maintaining quality of surface type and decreasing contamination risks.
The interactive informational tool allows the growers to select the type of food contact surface, which links to the acceptable type of chemical agent options to be used. The tool has specific information on chemicals helping growers to make a more knowledgeable decision. Future directions for this project are related to engage in more research on how different detergents and sanitizers minimize microbiological contamination of different food contact surfaces; explore developing a tool that would explain/interact how different types of soils contaminate surface contact surfaces; and research better procedures to clean and sanitize hard-to-access equipment.

163 Improved Perennial Stock Production Through Applications of Plant Growth Regulators

SEAN MARKOVIC

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The objective of these experiments was to evaluate the response of two hard to propagate herbaceous perennials, Salvia pachyphylla Mojave Sage and Osteospermum Avalanche, to repeated foliar applications of three plant growth regulators (PGR). The PGR were applied at two rates: Ethephon (2-chloroethyl Phosphonic Acid) (200 and 400 mg·L1 (ppm)) (Verve, Nufarm Americas, Inc.), 6-benzylaminopurine (250 and 500 mg·L 1) (Configure; Fine Agrochemicals Limited), and Gibberellins A4A7 (GA) & N-(phenylmethyl)-1H-purine 6-amine (50 and 100 mg·L1) (Fascination; Valent USA Corp.). Data collected to evaluate PGR efficacy: vegetative growth (height and width index), vegetative cutting numbers, fresh weight and dry weight of the harvested vegetative cuttings were assessed. A propagation study was conducted in synchronization to determine the PGR treatments effects on the rooting of vegetative cuttings taken from the treatments. No significant differences in propagation material, fresh or dry weights was observed in the first experiment for Salvia pachyphylla between treatments. Fascination significantly increased vegetative material production for Salvia pachyphylla when compared to all other treatments in the second experiment. In the propagation study with Salvia pachyphylla, no significant difference in rooting percentage was observed. Vegetative cutting harvested resulted in an 26% and 27% increase in vegetative cuttings with Fascination (50 or 100 ppm) treatments for Osteospermum Avalanche when compared to control. Fresh and dry weights of vegetative cuttings harvested resulted in no significant differences. Rooting experiments for Osteospermum Avalanche resulted in no significant differences with all treatments, including the control; all possessing high rooting percentages of 100%.

164 Mechanisms and Factors of Archaeal Transcription Termination and DNA Repair

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Accurately controlled transcription is essential for overall cellular health, response to environmental changes, and appropriate coupling of RNA synthesis to various other cellular processes. The activities of RNA polymerase (RNAP) are regulated through all steps of the transcription cycle- initiation, elongation, and termination. An active transcription elongation complex (TEC) is stabilized by multiple protein-protein and protein-nucleic acid contacts and must be disrupted with biologically relevant timing. Termination also offers regulatory potential through the synthesis of differing transcript isoforms in response to varied termination signals which can be regulated according to environmental conditions. Cellular mechanisms in cells to terminate transcription are driven by specific nucleic acid sequences or a handful of known protein factors external to the TEC. The Santangelo lab previously identified the first archaeal factors capable of disrupting the TEC- Eta, a well conserved superfamily II (SF2) helicase. We aim to complete a structure-function study of Eta employing select mutations derived from a crystallographic structure, leading to a model for Eta-mediated termination. Eta is non-competitive with actively elongating TECs, and thus is not a global termination factor. We hope to evidence that Eta stimulates nucleotide excision repair (NER) through transcription coupled DNA repair (TCR)- which has yet to be described in Archaea.

165 A Content Analysis of Corporate Political Activism on Patagonias Instagram

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This study is an exploratory analysis of environmental, social and political activism messages within corporate social responsibility (CSR) efforts of an outdoor apparel brand. Using Patagonia Inc.s Instagram channel as a case study, a qualitative content analysis explores, defines and compares prominent themes, topics and categories within the growing trend of corporate political activism (CPA) in two specific political contexts.

166 The Dynamics of Dynein in Disease

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Within cells, molecular motors drive the movement of signals and cargos to maintain the health of an organism. Disrupting the normal flow of these motors throughout a cell can cause problems for the human health. One such motor is dynein, which powers many functions important within neurons. Dynein has been implicated in various motor neurons and neurological disorders as a driving force of disease onset. To date over 40 different dynein mutations have been found and most occur spontaneously due to chance genetic mutation. However, the ways in which dynein mutations lead to neurological disease are currently not understood and human dynein remains difficult to study within cells. To understand these mutations, we have developed a fast, inexpensive, medium-throughput system using budding yeast dynein as a model system for dynein mutations present in disease. This system has

allowed us to correlate the severity of mutation with the classification of the disease e.g. motor neuron or brain development. Finally, we able to engineer further mutations to correct the motor dysfunction, pinpointing the cause of the disease and identifying potential avenues for future therapeutics. This system may be quickly and easily applied to any additional mutations that are discovered in the future.

167 Made You Laugh: The Interpretation of Interactive Laughter Within Friendships

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Various scholars have studied laughter as a form of communication, but prior research is scarce on how laughter is interpreted and received by interactants. This ethnographic study deepens our understanding of laughter as a communicative act by investigating how friends in dyadic interactions interpret the laughter that occurs during those interactions. Pairs of friends were video-recorded while conversing about a light-hearted topic for a short time. Following the conversation, each individual watched the video with the investigator, explaining in more detail what they were feeling as well as how they believed their friend felt during each instance of laughter. This study is still in the beginning stages, but the two interactants reported feelings and interpretations of each instance of laughter will be compared, and various statistical tests will be run to determine which variables (length of friendship, biological sex, and type of laughter) affect the accuracy of the laugh-receivers interpretation. Length of friendship is expected to be positively correlated with accuracy of laugh-interpretations. Same-sex friends are expected to more accurately interpret received laughter as compared to mixed-sex friends. Social laughter is expected to be the most misinterpreted type of laughter. This study offers a deeper understanding of laughter as a type of nonverbal communication by focusing on the reception and (mis)interpretation of that laughter. Future studies should be conducted with different types of relational partners to determine whether the type of relationship matters for laughter interpretations.

168 Modeling Cover Crop Management Impacts on Net Soil Carbon Balance

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Cover cropping is a promising negative emissions technology (NET) to achieve negative emissions in agriculture. While cover crops deliver numerous soil health and economic benefits, management differences may drive observed variability in the magnitude of these benefits across cropping systems and climate gradients. Management decisions like growing season, termination method, and cover crop type can influence subsequent greenhouse gas (GHG) emissions, soil organic carbon (SOC) storage, and performance of cash crops. Management-driven impacts are critical for informing GHG decision-support tools and improving estimates of soil C sequestration potential of croplands for national GHG

inventories. We will use the DayCent ecosystem model to: (1) estimate the baseline potential of cover crops to sequester soil C in the U.S., (2) understand the influence of climate and soil physical properties on the magnitude of SOC response, and (3) evaluate how different cover crop management decisions influence SOC response across the four major regions of the U.S. After a systematic review of the literature, we identified 30 unique publications that met our inclusion criteria for use as a model training dataset. The data from these publications were used to calibrate the DayCent ecosystem model for use in the 2017 U.S. National GHG inventory. Upon completion of model simulations for the inventory, we plan to conduct additional simulations using common cover crop management scenarios identified from a meta-analysis of the same data. The results from this research will inform on the capacity of cover to capture and store atmospheric CO2 to reduce climate change.

169 Understanding Physical Activity Maintenance 12-months Following the Fit Cancer Program

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Purpose: The Fitness Therapy for Cancer program (Fit Cancer) is an 8-week exercise program to help cancer survivors engage in physical activity (PA). This study explored characteristics of participants who maintained PA 12-months following completion of Fit Cancer.

Procedure/Description: PA was self-reported using the International Physical Activity Questionnaire (IPAQ) at pre-, post-, and 12-months following program completion. Frequency and duration of moderate, vigorous and walking PA were used to calculate total metabolic equivalent of task (MET) minutes of PA per week at each time point. At 12-months, participants within 20% of their post-program PA were coded as maintainers. We compared age, time since diagnosis, BMI, exercise session attendance, and pre-program PA between maintainers and non-maintainers using independent samples t-tests.

Results/Outcomes: Of the N=43 cancer survivors who completed the program, N=14 (32%) completed the 12-month PA questionnaire. Of those, n=10 (71%) were maintainers. PA maintainers reported more PA at pre-program, (M=2791.65±2939.31 MET-minutes per week) than non-maintainers (M=651±641.17 MET-minutes per week), this difference was significant $t(12)= 1.73$, $p<.03$. There was no significant difference in BMI, age, session attendance, or time since diagnosis between maintainers and non-maintainers.

Implications/Future directions: Fit Cancer participants who maintained PA 12-months after the program had higher levels of PA at baseline. Exercise programs for cancer survivors should assess pre-program levels of PA, as those with low levels may need additional support or strategies to maintain PA following program completion.

170 The Role of Nitrogen-Containing Compounds in Cytokinin-Induced Priming

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COLLEGE: INTRA-UNIVERSITY

Priming is the indirect enhancement of the immune response of plants to pathogens. Compared to unprimed plants, the immune response from primed plants, upon pathogen attack, is much stronger. Recent research in Arabidopsis thaliana has shown that the plant hormone cytokinin has a priming effect against biotrophic pathogens, a phenomenon we call cytokinin-induced priming. The molecular mechanisms behind priming remains largely unknown, although recent studies have indicated that chromatin modifications may play a role. Our research on chromatin mapping using Assay for Transposase-Accessible Chromatin using sequencing (ATAC-Seq) indicates that priming by cytokinin involves differential regulation of genes involved in nitrogen assimilation, metabolism, and amino acid transport which alters the susceptibility of the plant to pathogens. We show that priming by cytokinin does little to alter the metabolome but when a pathogen is present, the metabolic profile of nitrogen-containing compounds in a cytokinin-primed plant is significantly distinct from unprimed plants. We also demonstrate that plants grown with varying the levels of nitrate in soil or in a hydroponics solution alter the plants susceptibility to biotrophic pathogens. Further, this variation of susceptibility is dependent on cytokinin signaling. We propose a model in which cytokinin-induced chromatin regulation of overall nitrogen status in plants functions as a new and general mechanisms of defense priming against biotic stress.

171 Paper-Based Devices for Heavy Metal Detection in the Environment

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Heavy metal monitoring in the environment has become a prominent issue in recent years because of the variety of ways heavy metals can leach into water, food, soil, and consumer products, causing adverse health effects and disruption of ecological systems. Due to the expensive nature of traditional heavy metal analysis in environmental samples, paper-based microfluidics have received significant attention. They have proved to be a good alternative and suitable for in-field analysis. In this work, we report device designs for a fluorescent metal sensor and a 3D colorimetric sensor array for heavy metal detection. The aim of the sensors are for qualitative and quantitative detection of iron, nickel, copper, lead, cadmium, mercury and arsenic in the environment and in consumer cosmetic products.

172 Using Nitric Oxide for Enhanced Biocompatibility of Blood-Contacting Glucose Biosensors

ALYSSA MELVIN

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Biofouling, the accumulation of platelets and proteins on the surface of implantable sensors, prevents the accurate measurement of blood glucose levels. Despite significant time and money invested in glucose biosensor research and development, this issue has yet to be adequately addressed. Localized generation of nitric oxide (NO) from endogenous S-nitrosothiols (RSNOs) has been shown to reduce blood clotting on the sensor surface. CuBTTri, a metalorganic framework (MOF), is capable of catalyzing the release of NO from RSNOs. Here we present a novel application of CuBTTri to catalyze the release of NO on the surface of an implantable glucose biosensor.

173 Heavy Metal Detection via Multiplex Paper-Based Sensor Array

RUTH MENGER

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COLLEGE: NATURAL SCIENCES

Heavy metal contamination in the environment is a critical issue that affects millions of Americans every year. It can cause severe human health effects, including kidney disease, cancer, and nervous and skeletal damage as well as significant ecological impacts. Potential sources of heavy metals include mining, industrial waste, and agricultural runoff. These processes leach heavy metals into ground and surface water, which enter drinking water systems used by humans and animals. Detecting toxic heavy metals is necessary to evaluate a sites contamination levels and potential for remediation. Traditional detection methods are sensitive and accurate but are cost- and time-prohibitive when used regularly. Microfluidic paper-based devices (µPADs) offer a cost-effective, fast, and easy-to-use alternative that can be brought into the field for near real-time analysis. The proposed device in this work is a sensor array with several detection zones. Each zone is loaded with a detection agent that can complex with multiple metals in various oxidation states, producing different colors. After addition of a water sample, the µPAD has a pattern of colored spots. A picture of this array can be analyzed with machine learning and/or a smartphone app to produce comprehensive results about which metals are present in the sample and at what concentrations. The device is inexpensive, portable, and produces results quickly, so it can be used to evaluate remediation sites with a high spatial and temporal resolution as well as assess water quality.

174 Locus-Biased CNVs Accompany Large-Scale Chromosomal Rearrangements in S. cerevisiae

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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.

175 Nutrition Needs Assessment Survey for the State of Colorado

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COLLEGE: HEALTH AND HUMAN SCIENCES

Purpose: This study is Phase I of the 2019-2020 Nutrition Needs Assessment Survey for the State of Colorado. Ten focus groups will be conducted in different parts of Colorado to collect information on what Coloradans want to know regarding nutrition. The information collected from the focus groups will be used to develop a state-wide nutrition needs assessment survey.

Procedure: A needs assessment survey is a systematic way to study the interest, knowledge, and capability of targeted audiences. The CSU Extension nutrition specialist will use the results of the needs assessment as the primary guideline to develop outreach materials in nutrition and classes that tailor to the needs of the residents of Colorado. The researcher decided to utilize focus group research method to collect data in Phase I because it is considered as a reliable and effective way to design needs assessment surveys. Focus groups are especially useful to examine the attitudes, experiences, and interests of targeted audiences. The researcher completed an environmental scan and developed a focus group protocol. IRB request was submitted for approval.

Significance and Implications: CSU Extensions job is to determine what issues, concerns, and needs are unique to each community to offer sound and effective solutions (CSU Extension, 2016). The results of the nutrition needs assessment will inform extension specialists and agents future directions of engagement and provide evidence-based information to make informed decisions. Developing an accurate and reliable needs assessment survey contributes to CSUs land-grant mission.

176 Exploration of Consumer Acceptability of an Emerging Functional Food: Microgreens

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COLLEGE: HEALTH AND HUMAN SCIENCES

Microgreens are an emerging horticultural crop that have nutritional and sustainability implications for consumers worldwide. Microgreens are the edible cotyledons of vegetables, herbs, grains, and flowers that are in their early developmental stage. Research suggests they have a higher nutritional content than their mature counterparts, making them a nutrient-rich food. However, more research is needed to understand their acceptability by consumers, and factors contributing to or hindering their acceptability. The purpose of this study was to investigate the consumer acceptability and sensory perceptions of six microgreens species including bulls blood beet, broccoli, red cabbage, arugula, red garnet amaranth, and tendril pea shoots. Leafy green vegetable intake, knowledge of microgreens, and food neophobia were also assessed. We hypothesized that all six microgreens would have high acceptability, but that variability would be related to sensory perceptions and other factors. Microgreens were grown at the CSU Horticulture Center and transported to the Food Science and Human Nutrition Sensory Laboratory where they were prepared and distributed to participants (total n = 99, 56 females/43 males). Questions regarding consumer acceptability and sensory properties were evaluated using a nine-point hedonic scale. Results showed that all six microgreens had high overall acceptability, with tendril pea shoots having the highest overall acceptability and arugula having the lowest overall acceptability. The relationship between their acceptability, sensory perception, and other outcomes is being currently evaluated. However, these preliminary data suggest that microgreens have the potential to be to be a marketable functional food for promoting global health.

177 Capacity Building Creating Protected Area Leaders in Southeastern Brazil

JUAREZ MICHELOTTI

DEPARTMENT: WARNER COLLEGE OF NATURAL RESOURCES
COLLEGE: WARNER COLLEGE OF NATURAL RESOURCES

The purpose of this project is to draft a Protected Area Capacity Building Program in Southeastern Brazil. There is a lack of programs related to protected area management and nature interpretation there, especially in the Atlantic Rainforest biome. The partner to this project is the Social Service of Commerce SESC Brazil. The project will conduct research on courses in the US, interviews with protected area professionals, staff, suppliers, as well as directors of training facilities, teachers, and former students in order to gather needs, methodological and professional references. The same research will then take place in Brazil and other Latin American countries. After comparing the data, the specific needs will be defined, and methodologies will be chosen in order to draft the program itself. With this program a broader quantity of professionals working in private and public protected areas will be able to develop their capacity and skills. There is an International Memorandum of Understanding between SESC and CSU, that is opening a new perspective to the actual scenario. A five module course on protected areas is being implemented between 2019 and 2020 in SESCs venues. The future of this project is to be held at SESC Bertioga Private Nature Preserve, where protected area leaders will be enabled to enhance their skills in management and interpretation to connect with the public throughout Brazil and create meaningful

experiences in their protected areas.

178 Muscle Strength and Power Throughout the Menstrual Cycle

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COLLEGE: HEALTH AND HUMAN SCIENCES

Purpose: The purpose was to determine if maximal muscle performance varies across the menstrual cycle. Strength and ballistic force production was measured in normally cycling eumenorrheic women and in women on hormonal birth control. We expected greater performance during the follicular vs. luteal phase for the normally cycling women and more constant values for women on birth control.
Methods: Participants were physically active women between 18-40 years who were either 1) eumenorrheic and not taking hormonal birth control (N=13), or 2) taking birth control (N=10). Ovulation was determined via body temperature and LH strips, and along with menses, was tracked for one full cycle prior to strength testing as well as during their two months of strength testing. Tests were performed on four different visits over two consecutive months of menstrual cycles in the luteal and follicular phases. Tests include leg and arm strength, ballistic force production, and vertical jump at each visit.
Results: Comparisons will be performed between luteal and follicular phases within subjects and between the normally cycling and birth control groups. We have five remaining strength tests in the next two weeks. We will then complete results and discussion.
Conclusions: Meaningful differences between phases will suggest that the hormonal fluctuations affect muscle performance and that athletes should plan their training and competition schedules accordingly.

179 CO2 as a Natural Control of Hemp Russet Mite

ANDREW MILLER

DEPARTMENT: BIOAGRICULTURAL SCI & PEST MGT
COLLEGE: AGRICULTURAL SCIENCES

Hemp (Cannabis sativa) in the United States, and particularly in Colorado, has seen a tremendous increase in production since legislative changes in the Farm Bill of 2014 allow legal production. One of the most important pests that have emerged on this crop is hemp russet mite (Aculops cannibicola) which is particularly damaging to hemp crops being grown for production of CBD and other extractable compounds from flowers. This species has proved very difficult to manage, due to the absence of effective pesticides allowed for use on the crop. However, one approach that may be effective to eliminate this pest, and other arthropods on hemp, is exposure of plants to high levels of CO2. Trials exploring this management approach have shown that this method can kill hemp russet mite on live hemp plants. However, there is a balance that must be made between high CO2 levels, temperature, and humidity that must be maintained so that stress to the plant is minimal.

180 Measuring Kinetics in Reverse Micelles With Nuclear Magnetic Resonance Spectroscopy

SAM MILLER

DEPARTMENT: CHEMISTRY
COLLEGE: NATURAL SCIENCES

Confined water displays fundamentally different properties from its bulk phase. Nanoconfinement disrupts the physical properties that constitute our understanding of water as it typically exists in our everyday lives. We investigated the temperature dependent exchange of protons between water and glucose within nanosized reverse micelles (RMs) to characterize the kinetics of labile hydrogen exchange using exchange spectroscopy (EXSY) on the nuclear magnetic resonance spectrometer. The reverse micelle system used to encapsulate the polar core and chosen osmolyte, glucose, increased the energy barrier to this previously unobservable process, prompting the design of an Arrhenius experiment to measure this increased activation energy.

181 Are You What You Eat? Lipid Dynamics in Skeletal Muscle

DOMINIQUE MONTANO

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COLLEGE: NATURAL SCIENCES

Marine mammals are capable of diving to extreme depths for long periods of time. This ability to exercise under low oxygen conditions has sparked questions about mechanisms promoting such extraordinary aerobic capacity. Their high-fat diet has been suggested to contribute to their diving ability, and any specific types of lipids that affect the expression of the oxygen-binding protein myoglobin (found at concentrations ten times that of terrestrial mammals) and thus the impressive aerobic capacity of these divers has not been studied. This inquiry into nutritional influences on the diving physiology of marine mammals could elucidate mechanisms contributing to exercise performance in mammals.

182 Operant Conditioning With Wolves and Wolfdog Hybrids for Medical Procedures

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COLLEGE: NATURAL SCIENCES

Wolves and high wolf-content canine hybrids are naturally shy when humans are present. Their high levels of human-avoidance pose a crucial problem when the animals need medical attention as lifetime residents of sanctuaries. Therefore, the goal of my project was to develop enrichment for the canines at the W.O.L.F. Sanctuary in order to lower stress levels and

increase comfortability during human interactions, particularly during medical treatments, with the help of operant conditioning training. Operant Conditioning is where an individual learns that their actions have positive and negative consequences. In this case, the canines will learn that their choice to participate in training sessions and medical treatments will result in them receiving a reward (mostly food). I worked with W.O.L.F.s Director of Animal Care and Education Programs to develop behavior training protocols for medical procedures. The behaviors included in the training process include socialization, weigh-in, hip injections, nail clipping, blood draw from both jugular and cephalic veins, oral exam, muzzling, and harness and leash training. The products of my project include written step-by-step instructions for conducting training sessions, in addition to videos as visual aid for the requested behaviors. There are not any videos for blood draws due to current restrictions in animal enclosure designs. The implications of my project include assisting the Director in redesigning new enclosures for the animals, lowering the stress of both the animals and staff during health care interactions, providing critical thinking enrichment for the canines, and to encourage healthy and safe human-animal interactions.

183 Moderation Effect of Aging Perceptions on Activity/Fitness Among Adults

KRISTEN MOORE

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With consideration of our world's ever increasing population of older adults, paired with a multitude of obesity related comorbidities, a biopsychosocial approach to better understanding our aging population is imperative. A well-established positive association exists between physical activity (PA) levels and physical fitness among older adults, however, many questions remain involving self-efficacy and perceptions of aging among these individuals. This study aims to further investigate the moderation effect of aging perceptions with physical activity levels and physical/cardiovascular fitness among older adults in an effort to better tailor health interventions to fit the needs of this vulnerable population. We will use baseline data (N = 128 by Wave 6) collected from the AgingPlus project. The outcome variables include accelerometer measured PA and self-reported PA. The independent variables are VO2max, grip strength, blood pressure, heart rate. The potential moderators are Negative Views of Aging (NVOA) per AARC Questionnaire) and covariates include demographic variables (e.g., sex, age). We will analyze the data using multiple linear regression models including interaction terms (e.g., NVOA × VO2max or grip strength). We hypothesize that those with predominantly negative views of aging (NVOA) will be less likely to participate in PA and therefore will likely record inferior fitness levels to those without or with less NVOA. The implications of this study provide more insight among the field and emphasize the need for both physical fitness and aging perceptions interventions among older adults.

184 Rising Troubles: Preparing Historic Buildings for Climate Change

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DEPARTMENT: HISTORY
COLLEGE: LIBERAL ARTS

Much of the Portland, Maines infrastructure, economy, and identity are dependent on historic structures that were not built to withstand the stresses of climate change. As storms become more frequent and sea levels inch closer to a predicted 9-foot rise by 2100, the city needs to understand how its buildings will be damaged and what can be done to make those buildings more resilient.

I interned with Greater Portland Landmarks, a non-profit organization, to complete a climate change surveythe first of its kind in Maineof two historic Portland neighborhoods. Other interns and I visited every structure in both neighborhoods, 872 in total. We noted, for example, if there was negative drainage towards a building, or if an awning was above an entryway.

We recorded our observations in a database developed by the Maine Historic Preservation Committee (MHPC). A preliminary analysis reveals several concerns: 21.77% of buildings in Ferry Village already experience flooding, and 56.46% of buildings in Bayside have gas meters that sit less than two feet off the ground.

Using this information, MHPC can make recommendations to property owners about how to accommodate their buildings to become more resilient, without destroying their historic integrity. Some recommendations might include filling in basement windows, raising utility meters, and/or preparing a plan for relocation.

The success of this project will determine whether MHPC launches similar surveys in other communities. The publicity surrounding the project will also trigger a much-needed conversation about how these communities will change with the climate.

185 Heterogeneity in Susceptible Perinatal Windows to Air Pollution

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DEPARTMENT: STATISTICS
COLLEGE: NATURAL SCIENCES

Childrens health studies support an association between maternal exposure to air pollution and childrens birth and health outcomes. A common goal in such studies is to identify windows of susceptibilityperiods during gestation when there is increased association between maternal exposures to air pollution and a future outcome. These associations and the timing of windows of susceptibility are likely heterogeneous across different levels of biological and environmental characteristics (e.g. mothers age, fetal sex and neighborhood characteristics). However, few studies have considered effect modification when identifying windows of susceptibility and those that have are limited to a small number of pre-specified effect modifiers. We propose a statistical learning method that estimates windows of susceptibility at the individual level and identifies important characteristics that induce heterogeneity. The proposed approach uses distributed lag models (DLMs) to estimate windows of susceptibility based on an individuals recorded environmental exposures and Bayesian additive regression trees (BART) to account for effect heterogeneity and identify effect modifiers. This treed DLM

method creates a set of stochastic binary trees, which partition the data on a set of modifying characteristics and estimates a DLM for each subpopulation. We show in a simulation study that our model can identify both windows of sensitivity and important modifier(s) responsible for DLM heterogeneity within the population.

186 Insulin Sensitivity is Related to Mitochondrial Function During Insufficient Sleep

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COLLEGE: HEALTH AND HUMAN SCIENCES

Insufficient sleep induces metabolic dysfunction; however, the mechanisms by which this occurs are unknown. In other contexts, impaired insulin sensitivity is associated with reduced mitochondrial respiratory capacity, but it is unknown if insufficient sleep directly impairs mitochondrial function. Therefore, we sought to determine whether mitochondrial respiration is impacted by approximately one work-week of insufficient sleep.

Nine sedentary, healthy lean adults (27+1y; 23+1kg/m2; 8M) participated in a 6-day in-laboratory protocol with 9h in bed followed by 4 nights of 5h in bed (insufficient sleep). For one week prior to the study, participants maintained a 9h sleep schedule. For 3 days prior to the study and throughout the in-laboratory protocol, participants consumed a diet designed to maintain energy balance. Insulin sensitivity was assessed using a hyperinsulinemic euglycemic clamp before and after insufficient sleep. Muscle biopsies of the vastus lateralis were taken immediately before each clamp and mitochondrial respiration was examined.

Insulin sensitivity was significantly decreased during insufficient sleep 11.2+1.8 v 10.0+1.4 mg/kg/min; $p<0.05$). In contrast, ADP-stimulated mitochondrial respiration (state 3) and maximally uncoupled respiration (state U) were elevated in isolated permeabilized ex vivo muscle fibers using pyruvate/malate as substrates. In vivo insulin sensitivity was negatively associated with mitochondrial respiration, such that reduced insulin sensitivity was associated with higher mitochondrial respiration in state 3 ($r= -0.611$; $p<0.05$) and state U ($r= -0.672$; $p<0.05$).

The implications of elevated mitochondrial respiration in this context are unclear, but may represent an acute compensatory response to insufficient sleep, implicating sleep as an essential regulator of mitochondrial function.

187 Counterintuitive Control of Magnetic Relaxation via Paramagnetic Dilution

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Abstract: Fine-grained control of magnetic relaxation is a central goal in molecular information storage/processing and magnetic resonance imaging. Herein we present a new paradigm for

chemically controlling spin relaxation via paramagnetic-environment engineering. We dilute the mononuclear single-molecule magnet (Ph4P)2[Co(SPh)4] to varying degrees in the isostructural diluents (Ph4P)2[Ni(SPh)4] (S = 1), (Ph4P)2[Fe(SPh)4] (S = 2), and (Ph4P)2[Mn(SPh)4] (S = 5/2). For [M(SPh)4]2 (M = Ni2+, Fe2+) diluents, the timescale of magnetic relaxation for [Co(SPh)4]2 is slowed by three orders of magnitude, analogous to when M = Zn2+. In contrast, when M = Mn2+, increasing dilution hastens magnetic relaxation for [Co(SPh)4]2 by at least 1 order of magnitude. These results are the first observation of a lengthened relaxation time in the presence of a magnetic environment and the first control of spin relaxation via a paramagnetic dilution.

188 Adaptive Multi-Paddock Grazing Increases Soil Carbon Stocks and Soil Health

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COLLEGE: INTRA-UNIVERSITY

Continuous grazing has led to significant losses of carbon (C) in grassland soils. Yet previous research has shown that rotational grazing, specifically adaptive multi-paddock (AMP) grazing, can increase soil C stocks in these grasslands systems. By promoting grazing management that improves soil C sequestration and soil health, grasslands have a large potential to help alleviate rising atmospheric CO2 as well as increase the sustainability of the soil across a vast area of land. Our research analyzed soils from 13 grasslands in southeast United States representing either AMP grazing, continuous grazing, or native, un-grazed grassland management. We quantified soil C stocks as well as the distribution of C among soil organic matter (SOM) pools with varying mechanisms of formation and stabilization in soils. Additionally, we analyzed several other soil health indicators across each management type. Our findings show that the AMP grazing sites had similar soil C stocks as the native grasslands, but had over 13% more soil C compared to the continuous grazing sites. While there was only slightly more persistent C in the A-horizon on AMP grazing sites compared to continuous grazing sites, both grazed sites had significantly more persistent C than native grasslands. Additionally, overall soil health was higher on the AMP grazing sites compared to the continuous grazing sites, indicated by several soil health metrics. These findings provide evidence that AMP grazing could be implemented as a potential way to increase soil sustainability, sequester more C, and mitigate rising atmospheric CO2 levels.

189 Pathogenesis and Development of Rapid Diagnostic Test for Microsporum Canis

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COLLEGE: VETERINARY MEDICINE AND BIOMEDICAL SCIENCES

Microsporum canis is the primary pathogen in >90% of feline dermatophytosis (ringworm) cases. Few studies have investigated the molecular pathogenesis of M. canis. Correlates between strain variants, virulence factors, and clinical disease remain unexplored. Furthermore, a rapid, accurate, inexpensive point of care assay to assess active cases and

discriminate between transient carriage and active infection is not available. This study will interrogate genotypic and mRNA expression levels of two M. canis genes contributing to essential keratin digestion and may relate to strain and pathogen virulence. Second, we will usurp M. canis metabolic pathways that result in sulphite production to develop a novel colorimetric diagnostic assay. We have acquired approximately 70 hair samples from referring veterinarians from four states to establish a robust dermatophyte sample archive. We have developed PCR assays for two M. canis genes (ITS-1 and SSU1) and have subjected approximately half of samples to PCR and Sanger sequencing. Results indicate high homology to an M. canis reference isolate, validating isolate identity. We have preliminarily assessed a novel colorimetric assay that can detect dermatophyte sulphite metabolites from M. canis positive hair samples in 12-48 hours. This study proposes to extend our preliminary research to: (1) Further characterize SSU1, and an M. canis keratinolytic enzyme implicated in active infection (SUB3), and (2) Optimize a sulphite detection assay and assess specificity and sensitivity. This work will significantly enhance knowledge about M. canis molecular characteristics, provide diagnostic tools that address an unmet need in active dermatophytosis detection, and assess potential therapeutic targets.

190 Urban Expansion Into Patagonian Forest: Assessing Environmental Policy Challenges

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DEPARTMENT: UNIVERSITY WIDE - ECOLOGY
COLLEGE: INTRA-UNIVERSITY

Argentinas Native Forests Protection Act # 26,331 (NFPA) enforces the use of spatial planning to regulate land use in native forests. However, guidelines regarding the spatial planning of native forests in urban and wildland-urban interface (WUI) areas are lacking. Taking the city of Ushuaia as a case study, I used a mixed-methods approach (online survey, individual interviews, and focus groups) to assess stakeholders perceptions regarding native forest land use planning in urban and WUI areas. Results revealed that regulations addressing native forest land use in urban and WUI areas may be lacking but are considered a priority. Communication between stakeholders, public participatory processes, and current forest zoning criteria were identified as challenging aspects of native forest policy. Developing new instances for stakeholders communication, mechanisms for community engagement, specific criteria for native forest land use planning in urban and WUI areas, and dissemination and education, were emphasized as strategies to address these challenges. Within the next steps of this study, and taking a biophysical approach, I will focus on the city of San Martín de los Andes in Patagonia and analyze the effects of diverse urban development scenarios on different ecosystem services related to water provision. It is expected that the results of this second stage of the study would contribute to the development of specific forest zoning criteria for urban and WUI areas.

191 Advancing Solar Technology by Understanding Atomic Motions in Semiconductors

EVE MOZUR

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COLLEGE: NATURAL SCIENCES

Most of the solar panels that we use today rely on silicon and related materials to harvest energy from the sun. However, over the past 15 years, a new family of materials called hybrid perovskites has emerged as competitors to the more conventional materials despite their extremely different structures on the atomic scale. While silicon and other conventional solar materials crystallize in rigid structures, hybrid perovskites have many dynamic (vibrational and rotational) degrees of freedom. My research goal is to understand how a family of materials that looks so different to silicon can have such similar properties. In particular, I am using crystallography, calorimetry, spectroscopy, and electronic transport measurements to investigate how the lattice dynamic of hybrid perovskites modifies their ability to harvest light and transform it into electricity. The hybrid perovskite formamidinium lead bromide undergoes changes in organic cation dynamics as a function of temperature, which I have demonstrated relate to the current that the material can produce when illuminated. This work indicates that the dynamics of hybrid perovskites drive their transformative properties and has the potential to shift the paradigm of research into solar materials towards a dynamics-driven approach.

192 Metabolic Rate Variation Shapes Pace of Life at Multiple Scales

STEPHEN MUGEL

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Pace of Life (POL) models have recently emerged to integrate covariation among behavioral, physiological, and life history traits along a single fast-slow axis. Variation in metabolic rate (MR), the fundamental biological rate at which organisms process and expend energy, is often considered the primary driver of phenotypic covariation that defines POL at an organismal level. The metabolic theory of ecology however suggests that the functional importance of MR should also drive similar patterns at higher levels of organization, although such ideas have rarely been empirically investigated. Using honeybees (Apis mellifera) as an experimental model, we measured a number of behavioral, physiological, and life history traits at the individual and group level. Using a structural equation modeling approach we present evidence of a POL in honeybees consistent with theoretical predictions and demonstrate the role of MR in shaping overall covariation structure. To explore similar group level patterns, we bred genetic lines of honeybees with slow and fast MR based on the malate dehydrogenase locus and then created experimental groups that were homogenously slow, fast, and intermediate, and heterogeneously mixed groups of slow and fast bees. We then assayed these groups on behavioral, physiological, and life history traits at the group level, in resource rich and poor environments. Using a partitioning of variance approach on these trait values across different group compositions, we then investigated the relative selection (non-additive) and complementarity (additive) effects of MR and how they interact with the resource environment in shaping POL at higher levels of biological organization.

193 Phytochemical Compound Prevents Age-Related Declines in Musculoskeletal Health and Mobility

ROB MUSCI

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

Age-related oxidative stress and inflammation contribute to sarcopenia and osteoarthritis which cause disability and increase the risk for chronic diseases. However, it remains unknown if targeting or improving mitochondrial function to prevent oxidative stress or inflammation can mitigate sarcopenia or osteoarthritis. Thus, we treated Dunkin-Hartley (DH) guinea pigs, which develop both diseases similarly to humans, with the phytochemical compound, PB125. PB125 activates Nrf2, which is a transcription factor that stimulates the transcription of antioxidant and anti-inflammatory genes. We hypothesized that PB125 would improve mitochondrial function and subsequently improve mobility, potentially through improving skeletal muscle quality. We treated young (2-month) male and female DH guinea pigs with a daily dose of 250ppm PB125 for 3 months to prevent the onset of disease. Older (5-month) males and females were treated for 10 months to investigate if PB125 mitigates progression of disease. We measured mobility monthly with video analysis. We evaluated mitochondrial function in the soleus muscle using high-resolution respirometry. We also used deuterium oxide to measure muscle protein synthesis rates. PB125 improved a metric of mitochondrial function in young females by 21.7% ($p<0.05$) and it prevented age-related decline in mitochondrial function in males ($p<0.05$). PB125 also tended to increase synthesis of contractile proteins in the soleus muscle by 4% ($p=0.0713$). Moreover, PB125 improved stride length ($p<0.05$) in males and stance width ($p<0.05$) in females. In conclusion, treatment with PB125 improves mitochondrial function in a preclinical model of sarcopenia and osteoarthritis, which may contribute to improvements in muscular quality and mobility.

194 Changes to Moisture Recycling in the Future

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Moisture recycling refers to precipitation that originated as evaporation over land rather than as evaporation over the oceans. Therefore, moisture recycling is dependent on terrestrial evaporation, but also on moisture transport. This work uses global wind and moisture output fields of future projections from a general circulation model. This data is then used to track moisture trajectories using an Eulerian atmospheric moisture transport model to determine the fate of moisture given its origin. Several of the characteristics that affect moisture recycling are inherent to geo-climatic location, such as temperature and terrain, but othersnamely land useare under direct anthropogenic control. Not only does moisture recycling play an important role as part of the global hydrologic cycle, but it also serves to connect communities across the globe.

A broad question that this work aims to answer is: As the climate continues to warm, does this result in significant changes to the sink and source regions of terrestrial evaporation with respect to location, amount, variability, and persistence in the future? Such changes have the

potential to pose serious challenges to the livelihoods of those in regions where moisture recycling is a major source of local precipitation. As a follow-up to this question, future work includes a deeper examination of the socio-economic implications of changes to terrestrial evaporation and moisture recycling on a regional basis.

195 Implications of Covariation in Demographic Rates for Lesser Scaup

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The continental population of scaup remains well below population objectives. Previous analyses of long-term demographic data have revealed recruitment as the likely driver of population decline. Recruitment is comprised of several potentially important vital rates, which are often assumed to be independent in population models. This assumption could be costly because covariation in vital rates can sometimes have a greater influence on population dynamics than variation in any vital rate on its own. Long-term monitoring of lesser scaup (Aythya affinis) at Red Rock Lakes National Wildlife Refuge allows us to study temporal covariation in vital rates. This unique study has collected data across the annual life cycle of lesser scaup, including breeding propensity, clutch size, nesting success, duckling survival, post-fledging juvenile survival, and seasonal survival of adults. We examined the effects of hydrological variation on variation and covariation of vital rates, and the consequences of such (co)variation on population dynamics of the local lesser scaup population. Our results provide key insights into the life-history responses of lesser scaup to changes in wetland habitat conditions. Given that both climate and land-use change can drastically alter wetland hydrology, our work could guide similar studies on wetland habitat management and landscape conservation for lesser scaup amidst ongoing global change.

196 Microfluidic Biosensor System for Parasite Diagnostics

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Many diagnostic techniques in parasitology require the isolation of parasite eggs from a fecal sample using a separation and washing protocol utilizing a centrifuge, followed by visual examination under a microscope to identify and quantify eggs. This requires costly equipment and trained technicians, often forcing smaller or less-equipped labs to send samples out to larger diagnostic centers, increasing both cost and turnaround time. Microfluidic technology aims to miniaturize benchtop laboratory protocols onto microchips for low-cost, rapid testing, allowing for more frequent and widespread use of diagnostic testing, which would help control and prevent outbreaks in both human and animal populations. This work focuses on the development of a microfluidic impedance cytometry (MIC) device for the identification and enumeration of parasite eggs, cysts, and oocysts in fecal samples using multi-frequency electrical impedance measurements. MIC has been used for the characterization of mammalian and bacterial cells and is commonly used for phenotyping in whole blood counts.

More recently, it has been demonstrated effective in counting and categorizing parasite (Giardia and Cryptosporidium) (oo)cysts in water/saline samples. This work aims to expand the use of microfluidic impedance cytometry for parasite egg/(oo)cyst detection from fecal samples, which adds a level of complexity to the identification of signal from noise, but would open doors for the use of MIC for the diagnosis of many common parasite infections.

197 Automated Process of Detecting Positive Market Trends Using Deep Learning

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COLLEGE: NATURAL SCIENCES

This work stems from an internship project done at a computer hardware company. The goal of the project is to detect growing technologies in the IT sphere using open data, for the company strategic planning. The implemented process consists of 3 main steps. First, online media texts are collected. A model is trained to output a list of topics that appears on the media and are relevant to the companys hi-tech interests. Second, popularity time-series for each relevant topic is retrieved. The popularity data come from Google Trends website, which provides the number of Google search requests of a topic over time. Third, a deep learning model is trained to automatically recognize whether a popularity time-series shows a positive trend. This process eventually provides a list of topics with positive trends. The main contribution of this work lies in the vastly reduced amount of time spent on market research that an analyst normally needs. This process can also be used to search for trends in different industries other than hi-tech.

198 Mechanical Response of Stem Cells to Cardiac Bio-Mimicking Scaffold

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An emerging treatment for heart failure (HF) is the delivery of stem cells onto the heart to regenerate the tissue and rescue cardiac function. It is well known that the heart tissue has altered mechanical behavior during HF progression. However, the response of stem cells to the mechanical environment of the cardiac wall is still unclear. In this study, a new class of nanofiber scaffolds is fabricated to mimic the stiffness of ovine heart. Then, the effect of the scaffolds mechanical properties on stem cells will be studied.
To fabricate scaffolds, 12% w/v polyester urethane urea (PEUU) was dissolved in hexafluoro-2-propanol and then electrospun into nanofiber scaffolds using a custom electrospinning apparatus. Two different applied voltages (16 vs. 20 kV) were used to generate stiff and soft scaffolds, respectively. The elastic moduli of the scaffolds were obtained by tensile tests. Stem cells were cultured on the soft and stiff groups and cell viability and proangiogenesis (formation of blood vessels) will be examined using in vitro assay kits. The different electrospinning protocols were able to successfully generate soft and stiff PEUU scaffolds. It is expected that the soft scaffolds, which mimic healthy hearts, will lead to enhanced viability and

proangiogenesis. In this study, we demonstrated the ability to fabricate PEUU nanofiber scaffolds. To date, this is the first time that PEUU is being used in cardiac regenerative tissue engineering. Future study will further elucidate stem cell responses and involve tests in a larger stiffness range to recapitulate healthy and diseased hearts.

199 Electrochemical Studies of Electrodeposited Antimony/Carbon Nanotubes in Sodium Cells

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Recent advances in technology are beginning to exceed the energy demands that lithium-ion (Li-ion) bat-teries can supply and therefore alternative systems are under investigation. Sodium-ion batteries (Na-ion) have risen in interest as a naturally abundant alternative to Li-ion batteries, but development has been slow mainly due to the carbonaceous anode material. Alloy type materials, such as antimony, have become more prominent in the field due to its physical and chemical properties and for its relative abundance and non-toxicity. However, the cycling performance of antimony on its own is poor, and its failure mechanism is still not well understood. Here we report the implementation of electrodeposited antimony with amine-functionalized carbon nanotubes on a textured copper foil (Sb/ACNT @tCu) as a model anode in a Na-ion half-cell. The investigation of Sb/ACNT was conducted to elucidate reaction pathways of the sodiation of Sb/ACNT in a Na-ion half-cell, the possible role electrolyte composition has on those pathways and the creation of the solid electrolyte interface.

200 Using Fluorescence Energy Transfer to Investigate Nanoparticle Defects

ZACH NILSSON

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COLLEGE: NATURAL SCIENCES

Nanoparticles are becoming more and more common in devise that we use every day. Precise control of electronic and optical properties (usually through precise control of particle size) makes nanoparticles attractive for application such as lighting and display technologies. This precision control of electronic and optical properties can be disrupted by defects within the nanoparticles. Defects can fundamentally change the way a nanoparticle behaves. Not all defects are undesirable however, in some applications it is the defects that are responsible for desired outcome. Understanding the role that defects within the nanoparticles play in determining the overall performance of the particle is crucial to effectively utilizing them. To this end, we have been developing a technique that uses organic dye molecules to investigate defects on zinc oxide nanoparticles. The dye molecules can engage with the defects though an electronic coupling interaction (energy transfer). This interaction facilitates the fluorescent emission of the dye molecules and can only occur when the dye molecules are in very close proximity (less than 10 nanometers) to the defects on the nanoparticles. This proximity requirement will allow us to determine the physical location of defects. Once the location of the defect sites is known, we will use a second system of dye molecules that are sensitive to

oxidation or reduction active sites to correlate the defect locations with reactive locations.

201 Cerebellar Neuroanatomical Correlates of Sensory Reweighting Impairment in Multiple Sclerosis

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Purpose
Sensory reweighting, the ability to change relative contributions of each sensory system to balance in response to a changing environment, is critical to maintaining stability. The cerebellum contributes to sensory re-weighting via its white matter connections to the brainstem, the cerebellar peduncles (CPs). People with multiple sclerosis (PwMS) have both impaired sensory reweighting and CP microstructure. The purpose of this study is to examine associations between the white matter microstructure of the CPs and balance performance during manipulated sensory conditions in PwMS and healthy controls (HCs).

Procedure
PwMS (15F, 5M) and age-matched HCs (12F, 2M) underwent manipulated sensory-feedback conditions of the modified Clinical Test of Sensory Integration of Balance atop a BTrackS balance plate. Center of pressure-derived measures of path length, sway velocity, and root mean square of sway (RMS) were utilized to quantify balance performance. White matter microstructure of the CPs was evaluated by diffusion tensor imaging with radial diffusivity (RD). Pearsons correlations were used to associate CP microstructure and balance performance in each condition.

Results
In all conditions, PwMS exhibited worse balance than HCs reflected by a group main effect for all balance measures. PwMS had higher RD values in each CP shown by a group main effect for CP microstructure. Notably, RD of the inferior CP was associated with RMS in the eyes closed, compliant surface balance condition in both groups.

Implications
Investigating the neuroanatomical correlates of balance performance during sensory reweighting will allow for development of rehabilitative interventions more effective in reducing imbalance in PwMS.

202 The Cyan Project - Reducing Carbon Emissions in Emerging Markets

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COLLEGE: BUSINESS

The building sector is a primary driver of carbon emissions, contributing over one-third of global annual emissions. There is an urgent need to address rapid growth of inefficient and

carbon intensive building investments in emerging markets. With the mission to mitigate and adapt to climate change by significantly reducing carbon emissions caused by our built environment, the team conducted 8 weeks of field research in Santiago, Chile and San Jose, Costa Rica to evaluate market entry points for potential business opportunities. In the field, the team conducted nearly 50 in-depth interviews with industry professionals (such as architects, engineers, construction companies, sustainability consultants, academics from local universities, NGOs, government ministry representatives, material experts, and others) that provided insight into the existence and market reach of alternative, more sustainable construction materials. Interview processes were guided by four primary research questions that ultimately informed the teams detailed understanding of current barriers to sustainable building in practice, micro and macroeconomic trends, regulatory trends, and the technological landscape within the context of Latin American culture. Qualitative data analysis informed the development of data visualizations and business model canvas (BMC) iterations. These findings and research processes elicited the conclusion to develop and launch a business accelerator that will support new sustainable building products developed within Latin America in achieving significant market share.

203 Tillage Effects on Microbial Community in an Irrigated Corn System

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As microorganisms metabolize soil organic matter, they assimilate carbon as biomass or respire carbon as CO2, thus resulting in the stabilization or loss of carbon, respectively. As we push for soil carbon sequestration to combat climate change, it is particularly important that we understand how microbial communities and their processes are affected by various agricultural management practices, such as tillage (till), as that will affect our ability to sequester carbon. We conducted a study comparing residue carbon movement within no-till and till treatments in an irrigated, continuous cornfield. After two years, our data revealed that no-till resulted in greater carbon loss than till. To determine how tillage affects microbial community structure and how this relates to our surprising results, we will extract phospholipid fatty acids (PLFAs) and neutral fatty acids (NLFAs) throughout the soil profile of our treatments from the first two years of the study. Since the organic material used in our treatments is labeled with 13C, we plan to analyze the 13C content of our PLFA extractions in order to track what microbial members are actively decomposing the labeled organic matter over time and at depth. We expect our no-till treatment to have greater total and labeled microbial biomass, as well as a greater fungal:bacterial ratio than the till treatment, with both treatments decreasing in fungal:bacterial ratio over time and at depth. Ultimately, we hope to understand the effects of tillage on microbial community structure and activity, and how they link to the carbon dynamics of our system.

204 Sex, Sexuality and Pregnancy Among Adolescents in Ecuador

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In Latin America, some of the highest rates of pregnancy among adolescents, ages 15-19, exist in Ecuador. As of 2017, the UN recorded 72 births per 1,000 women, compared to the rate of 19 births per 1,000 women in the United States (The World Bank, 2017). In attempts to better understand the complexities of this phenomena, semi-structured interviews were conducted with seven young mothers between the ages of 14-19 and five key informants. These interviews are aimed towards building an understanding of the cultural models about sexuality that exist among the Ecuadorian youth, as well as the initial influences that may be shaping them. Preliminary data demonstrates a model of motherhood that is aggressively taught to new young mothers by older generations; young mothers are taught to learn how to love their child, yet they still express having initial feelings of an unwanted pregnancy and doubts moving forward as a mother. Ideas about the prototypical intimate relationship heavily influence the ways in which these young mothers understand love and sexuality, and the native typology of cuidate is seen among both young and older participants that provides insight into how young mothers learn to think about their own sex roles. Future research for this project will collect survey data to confirm if these models of understanding exist among the wider general population in current day Ecuador.

205 GM-Over It? The Impact of GMO Labeling on Purchase Intent

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Background: Little is known about the way U.S. consumers interact with and utilize food labels indicating the presence or absence of genetically modified organisms (GMO). Purpose: The aim across two studies was to determine if GMO labels present during food selection have an impact on consumer willingness to purchase (WTP). Methods: In Study 1, participants (n = 203) were presented with 64 foods which were accompanied by either: no GMO labels, GMO Free labels, or Contains GMOs labels. Participants were also shown a full nutrition facts panel and photos of the foods. WTP was collected for all 64 foods followed by one question gauging perceptions of GMO-related risk. Study 2 (n = 231) was identical to Study 1 in all ways except the labels were placed on different foods to better understand if label effects were dependent on food type. Results: Study 1 participants in the Contains condition did indicate they would purchase fewer foods ($p=0.048$) however, when a Bonferroni correction was applied the p-value exceeded that of the more conservative corrected value ($p<0.017$). Study 2 found no significant differences. Overall, 85% of participants stated they believed GMOs to be at least somewhat harmful to health with 42% indicating they believe GMOs to be dangerous. Conclusion: Although the majority of participants indicated they believed GMOs to be somewhat harmful to health, the labels had no impact on their WTP. Thus, self-reported attitude toward GMOs may not be a useful predictor of subsequent consumption behavior.

206 Rising from the Dead: Who are the Monsters and Why?

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The purpose of this poster is to compare the role of monsters that appeared in 19th-century novels with their new incarnations in contemporary work. The focus will be on Jekyll/Hyde from R.L Stevensons The Strange Case of Dr. Jekyll and Mr. Hyde (1886) and Griffin from H.G. Wellss The Invisible Man (1897) who are reimagined in Alan Moores graphic novel, The League of Extraordinary Gentlemen (LEG, 1999-2003). This comparison between the original 19thcentury monster figures and how they are represented in contemporary fiction will ask if monsters can change when reinterpreted and what these changes, or lack thereof, means in terms of societal fears.
The project is framed within cultural studies research on monsters as framed by Jeffery Jerome Cohen and Alexa Wright. They suggest that monsters embody specific cultural fears (Cohen 4) that define what constructs acceptable human identity (Wright 1). Within the original texts, Hydes monstrosity is an embodiment of homosexuality while Griffins personifies the fear of the unknown, racial Other.
However, changing cultural attitudes create a change within the monster. In LEG, Hydes decreasing monstrosity suggests greater acceptance of homosexuality while Griffins lack of change displays a continued fear of the unknown Other. The implications of this outcome indicate a transformation in how our culture perceives deviant sexual orientations but a continued fear of the racial Other.
Monsters are continuously reimagined, offering a method to examine how society has or has not changed, especially in terms of present-day treatment of diverse sexual identities or of racial Others.

207 Heart Development: The Peanut Butter to Our Cardiac Jelly

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Malformations in the heart are the most common congenital birth defects in the United States. Many defects occur within the developing valve. The severity and frequency of these defects emphasize the importance of research to discover the necessary factors of embryonic valve development. The early embryonic heart begins as a linear tube consisting of a monolayer of endocardial cells surrounded by a monolayer of myocardial cells. Biomechanical forces such as blood flow or heart contractility influence development of the early valve structure. This structure is characterized by an expansion of the extracellular matrix called the cardiac jelly (CJ). The CJ is a compressible, acellular, gelatinous layer secreted by the myocardium. While the heart contracts, the CJ may create a necessary stress environment for developmental signaling to occur between the two cell layers. We predict that proper CJ expansion relies on biomechanical cues while also contributing to biomechanical function and proper organogenesis. In a zebrafish model, we utilized a morpholino approach to decrease expression of three previously characterized genes that influence the presence of CJ. Hyaluronan synthase 2 (Has2), Nephronectin (npnt), and Cadherin 5 (cdh5) knockdown decreased, increased or altered the composition of the CJ, respectively. We used high speed videos to show that alterations in CJ production lead to decreased cardiac function. Heart

chamber volume and cardiomyocyte shape, number and compliance confirm that changes in cardiac function coincide with abnormal cell differentiation and organization. Our results indicate a relationship between the CJ and essential biomechanical forces to influence heart valvulogenesis.

208 Influence of Ligand Encapsulation on Cobalt-59 Chemical-Shift Thermometry

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Thermometry via magnetic resonance imaging (MRI) would provide a powerful noninvasive window into physiological temperature management. Cobalt-59 nuclear spins demonstrate exceptional temperature dependence of their NMR chemical shifts, yet the insight to control this dependence via molecular design is lacking. We present the first systematic evidence that encapsulation of this spin system amplifies the temperature sensitivity. We tested the temperature dependence of the cobalt-59 chemical shift in a series of five low-spin cobalt(III) complexes as a function of increasing encapsulation within the 1st coordination sphere. This study spans from [Co(NH3)6]Cl3, with no inter-ligand connectivity, to a fully encapsulated dinitrosarcophagine (diNOsar) complex, [Co(diNOsar)]Cl3. We discovered temperature dependent chemical shift sensitivities spanning 1.44(2) ppm/C in [Co(NH3)6]Cl3 to 2.04(2) ppm/C in [Co(diNOsar)]Cl3, the latter among the highest for a molecular complex. The data herein suggest that designing cobalt-59 NMR thermometers toward high chemical stability can be coincident with high temperature sensitivity. To better understand this phenomenon, variable-temperature UV-Vis, cobalt-59 NMR relaxation and Raman spectroscopic investigations were performed. Data from these measurements highlight an unexpected impact of encapsulation an increasingly dynamic and flexible inner coordination sphere. These results comprise the first systematic studies to reveal insight into the molecular factors that govern the temperature dependent properties and provide the first evidence of cobalt-59 nuclear-spin control via vibrational means.

209 Cortical Circuitry Dampening the Fight-or-Flight Response

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How our brains respond to chronic stress is unclear at a time when the burden of neuropsychiatric and cardiovascular disease is staggeringly high. Human imaging studies have found that the prefrontal cortex is a key site for processing stress-related information. Within the rat prefrontal cortex, the infralimbic area (IL) is critical for behavioral and physiological stress reactivity. Interestingly, we recently found that the IL provides direct input to the ventrolateral medulla (VLM). Since the VLM is a critical mediator of the fight or flight stress response, an IL-VLM connection may underlie a crucial link between stress appraisal and sympathetic reactivity. Here, the VLM of rats exposed to chronic stress was used for gene

expression analysis probing signaling molecules. Chronic stress was shown to decrease the expression of an inhibitory receptor subunit and increase expression of excitatory catecholamine-synthesis molecules. Next, we used a viral-packaged fluorophore to map IL projections onto different VLM neuron-types. These tract-tracing studies showed IL terminals project to VLM catecholamine-synthesizing neurons and inhibitory cell-types. Lastly, a viral vector containing the light-gated cation channel, channelrhodopsin-2, was injected into the IL along with fiber optics targeting the VLM. Thereafter, photoactivated IL synapses in the VLM blunted the glycemic component of the stress response. These studies produced structural and functional evidence indicating the IL may limit sympathetic reactivity by regulating local inhibitory neurons in the VLM. Moreover, the IL-VLM circuit is susceptible to genomic and signaling changes that may underlie the deleterious pathologies associated with stress.

210 Finding the Order Within a Disordered Next-Generation Semiconductor

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The photovoltaic sector has seen an overhaul with the introduction of low-cost, solution-processed 3D hybrid organic perovskite (HOP) materials surpassing conversion efficiencies of 20%. Due to the high toxicity of lead, other alternatives, such as the tin analog, have been the focus of attention. In this work, we studied the structural disorder in the vacancy ordered double perovskite methylammonium tin iodide. While the band structure of HOPs is mainly determined by the inorganic octahedral framework, composed of the metal and halogen atoms, the organic cations can strongly interact with them through hydrogen bonding leading to octahedral distortions. To gain further understanding of the structure-property relationship within the HOPs, it is of interest to describe the interactions of the MA molecules with the inorganic framework. Experimental acquisition of this information has been difficult due to the disordered motions of the MA molecules at room temperature. To study the time-averaged orientations of the individual organic cations, we used pair distribution function analysis of both neutron and X-ray scattering data to provide constraint to both the inorganic and organic components. These data were used to constrain models generated by Reverse Monte Carlo simulations, which are used to determine the relationships between octahedral tilting and organic cation orientation. Our results help to improve the understanding of how physical properties are influenced by the underlying interactions and dynamics between the organic cation and the inorganic framework within HOPs to aid in the design of next-generation semiconductors.

211 A Tissue-Engineered Repair Patch to Treat Spinal Herniation

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Chronic low back pain caused by herniation of the intervertebral disc (IVD) drives the need for advanced regenerative tissue engineering (TE) strategies. Additive manufacturing of bioresorbable TE scaffolds allows for customizable architectures and mechanical properties. However, it is prohibitively intensive to assess numerous designs experimentally. Accordingly, this research leverages experimental and computational techniques to design an IVD repair implant that: (1) replicates the physiologically-relevant mechanics of the original IVD tissue, (2) generates the requisite cellular micromechanical environment (CMME) for IVD regeneration, and (3) integrates mechanically with the spine. Cell-free, 3D-printed, polycaprolactone (PCL) scaffolds were mechanically tested in biaxial tension. Similar, cell-seeded scaffolds will be cultured with dynamic, biaxial stimulus in a custom-built incubator. An IVD implant was designed and the surgical integration of this implant will be mechanically tested with an ovine lumbar spine model. A multi-scale, parametric, finite element (computational) model was developed to complement all experimental results by predicting the corresponding scaffold mechanics. Printed scaffold mechanics matched reported IVD tissue mechanics and were successfully predicted by the computational model. The model predicted the critical scaffold architectural parameters to replicate IVD tissue mechanics and stimulate tissue regeneration. In future work, biaxial incubation results will be used to validate the computational CMME model. It is expected that future results will elucidate which implant designs and surgical attachments are the most effective for IVD repair. Successful implantation in an ovine model will facilitate further development, translation to human treatment and, ultimately, regeneration of healthy IVD to treat chronic low back pain.

212 The Subcellular Localization of mRNA Transcripts During Caenorhabditis elegans Embryogenesis

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Asymmetric cell divisions are important for cell-fate determination during development. After the first Caenorhabditis elegans embryonic cell division, 280 mRNAs partition asymmetrically between the AB and P1 daughter cells.

Strikingly, we have observed subcellular localizations for many of these transcripts that may underlie their cell-specific enrichment patterns. For example, the AB-enriched mRNA transcript erm-1 concentrates at the cell cortex whereas imb-2 mRNAs localize to the nuclear periphery when imaged by single-molecule Fluorescence In Situ Hybridization (smFISH). Intriguingly, these are the destinations where the encoded proteins will ultimately function. In contrast, the P1-cell enriched mRNA transcripts chs-1, nos-2, clu-1, and cpg-2 localized into clusters in the posterior of the embryo. Of these granular transcripts, some showed strong overlap with markers of P granules (ribonucleoprotein particles, RNPs, associated with germline function) whereas others co-localized with both markers of P granules and P-bodies (RNPs associated with mRNA degradation).

We aimed to identify sequences and machinery required for subcellular mRNA localization and have identified that some, but not all, 3UTR sequences were sufficient to direct subcellular localization. However, the sequence information that directs erm-1 mRNAs to the cell cortex still remains unknown as the 3UTR of erm-1 was insufficient to direct transcripts to the cortex, and the introns of erm-1 were also dispensable. RNA binding proteins that are known to be

necessary for translational control of nos-2, are also required for the granular localization of nos-2 and other P1-enriched transcripts. Our findings point to a relationship between translational regulatory control and mRNA subcellular localization.

213 Decision Support System Evaluating Fish Habitat in Alternative Flow Scenarios

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A critical part of managing water resources to support fish populations is ensuring that adequate habitat is available. A decision support system that evaluates fish habitat availability under various flow scenarios has been developed to support improved water management and protection of instream flows. This system synthesizes physical and biological model outputs into relevant, coherent metrics that can be used directly in water resource management. A 2-dimensional physical model of the stream channel is generated for a range of flows to determine the spatial distribution of flow characteristics. These flow characteristics are cross-referenced with the habitat preferences of local fish species to map suitable habitat at each modeled flow. Suitable habitat is quantified and used to develop curves of habitat area by discharge. The total suitable habitat area available at any flow within the modeled range can be estimated from these curves. Flow scenarios can be supplied to evaluate how habitat availability will change in response to water withdrawals, climate change, or dam operations on the stream. Historic flow records may also be used to identify flow patterns that are most favorable for certain species aiding in the recovery and protection of threatened or endangered species. The system is currently being applied to rivers in Arizona but is applicable to rivers across the country.

214 Modeling, Simulation, and Control of Soft Robots

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Soft robots are a new type of robot with deformable bodies and muscle-like actuations, which are fundamentally different from traditional robots with rigid links and motor-based actuators. Owing to their elasticity, soft robots outperform rigid ones in safety, maneuverability, and adaptability. With their advantages, many soft robots have been developed for manipulation and locomotion in recent years. However, the current state of soft robotics has significant design and development work, but lags behind in modeling and control due to the complex dynamic behavior of the soft bodies. This complexity has limited the development of dynamics models, computationally-efficient real-time simulations, and real-time closed-loop control schemes.

In our work, we address the three problems of modeling, simulation, and control of soft robots. For the modeling, we establish a general modeling framework for the dynamics by integrating Cosserat theory with Hamilton's principle. We develop efficient numerical algorithms for

simulating the dynamics and focus on preserving certain qualities of the dynamics, that are typically neglected, to improve the qualitative predictions. Using the developed numerical algorithms, we investigate the control of soft robots with the goal of achieving real-time and closed-loop control policies. Several control approaches are tested on a few key tasks. The results show that model predictive control is possible but is computationally demanding, while reinforcement learning techniques are more computationally effective but require a substantial number of training samples. The modeling, simulation, and control framework developed lays a solid foundation to improve the applications of soft robots.

215 Developing Management Tools for Wheat Stem Sawfly

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COLLEGE: INTRA-UNIVERSITY

Wheat stem sawfly (Cephus cinctus Norton) is a relatively new pest of Colorado winter wheat, causing significant yield reduction in Northeastern Colorado starting in 2010. During the growing season and before normal harvest, the sawfly larvae consume tissue within the wheat stem, causing it to fall to the ground. Currently, management options are limited to unattractive cultivars and naturally occurring biological control. Planting a trap crop, an alternate crop used to attract insects away from the main crop may be an additional method for cultural control. We evaluated winter triticales (× Triticosecale) attractiveness to sawfly relative to winter wheat. Projects to determine suitability included 1) greenhouse choice studies between wheat and triticale, 2) individual stem field choice tests, and 3) large plot field choice tests. Data has been collected for all projects and is in the process of being analyzed. Early findings show triticale is equally as attractive as the most attractive wheat cultivar on the market. Our data also shows larval size is similar in both triticale and wheat, suggesting triticale is a suitable host for sawfly. From this preliminary data we believe if triticale is planted on the border of a field of an unattractive cultivar, the two crops can complement each other in reducing sawfly damage and yield loss. Once our hypothesis has been further supported, we will encourage farmers to incorporate triticale into their cropping systems to lower sawfly populations.

216 Drone Mapping of Stone Tool Surface Assemblages at Isimila, Tanzania

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Recent years have seen an explosion in the usage of drones in archaeological research. Drones allow researchers to address large scale spatial questions about site distributions by providing low-cost mapping and survey capabilities. Archaeologists who study human ancestry and early stone tool technology have recently begun to deploy drones in the field. The Middle Pleistocene archaeological site of Isimila, Tanzania presents an opportune testing ground for drone survey. Located in a large erosional stream bed, Isimila is best known for the spectacular array of stone tools strewn across the surface of the site and for its impressive geological formations. While no ancestral humans have yet been found at Isimila, it has

continued to be an important window into early human behavior. Although Isimila was extensively studied in the 1950-60's, very little research has been carried out at the site since, leaving lingering questions about the vast amounts of stone tools that have been discovered there. Using a drone and digital photogrammetry, our team created high resolution maps and elevation models of the site, documenting previously unmapped exposures and archaeological localities, along with the noticeable effects of erosion on the site. We also mapped the extent and relative densities of the surface tool assemblages revealing patterns of distribution that may support previous hypotheses regarding raw stone transport and recurring occupation of the site by early humans. The maps and spatial analysis also provide a crucial baseline for planning future excavations at Isimila to preserve its important cultural heritage.

217 Effects of Orientation on Immobilized Enzymes

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Enzymes have been used for decades in the manufacturing and degradation of goods. In order to control the reactivity and the location of enzymes they tend to be immobilized onto different architectures. I have chosen the model enzyme laccase in order to test the effects of orientation on the enzyes reactivity. The laccase enzymes is able to oxidize the phenols while also reducing oxygen. The substrate ambiguity of the laccase enzyme allows for the testing of steric hinderance on the different substates approaching the immobilized enzyme.

218 Electroacupuncture Improves Gait in a Rodent Model of Spontaneous Osteoarthritis

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When faced with the frustration of chronic discomfort and restricted mobility due to osteoarthritis, many individuals have turned to acupuncture. Acupuncture is a traditional Chinese practice for pain alleviation that involves needle insertion into the skin followed by manual or electrical stimulation. However, the efficacy of acupuncture is uncertain, as much of the evidence is of questionable quality. The purpose of this study was to evaluate electroacupuncture in a rodent model of osteoarthritis such that unbiased conclusions regarding its efficacy for symptom modification could be drawn. Ten 11-month-old, male Dunkin Hartley guinea pigs, which characteristically have moderate osteoarthritis at this age, were randomly assigned to receive electroacupuncture (n=5) or anesthesia only (n=5). Gait analysis and enclosure monitoring were performed bi-weekly to evaluate changes in movement. Serum was collected for inflammatory biomarker testing, and knee joints were collected for histology and gene expression. Animals receiving electroacupuncture had significantly greater changes in movement parameters compared to those receiving anesthesia only. There was a trend toward decreased serum C3 and TNF protein concentrations in the electroacupuncture group compared to the anesthesia group. COL2A1,

FGF-18, TIMP-1, TGF-B1, iNOS, and SOD-2 gene transcripts in articular cartilage were significantly increased by electroacupuncture. There was not a significant difference in total joint histology scores between groups. This study provides evidence that electroacupuncture had a positive effect on symptom, but not disease, modification in a rodent model of osteoarthritis. Further investigations into mechanistic pathways that may explain the efficacy of electroacupuncture in this animal model are needed.

219 Corporate Personhood in the Announcement of the Tumblr Porn Ban

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In late 2018, Tumblr announced updates to its Community Guidelines that banned all adult content from the platform. The microblogging platform had historically been an online queer space, known for being an online venue for LGBTQ+ individuals and communities to safely meet, communicate, and explore their identities in ways that may not have been possible in physical settings. Because the new adult content policy was such a radical change from this previous meaning of the platform, Tumblr used corporate personhood to announce the updated community guidelines. By presenting its corporate person as if it were any other user, Tumblr created a false sense of equality and downplayed the inherent power imbalance present in the platforms ability to define itself contrary to the desires of its users. Because this corporate person is necessarily more powerful than the users, it challenges the extent to which social network sites are compatible with prior myths of online communication as free, open, and equalizing. This article analyzes the announcement of Tumblrs updated adult content policy to demonstrate how corporate personhood is used to downplay the power imbalance between a platform and its users, most notably the platforms ability to include and exclude certain members from the community.

220 Synoptic Environments Favorable for Widespread Convection in Subtropical South America

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Subtropical South America is a global hotspot for severe thunderstorms as a result of three key ingredients: a strong low-level jet transporting moisture from the Amazon along the Andes Mountains, a capping inversion prolonging the release of instability as mid-level dry air flows down from the mountainous terrain, and a triggering mechanism that releases the instability. Previous work shows that convective storms in South America are larger and longer-lasting than their North American counterparts, largely due to the extreme height of the Andes compared to the Rockies.

While previous work identifies synoptic-scale environments favorable for these events during the summertime, this study also compares both summer and springtime events. In the

summer, the upper-level trough is further poleward and passes over the southern and lower Andes topography. This trough remains largely intact as a result, allowing for more upper-level support close to the high terrain as the foothills initiate a greater frequency of terrain-locked storms. In the spring, however, although the trough is initially stronger, it passes over the Andes further equatorward, where the Andes are taller and cause a greater disruption of the upper-level flow. Instead of the terrain primarily initiating storms, weaker upper-level synoptic support and enhanced spring lee cyclogenesis cause storms to develop further eastward. To put these findings into context, we investigate a particular case that occurred in November 2018 during the RELAMPAGO field campaign. Results will show substantial synoptic forcing, initiation near the terrain, and the role of lee cyclogenesis in meridional moisture transport.

221 Sensitivity of the Shortgrass Steppe to Deluge Size

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Climate change is intensifying the hydrologic cycle globally, resulting in more extreme weather events, ranging from extended droughts to more frequent large precipitation events, or deluges. While many ecosystem types will be affected by such alterations in precipitation patterns globally, arid and semi-arid systems are expected to be the most responsive. In these ecosystems, ecological processes are largely controlled by the pulsed nature of individual precipitation events, and deluges represent an extreme precipitation pulse. Since climate change models predict an overall increase in deluge magnitude, I designed an experiment to assess how deluge size affects ecosystem function in the shortgrass steppe of Northeastern Colorado. Using a replicated regression approach, I administered a single deluge of varying size (20-120 mm) to plots during peak growing season. I then monitored several ecosystem responses, including soil moisture, soil respiration, canopy greenness, and above- and below-ground net primary production (ANPP & BNPP), as well as leaf growth and flowering of the dominant grass species, Bouteloua gracilis (blue grama). The shortgrass steppe was extremely sensitive to deluge size, with all measured responses exhibiting a general positive linear trend with increasing deluge size. There was little evidence of response saturation, suggesting that this ecosystem is able to effectively utilize large water inputs from deluges. These findings have important implications for understanding ecosystem functioning of the shortgrass steppe under future precipitation regimes.

222 Sticky and Gassy: The Story of Stir-Fry

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Cooking emissions are an important source of indoor aerosols and may be harmful to human health. However, the chemical composition and characteristics of these particles will impact their fate by controlling the ability of organic molecules in the particle phase to partition to the gas phase. During the HOMEChem (House Observations of Microbial and Environmental Chemistry) campaign in Austin, TX in Summer 2018, we used a thermal denuder coupled to a Time-of-Flight Aerosol Chemical Speciation Monitor (TD-Tof-ACSM). This instrument setup

allows us to investigate the gas-particle partition characteristics of cooking emissions. Here we focus on cooking emissions from a frozen vegetable stir fry. The aerosol mass spectrum is dominated by organic aerosol. Positive Matrix Factorization (PMF) identified three unique factors in cooking aerosol, associated with more volatile, intermediate volatile and low volatility compounds. We probe these factors with a kinetic gas-particle partitioning model which enables us to model volatility basis set (VBS) distributions of the three PMF factors, and consider the implications of cooking emissions to indoor loadings of organic aerosol.

223 Modeling Regional Patterns of Post-Disaster Housing Reconstruction in the U.S.

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Increasing weather-related hazards have caused significant damages to U.S. housing stock, as exemplified by the 2018 billion-dollar hurricane season. Reconstruction of damaged residential housing is an essential component of housing recovery and long-term resilience of communities. Post-disaster housing reconstruction is a resource-driven process that is influenced by the availability and accessibility of financial capital and construction industry resources. Previous case studies have illustrated that housing reconstruction outcomes are uneven across different disaster-affected regions of the United States and may be attributable to unequal access to reconstruction resources. However, there is a paucity of quantitative studies exploring the strength of spatial relationships between resources and reconstruction outcomes across varying geographical regions of the United States. Although qualitative case studies have identified socioeconomic factors as a catalyst for post-disaster resource accessibility, there are a lack of quantitative studies that correlate socioeconomic characteristics with post-disaster housing reconstruction outcomes at the regional scale. Using geospatial regression analysis tools, this study develops two predictive models using Ordinary Least Square regression (OLS) and Geographically Weighted Regression (GWR) to explain housing reconstruction patterns and explore spatially varying local relationships between socioeconomic, construction industry, and federal government resourcing factors and housing reconstruction outcomes. OLS results show a global relationship between resourcing variables and housing reconstruction outcomes, while GWR results reveal that the relationship between housing reconstruction outcomes and resourcing variables significantly varies across regions. The study will help policymakers identify regions vulnerable to resourcing crises for housing reconstruction after large-scale disasters and effectively allocate reconstruction resources.

224 Bio-Mimicked Shark Skin Fabric and Its Characterization

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Bio-memetics textiles is an innovative branch in functional textiles that is concerned with making of textiles wherein nature is the inspiration. One interesting type of biomimicry in

textiles is shark skin inspired fabric. The purpose of this study is to conduct a systemic review regarding shark skin biomimicry. Scholarly publications regarding bio-mimicked shark skin textiles were analyzed with the aim of understanding the concept of shark skin biomimicry in terms of manufacturing, applications and testing. It was found that shark skin biomimicry is capable of reducing drag. There has been discovery of several ways to produce bio-mimicked shark skin textile; such as computer numerical control (CNC) milling or molding as well as 3D printing. Most effective way to develop the fabric is the use of 3D technology. Bio-mimicked fabric that actually mimics sharks scaled skin can serve various applications owing to its drag reduction and anti-microbial properties. The significant areas of applications are; it can be used in aircraft and watercraft industry to reduce cost of transportation, allows faster flow of liquid when used inside pipes, can be employed in areas like hotels and hospitals to prevent bacterial growth. Lastly, it can be used in sports functional wear to reduce drag. Since research evokes doubts on attempts at biomimicry of shark skin which were carried out at commercial level, it can be concluded that commercialization of shark skin bio-mimicked textiles would be an advancement in the field of functional clothing which would be capable of serving numerous applications.

225 Nitrification of Ammonia-Rich Influent via Ammonia/Nitrite Oxidizing Bacteria

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Disposal of wastewater created as a byproduct during anaerobic digestion proves to be a significant setback in efforts to achieve economically feasible digestion of organic wastes. This fact, combined with the value of nitrogen as a fertilizer, makes the recovery of nitrogen from anaerobic digestion waste streams a constructive goal. This project aims to achieve the conversion of ammonia to nitrate (the product acting as a liquid fertilizer) using one reactor that contains a culture of both Ammonia Oxidizing Bacteria (AOB) and Nitrite Oxidizing Bacteria (NOB). This reactor would be fed a solution with high concentrations of ammonia, with the aim of achieving sustained operation at nitrogen concentrations higher than 7100 ppm. Thus far, cultures of AOB and NOB have been grown in isolated containers before they are mixed to serve as the biomass in a standalone nitrifying reactor. The experiment will focus on determining the inhibiting effects of nitrate production on the oxidation process, the effect of the AOB:NOB mass ratio on the reactor start-up process, the overall stability of the reactor, and the economic feasibility of such a process in real-world, large scale operation.

226 Microalgal Proteins to Bioplastics: Techno-Economic and Life Cycle Assessment

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The low price of petroleum-based fuels and the high capital costs of algal growth architectures have made it impossible for microalgae derived fuels to compete in the market. Over the last

decade, researchers have been focusing on a variety of alternatives to fuels such as nutraceuticals, cosmetics, pharmaceuticals, and animal feed. Nonetheless, the quality of the protein plays an important role in the determination of the most suitable product. Given their large market size and relatively high value, bioplastics are a promising alternative for low quality protein biomass. This study explores the economic and sustainability implications of a bioplastic biorefinery with biofuels co-products. The model of our system includes the different sub-processes involved in the production of bioplastic feedstock and has been validated by experimental data. A total of nine scenarios were modeled, each with different levels of processing. A techno-economic and life cycle assessment were performed to determine the economic viability and environmental impact of bioplastic production. Results indicate significant improvements in environmental performance of the produced bioplastic feedstock, with reductions ranging between 67-116% compared to petroleum based plastic resins. Additionally, the minimum selling price of the bioplastic feedstock is within the range of economic competition with prices as low as $970 USD tonne-1. These results indicate that an algae biorefinery focused on bioplastic feedstock production and fuels have significant potential to operate both economically and sustainably.

227 The Galapagos - A Conservation Legacy Through Conservation

AUDREY RAMSEY

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The purpose of my project is to communicate to the public about ecotourism/conservation best practices for living in, or traveling to, the Galapagos Islands. The National Parks Service of Galapagos had control of tourists when the only type of tourism was the live-aboard boat model. Now, there are many types of tourism on the islands such as hiking, camping, SCUBA, horseback riding, fishing tours, mountain biking, etc. which are not able to be as regulated by the parks and are degrading the ecosystem. I will aid in implementing ways to communicate with all visitors about the importance of practicing sustainable tourism. I will do this through interpretive signs, educational programs, and possibly videos that tour operators and hospitality businesses can show to their clients/employees. The goal of this project is to have a more informed and educated public in order to conserve this precious biodiversity hotspot. I will explore the difficulties of effectively communicating to the public and learn ways to overcome them in order to create a productive plan to get this important message to the people. My project will impact my field of study and create a legacy example because these Islands are already looked at as one of the Hope Diamonds of Ecotourism in the world. However, that doesnt mean it is perfect. I hope I can improve the ecotourism educational model in the Galapagos so it may enable and encourage others to create exceptional ecotourism models that can be applied all over the world.

228 An Unexpected Turn: Uncovering the Drivers of Fort Collins UTC

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Urbanization is occurring rapidly worldwide, with more than half of the current global population residing in cities. As urban areas continue to grow, proper provisioning of ecosystem services will become increasingly important to ensure high quality lives for urban residents. One way to attain the proper provisioning of ecosystem services is by increasing urban green space, particularly urban tree canopy (UTC), which has been associated with a multitude of benefits. By identifying the drivers of UTC, cities can discern which local characteristics significantly impact UTC distribution. This project analyzes the City of Fort Collins, CO: a semi-arid, mid-size city projected to undergo rapid population growth, with the primary sociodemographic and urban morphological drivers of UTC still undetermined. Using a series of multiple regression and spatial modeling techniques, we found that UTC is driven primarily by urban morphological characteristics, along with the rental and Hispanic population. In particular, we found that the amount of UTC is likely to decrease in neighborhoods with higher Hispanic population. These results suggest that despite being a mid-size and relatively young city, we are already witnessing inequities with respect to the UTC.

229 rSNAPsim: RNA Sequence to Nascent Protein Simulator

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Translation is a ubiquitous cellular process in which ribosomes read a mRNA sequence and create an encoded protein. Robust modelling of mRNA translation dynamics can lead to new insights, novel avenues of research, and directed experimental design. Recently, single-molecule resolution movies of translation provide access to live cell images of ribosome initiation and elongation. We provide a unique modelling approach to simulate these fluorescence traces of mRNA transcripts based on the codon composition of the chosen construct. We developed and released a Python library to provide access to our model. RNA Sequence to Nascent Protein Simulation (rSNAPsim) provides a platform for users to create, simulate and analyze fluorescently tagged mRNA constructs. Along with a python library, we have also developed a GUI that allows users a way to compare a myriad of model parameters with their fluorescent trajectory data. The GUI has options for analyses such as codon optimization, simulated kymographs, FCS covariances of various normalization regimes, ROA and FRAP assays, and ribosomal profiling.

230 Roles for piRNAs and WAGO Class siRNAs in Caenorhabditis Elegans

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Piwi-interacting RNAs (piRNAs) and small interfering RNAs (siRNAs) are distinct classes of small RNAs with roles in transposon silencing and germline development. In C. elegans, both piRNA and WAGO class siRNA mutants display temperature sensitive defects in fertility. However, their specific mRNA targets and their effects on gene expression are not well understood. To identify the impact of the piRNA and WAGO class siRNA pathways on germline gene expression, we subjected dissected gonads from piRNA- and siRNA-defective mutants to small RNA and mRNA sequencing. We identified widespread gene misexpression in the absence of either piRNAs or siRNAs, including upregulation of spermatogenic genes and downregulation of oogenic genes. Histones were among the most strongly misregulated genes in piRNA mutants. We show that in the absence of piRNAs, histone mRNAs are misrouted into the nuclear RNAi pathway involving the Argonaute HRDE-1. Additionally, we show that high-level gene expression in the germline correlates with high levels of siRNAs, although genes targeted by the WAGO branch of the siRNA pathway are typically poorly expressed and respond unpredictably to loss of siRNAs. Our results point to broad roles for piRNAs and siRNAs in both promoting and suppressing gene expression in the C. elegans germline.

231 A Microfluidic Device for Culture of Mammalian Intestines Ex Vivo

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Current tissue-on-a-chip systems rely heavily on in vitro cell culture to create reductionist models of tissues and organs. These systems recapitulate some tissue functions but fail to capture the richness of cell interactions of tissues in vivo because they lack the cellular diversity and complex architecture of native tissue. We report a microfluidic device that supports differential flow with physiological oxygen concentrations over intestinal explants containing epithelial, neural, immune, muscular, and microbial components. Device prototypes were made using injection molding and consist of three cyclic olefin copolymer layers separated by polyurethane gaskets. Intestinal tissue explants are housed in the middle layer with the mucosa and serosa facing independent microfluidic channels. Glass coverslips fixed on the top and bottom directly above the tissue enable on-chip imaging and tissue visualization. Dissolved oxygen concentrations (DOC) were measured using oxygen sensor spots adhered to the inner surface of the device. Mouse colon explants were cultured in the device for 72 h ex vivo maintaining intact tissue architecture with minimal cell death. Culture media perfused in each channel remained separated over 72 h as demonstrated by the lack of fluorescein leakage across the tissue, indicating an intact intestinal barrier. Fluorescent gram stains revealed increased bacterial presence on the tissues mucosal surface when perfused with media containing low DOC versus ambient DOC. Ultimately, the device supplemented with additional sensing functions will be implemented in long-term studies to elucidate the relationship among microbial, epithelial, neuro and immune components of the

gut wall in health and disease.

232 A Mechanistic Evaluation of White Matters Role in Bilateral Coordination

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The corpus callosum, the anatomical structure bridging the two hemispheres of the brain, is integral for the coordination of complex, coordinated movements of the upper limbs, however, little is known regarding its association with lower limb control. Bilateral coordinated movement and corpus callosum structural integrity are substantially compromised in persons with multiple sclerosis (PwMS). Thus, the aim of this project was to assess MRI-derived measures of transcallosal sensorimotor fiber tract microstructural integrity (via diffusion imaging) and identify the relation to gait coordination using novel methods of ecologically-valid mobility assessments in PwMS and age and sex-matched neurotypical adults.

Neurotypical adults (4 male and 12 females; 43 ± 17 years) and PwMS (8 males and 16 females; 49 ± 12 years) performed a two-minute walk at a self-selected pace. Lower limb asymmetries were quantified via the Phase Coordination Index (PCI) and white matter microstructural integrity of transcallosal tracts connecting homologous regions of the sensorimotor cortices was evaluated with diffusion tensor imaging. Radial diffusivity, an indirect marker of myelination, was utilized as the primary outcome.

In this preliminary analysis of an ongoing data collection, results indicate that PwMS have decreased bilateral coordination during over-ground walking and poorer transcallosal white matter microstructural integrity of sensorimotor fiber tracts in comparison to an age and sex-matched neurotypical cohort. Additionally, fiber tract integrity of transcallosal white matter connections between primary and secondary sensorimotor cortical regions are strongly associated with gait coordination during over-ground walking in both a neurotypical and a clinical population with callosal degradation.

233 Non-Lethal Methods Used to Detect Renibacterium salmoninarum in Brook Trout

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Studies of bacterial kidney disease, caused by Renibacterium salmoninarum, have increased in the past 40 years, in part because of salmonid declines in both aquaculture facilities and wild populations. Detections in Colorado have been infrequent since the 1960s, but the pathogen has recently been detected in hatcheries with greater frequency. Typically, detection of the pathogen has required sacrificing fish. However, many hatcheries have valuable and sometimes irreplaceable broodstocks, and lethal sampling is undesirable. Therefore, the development of non-lethal detection methods is a high priority. The goal of our study was to

compare non-lethal methods with the standardized lethal methods used to detect R. salmoninarum infections in Brook Trout (Salvelinus fontinalis). In 2017, we collected mucus, buccal, and anal swabs (non-lethal), and kidney tissue (lethal), from 72 Brook Trout reared at the Colorado Parks and Wildlife Pitkin Brood Unit. Assays used to assess bacterial infection included PCR, qPCR, and direct-fluorescent antibody tests (DFAT). Results from all tests combined indicated that 62 of 72 fish were positive for R. salmoninarum, however detection varied among assessment methods. DFATs on kidney were the most sensitive test (75.8%) and qPCR on mucus swabs also had high detections (62.9%). The likelihood of positive tests in all three non-lethal methods combined provided higher detections than the standard DFAT and PCR on kidney tissues, highlighting the utility of non-lethal methods. The overall equivalence between non-lethal and standardized lethal methods suggest non-lethal methods may be used to detect R. salmoninarum, preventing further depletion of rare, valuable, or irreplaceable broodstock.

234 Zooming in: Evaluating Global Change Effects on Soil Carbon Components

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Understanding the effects of our changing environment on carbon (C) cycling is crucial for assessing future stability of our ecosystems. Increasing or maintaining C storage is often cited as a way to prevent carbon dioxide (CO2) build-up in the atmosphere, which contributes to climate change. Soil C represents the largest terrestrial stock of C larger than the stocks in vegetation and the atmosphere combined so understanding the response of soil C is especially important for predicting future C dynamics. However, even after decades of researching soil C responses to global change, we have yet to reach consensus on what will happen in response to phenomena such as increasing temperatures and N pollution. To understand stability of soil C in light of these global changes, we must zoom in. We propose assessing soil C responses to global changes by separating soil C into two distinct components: one that is associated with soil minerals and is thus more stable (mineral-associated organic matter; MAOM), and one that is not associated with minerals, and is thus less stable (particulate organic matter; POM). We will first survey the literature on responses of MAOM and POM to various global change factors to obtain baseline knowledge on this subject. We will then use this survey to inform experiments that will determine which ecosystem properties are associated with changes in MAOM and POM. Greater understanding of these responses will allow us to more accurately forecast C cycling and inform land management for greater soil C storage.

235 Characterization of a Mouse Model of Pesticide-Induced Parkinson's Disease

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A number of environmental pesticides have been implicated as risk factors for Parkinsons disease (PD) due their capacity to damage dopaminergic neurons. Rotenone is a naturally occurring insecticide that inhibits mitochondrial complex I, leading to neurochemical and neuropathological deficits that closely resemble those in idiopathic PD, including loss of dopaminergic neurons in the substantia nigra pars compacta (SNpc), decreased dopamine levels and aggregation of alpha-synuclein. The rotenone model has been successfully reproduced in Lewis rats, however, it has little functionality in murine models due to rigorous dosing regimens, high lethality rates, and off target effects. We therefore postulated that by optimizing the dose of rotenone through intra-peritoneal injection we could successfully model PD-like neurological and neuropathological symptoms in mice. Wildtype (C57Bl/6) mice were exposed to 2.5mg/kg/day of rotenone for 14 days and then allowed to develop a progressive lesion for an additional 14 days. This revealed progressive neurodegeneration by means of TH intensity in the striatum along with stereological determination of dopaminergic neuron loss in the SNpc. Gliosis and protein aggregation were also investigated and revealed that gliosis preceded dopaminergic neuron loss. Activation of astrocytes and microglial cells occurred in a temporal pattern that moved from lateral cortical regions early in the exposure period to medial regions deep within the mesencephalon at later time-points. Following these events, there is evidence of phospho-serine 129 alpha-synuclein (p129+) protein aggregates. Given this data, we propose that this novel murine model allows for a mechanistic approach to examining the progression of Parkinsons Disease.

236 Synthesizing New Ternary Nitrides

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Nitrides are a class of materials that are critical for a green energy future, but are underexplored due to the difficulty of synthesis. Historically, only about 3.3 new nitrides have been discovered per year, but recent computational studies have predicted multiple new phases and can accelerate discovery. Our experimental efforts focus on turning these predictions into reality. Specifically, we use metathesis reactions to target the ternary nitrides MgSnN2 (a predicted semiconductor) and Ca2CoN2 (a predicted ferromagnet). These methods allow for precise control of nitrogen reactivity, producing materials that are inaccessible by more traditional techniques. Following successful synthesis, these compounds will be assessed for useful electronic, optical, and magnetic properties. Thus, this work will advance both solid-state synthetic methods, and produce materials for renewable energy applications.

237 Shear Wave Splitting Measurements in British Columbia

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The Canadian Cordillera has a complex tectonic history that includes transpressional deformation, accretion of allochthonous terranes, and deformation of autochthonous

structures. We use a new shear wave splitting method to investigate anisotropy in the region. This method incorporates the effects of pre-event microseismic noise to more accurately estimate uncertainty and allows for a formal statistical estimation of station-averaged splitting parameters. Our goal is to consider whether tectonic inheritance is a major cause of shear wave splitting, or if asthenospheric flow is a more likely cause of observations. Many of the stations in this region have data that is not available through the IRIS Data Management Center, and we believe this may be the first wholistic examination of this highly deformed region.

238 Investigation of Cryoprotectant Permeation and Localization in Living Plant Cells

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Cryopreservation freezing biological materials at liquid nitrogen temperatures is an established technique used in fields from fundamental cell studies to common medical practices to conservation biology. Though this technique is widespread, the fundamental nature of the molecules used to ensure viability post-freezing, cryoprotecting agents (CPAs), is not well understood. Oryza sativa (Asian Rice) callus cells were established as a model biological system to be used to image CPAs interacting with living cells.

To ensure that the first moments of cryoprotectant exposure were captured, a method was developed using poly-L-lysine to adhere the cells inside a rudimentary perfusion chamber designed to be used on an inverted microscope. Bright field studies indicate that the common CPAs dimethyl sulfoxide (DMSO), glycerol, and ethylene glycol at concentrations relevant to cryopreservation induce different levels of plasmolysis and deplasmolysis in living cells. This is indicative of differing interactions with the cells, though these interactions are not directly observable with bright field microscopy.

Vibrational microscopies are frequently used to observe unadulterated molecules, as these microscopies do not require the addition of bulky fluorophores. Using coherent anti-Stokes Raman scattering microscopy, deuterated DMSO was observed inside living rice callus cells. This preliminary work indicates that with further improvements in methodology, kinetic information of CPA permeation is obtainable. Understanding fundamental differences in CPA-cell interactions will inform improvements of current CPA formulations, maximizing post-freezing viability, improving the outlook of frozen cells used in an exceptionally wide variety of fields.

239 FttA, a CPSF73 homolog, Terminates Transcription in Archaea

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Only select sequences or transcription termination factors can disrupt the otherwise extremely stable transcription elongation complex. We demonstrate that one of the last universally conserved archaeal proteins with unknown biological function is the Factor that terminates transcription in Archaea (FttA). FttA is an orthologue of the eukaryotic cleavage and polyadenylation specificity factor subunit 73 (CPSF73) that cleaves nascent transcripts and terminates archaeal transcription. FttA-mediated termination shares mechanistic similarities with bacterial rho-mediated transcription termination and is kinetically coupled to RNA polymerase by the only universally conserved transcription elongation factor, Spt5. FttA preferentially cleaves C- and U-rich RNA and while addition of Spt4/5 tempers sequence requirements, FttA-mediated termination is reliant on the conserved stalk domain retained in eukaryotic and archaeal RNA polymerases. Reduced FttA expression and inhibition of FttA-mediated termination result in altered 3-end formation and transcription termination in vivo. Our results complete the archaeal transcription cycle, provide a missing-link between prokaryotic and eukaryotic transcription regulation and rationalize the evolution of the processing activities involved in RNA 3-end formation.

240 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.

241 Single Step CVD Synthesis of Highly Branched Silica Nanowires

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Branched nanowires are a unique structure with the potential to impact the performance and practical use of nanowire devices. Previously however, in order to synthesize branched silicon-based nanowires, a multi-step CVD process has been used which involves first depositing a catalyst, then growing the primary backbone wire, followed by treatment of the product, secondary catalyst deposition, and a second growth step. Here we have demonstrated the ability to produce branched silica nanowires using a Cu catalyst in a single CVD reaction.No previous report on nanopeapodding addresses the growth of the multi-wire backbone. Through studying and understanding the processes involved in the formation of these branched nano-wire structures, we provide evidence for the multi-wire hypothesis, as well as demonstrate how to manipulate the growth of the branched products through controlling synthetic variables. By understanding this system, we have been able to develop a CVD process which reliably and reproducibly synthesizes a high-density of branched nanowires.

242 Intestinal Goblet Cell Production is Regulated by Enteric Neuronal Fibers

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Innervation of the intestinal epithelial barrier has been known for over 100 years, however, the role(s) these neuronal fibers play in maintaining the epithelial and mucus barriers are still poorly understood. Goblet cells are a subset of epithelial cells that are responsible for the gut wall mucus barrier, an early stage line of pathogen defense. The present study was conducted to demonstrate both the proximity of mouse ileal goblet cells to submucosal neuronal fibers, and to test the hypothesis that goblet cell production could be regulated by the neuronally generated vasoactive intestinal peptide (VIP). Glycosaminoglycans were labeled ex vivo via a copper-free click-reaction, and these goblet cells were counted and shown to have at least one peripherin immunoreactive varicosity projecting within 3µm of the cell, 51% of the time. Treatment with a VIP receptor antagonist (VPACa) resulted in an increase in the percentage of goblet cells in close proximity to peripherin varicosities in the ileal crypt. Treatment with VPACa or tetrodotoxin substantially decreased goblet cell counts in both the intestinal crypts and villi. When cultured with 5-Ethynyl-2-deoxyuridine as an indicator of cell proliferation, labeled goblet cells were counted in ileal crypts and decreased by 77% when treated with VPACa. The present study demonstrates a close relationship of goblet cells with neuronal fiber varicosities. The results show VIP receptor regulation of gut wall goblet cell production. They add to the hypothesis that the gut wall barrier depends on the interaction of multiple cell types in the gut wall, including enteric neurons.

243 Building Communities of Care for Dementia Caregivers

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Background: Nearly 16 million Americans provide more than 18 billion hours of annual unpaid care for individuals with dementia. Caring for individuals with dementia often has detrimental effects on the physical, psychosocial, emotional, and mental health of the caregivers who, in turn, experience higher-than normal risk for developing chronic health conditions. There is no consensus on the optimal types or combinations of caregiver supports and services. Our long-term goal is to create a community-based caregiver collaborative for translational research on the benefits of community-based supports on the health and functioning of family caregivers for individuals with dementia.

Outcomes: While this research is in its beginning stages, the researcher has completed the initial steps of assessing community need in the areas of aging and caregiving resources and supports. This assessment informed the creation of a community-based caregiver collaborative that includes key stakeholders from Colorado State University and surrounding Northern Colorado communities. Each member of the research collaborative will provide ongoing support and services in their area of expertise to address the health and wellness needs of caregivers in the community.

Impact: This community-based caregiver collaborative aims to expand current community supports and services to meet the growing needs of an aging population and to develop a model of community resilience for aging adults. The team will operationalize current community support systems and build in assessment strategies to enhance outreach to diverse populations, including rural caregivers. We are currently exploring different funding agencies and mechanisms for a Spring 2020 submission.

244 Rallying Behind Rebranding: Rewiring Memory in Le Pen's National Rally

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This project critiques the French far-right political party Front National (National Front) and its attempts to rebrand party image by changing the party name to the Rassemblement National (National Rally) in June 2018. For this project, I conduct a rhetorical analysis of party leader Marine Le Pens speech announcing the name change, the official party press release, and the updated party logo, and I argue that Le Pen uses this type of rebranding as a way to solidify party allegiance and reinvigorate the party base following her loss in the 2017 French presidential election. My analysis has found that Le Pen performs what I call rewiring party memory by encouraging a form of selective forgetting by party members. She does so in three ways: creating a political family, urging members to battle for a better France, and bring together the old and new guard of the party. As such, the party is able to part ways with its anti-Semitic, Islamophic past while enthusiasm for the party message remains intact. Therefore, I argue that Marine Le Pens rebranding of the National Front by rewiring party memory is an attempt to replace negative connotations and memories of the past with positive messages of futurity and political unity. This project not only opens the discipline of

communication studies into a more international, non-English speaking electoral and cultural context, but it also helps us learn more about political branding and the rhetorical strategies that the far-right employs to spread its message to voters.

245 RAD51AP1 and RAD54 Synergism During the Synaptic Stage of HR

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Radiation therapy (RT) uses ionizing radiation (IR) to produce a plethora of DNA lesions, the most toxic one of which is a DNA double-strand break (DSB) that can be repaired by the least error-prone DNA repair pathways, Homologous Recombination (HR). However, HR is up-regulated in some tumor types, rendering these more resistant to RT. Hence, targeted inhibition of HR during RT 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). Whether these two proteins work independently or together in HR has remained unclear.
We have generated RAD51AP1 and RAD54 single and double knockout (KO) HeLa cells using CRISPR/Cas9. We find that under unperturbed conditions, compared to single KO cells, double KO cells show reduced growth rates, indicative of their more pronounced defect in repairing endogenously occurring DNA damage. Following exposure to mitomycin C, a chemotherapeutic agent that induces inter-strand DNA crosslinks which are repaired by HR, double KO compared to single KO cells are more sensitive, and a higher fraction of them arrest in G2 phase, suggesting that double KO cells overcome damage less well.
Taken together, our results show that RAD51AP1 and RAD54 largely function independently of each other in the HR reaction. Hence, targeted inhibition of both RAD54 and RAD51AP1 during RT may increase therapeutic gain and improve the survival rates of cancer patients.

246 Multi-Phase Skarn Mineralization Along a Transpressional Shear Zone, Copiapó, Chile

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The Chilean Iron Belt hosts world-class iron oxide-copper-gold (IOCG) deposits that are spatially associated with the Atacama Fault System (AFS). Here we combine new mapping and structural measurements with geochronometric and laser fluorination stable isotope analyses to understand the magmatic, deformation, and mineralization history of an IOCG deposit near Copiapó, Chile. The main branch of AFS is defined by a ~500-m-thick steeply NW-dipping shear zone that lacks brittle overprint. Zircon U-Pb ages document synkinematic emplacement of a tonalite in the shear zone at ~121 Ma. NW-dipping ultramylonitic fabrics in the tonalite strike ~510° clockwise of the shear zone boundary on average and have shallowly NE-plunging lineations. Kinematic indictors record oblique sinistral-reverse shear, but locally coaxial fabrics dominate, indicating an overall transpressional regime. The shear zone records

a synkinematic endoskarn assemblage that overprints original mylonitic microstructures, and is cut by an unstrained diorite that also contains pervasive endoskarn mineralization. A late skarn vein has a ~96 Ma andradite U-Pb age. Stable isotope analyses of the skarn vein yield 18O values of +11.1 (qz), +5.4 (grt), and +5.7 (ep), indicating alteration by magmatic fluids at 410470°C. Together, these relationships document three pulses of skarn mineralization over a ~35 Myr period. The oldest is synkinematic with Early Cretaceous shearing and overlaps in age with other AFS sections. The lack of brittle faulting and postkinematic skarn mineralization is likely related to heat from the Copiapó batholith complex, which is younger than most plutons in the Coastal Cordillera.

247 Cost-Effective Energy Efficient House

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The world has seen unprecedented growth in the solar energy industry in the past few years. The new electric capacity addition by solar has increased from a mere 4% in 2010 to more than 40% in 2016-17 in United States alone. This growth has been aided by the falling prices, which makes solar industry competitive with other forms of energy generation. Cadmium Telluride solar cells in past 10 years have emerged as another big potential in the photovoltaics (PV) market. The levelized cost of energy (LCOE) from CdTe PV is ~$0.04/kWh, while the national average LCOE from all sources is $0.11/kWh.

Convergence between economy, ecology and energy should define our future -Mr. Narendra Modi, Prime Minister of India

As urged to the youth by the Prime minister of India to tap solar energy for clean cooking, this model of energy-efficient house aims to achieve following sustainable goals:

Demonstrate a solar household with all basic utilities such as cooking, lighting and running other electrical appliances even on the rainy days.

Our group has developed a solar panel mounting technology using adhesives that eliminates the complex drilling step on the roof, thus saving it from leakage during rainy season.

Preliminary market research shows that the model is economically feasible with cost recovery in 3-5 years in developing countries.

Use of clean energy for cooking will eliminate the use of fuels like wood, coal. which in turn will help to strive for a perfect balance between economy, ecology and energy.

248 Alternative Ventricular Assist Device

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Our goal is to develop a new ventricular assist device (VAD), overcoming disadvantages to current commercially available VADs, by improving hemodynamic (blood flow) performance

through an innovative technology involving a flexible pulsatile undulating multilayered pump . Current VADs suffer from bleeding, and hemolysis complications due to nonyphysiological shear stress. Our design will overcome the former by restoring physiological flow within the pulsatile undulating multilayered pump. We have demonstrated an ability to create a device that can recreate the output of commercial VADs. This document builds upon these efforts and leverages the biofluids, medical device design, hemostasis and thrombosis, and surface science expertise of the investigators. The impact of this work goes beyond VADs and would be applicable to other blood pumps (extracorporeal or implanted).

249 Agriculture in a Changing Climate: Preventing Heat-Induced Plant Disease Susceptibility

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Under increased temperatures, such as those predicted as a result of global climate change, plant defense responses are attenuated leading to a process known as heat-induced disease susceptibility (HIS). The plant growth hormone cytokinin is known to regulate responses to both biotic and abiotic pressures. To address the role of cytokinin in HIS of Arabidopsis to Pseudomonas syringae pv. tomato DC3000 (Pst), wild-type plants and a cytokinin receptor mutant (ahk2,3 mutated on ARABIDOPSIS HISTIDINE KINASE 2 and 3) were exposed to Pst at two different temperatures, normal (22°C) and high (28°C). Pst populations were measured to assess pathogen fitness and host susceptibility. Stomatal conductance, fluorescent microscopy, and gene expression were measured to evaluate how cytokinin signaling impacts HIS. Results show that ahk2,3 plants are less susceptible at 28°C, with Pst populations plateauing 36 hours post inoculation. Moreover, pathogen-induced stomatal closure and expression of defense-marker genes were impaired under heat stress. However, a synthetic cytokinin reporter showed that high temperature increased cytokinin signaling. These results suggest that apart from its role in defense under normal temperature conditions, cytokinin promotes physiological conditions that contribute to pathogen proliferation under high temperature. Together this highlights the value of cytokinin-based chemical and genetic approaches to diminish the negative consequences of disease as a means to improve crop production under warmer temperature conditions.

250 Regression Test Selection Using a Machine Learning Approach

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Regression testing is crucial to ensure that previously tested functionality is not broken by code changes. Since regression testing is expensive, researchers have developed regression test selection (RTS) approaches, which select and run only those test cases that are relevant to the code changes. Though capable of reducing testing time with reasonable accuracy, the state of the art RTS tools do not scale up to industrial software and multi-language

development environment. Machine learning (ML) has been demonstrated to be successful in solving Software Engineering problems such as test prioritization and automatic program repair in companies like Facebook and Salesforce. ML approaches developed to address Software Engineering problems use a similar set of features collected from source code, test cases, and execution data. In this research, I am developing a new, faster RTS approach using ML that takes less analysis time to find build dependencies and selects fewer tests than current RTS techniques. I am identifying the set of features that can be used to learn from prior regression testing data to determine which tests must be selected for the next version of the software. So far, I found potentially useful features such as text-based similarity score for changed source code contents and filenames. I am developing and comparing supervised ML models to find the best algorithm in terms of accuracy and time of execution. I will evaluate my approach using multiple open source projects and compare the accuracy and scalability of my approach with traditional approaches.

251 Role of a Vasoactive Hormone in the Midbrain

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At least 70 % of the synapses formed on midbrain dopaminergic neurons are GABAergic and the axon collaterals of the GABAergic substantia nigra pars reticulata (SNr) projection neurons acts most consistently to inhibit dopaminergic neurons in vivo. Angiotensin II (Ang II) is a well-characterized regulator of cardiovascular function in the periphery but it is also found in the central nervous system where local concentrations can exceed those found in the circulation. Ang II signaling is known to modulate GABAergic neurotransmission in the median preoptic nucleus, anterior hypothalamus, and dorsolateral periaqueductal grey neurons. Interestingly, Ang II, angiotensinogen and the primary receptors for Ang II, AT1R and AT2R, are widely expressed in the SNr in both primates and human brain. However, if Ang II signaling takes place in SNr GABAergic cells and if it can affect GABAergic neurotransmission in dopaminergic cells is not known. Here we present evidence of Ang II signaling in GABAergic pars reticulata projection neurons. We find that Ang II significantly decreases the frequency of evoked firing of SNr projection neurons and increases the amplitude of picrotoxin sensitive GABA(A) receptor mediated inhibitory post synaptic currents (IPSCs). These results provide, for the first time, evidence of Ang II-mediated potentiation of GABA(A) receptors on SNr GABAergic neurons and inhibition of their firing. Since GABAergic SNr neurons provide most of the inhibitory input to dopaminergic neurons in the nigra compacta, these data suggest that Ang II signaling in GABAergic cells could potentially increase dopaminergic cell firing and modulate their activity

252 Urban Wood Utilization Feasibility Study Fort Collins, Colorado

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The process of rapid, unsustainable urbanization can further compound urban ecological issues, such as urban tree disease. If unmanaged, urban tree diseases can spread quickly, requiring the pruning/removal of the impacted tree canopy. Unsustainable management or removal of trees can lead to an excess of wood waste. Accumulation and improper disposal of wood waste can also lead to higher greenhouse gas emissions, a major deterrent to sustainable development. The City of Fort Collins expects a large portion of its urban tree canopy to be impacted by Emerald Ash Borer, sparking debate on how to utilize its impending wood waste and limit greenhouse gas emissions. This project analyzes the social, environmental, and economic barriers and benefits to transforming the current urban wood waste utilization system in Fort Collins and the associated Front Range area. Through stakeholder interviews and network analyses, we aim to develop path analyses and Life Cycle Assessments that support appropriate management of urban wood waste for its highest and best use and advise in sustainable policy recommendations for the City of Fort Collins. Preliminary results show the main barriers stakeholders are experiencing are costs/economics, equipment and land or storage space. Alternatives identified include pursuing a centralized sort yard and applying for grants to build a localized urban wood network. Other cities have successfully implemented urban wood utilization initiatives. Some solutions, such as biomass burning, are not viable for our location, while our study shows that a localized network to develop socially responsible interventions is a potential way forward.

253 Effect of MCWF on Health and Fertility in Dairy Cows

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The transition period is the most challenging time in the life of a dairy cow. Our objective was to evaluate the effect of Mycobacterium cell wall fraction (MCWF; Amplimune®, NovaVive Inc., Belleville, Canada) on presentation of peripartal diseases, reproductive performance and milk yield of Holstein cows. Cellular immune response, metabolic status, general health, and production were assessed up to 150 days in milk. A total of 136 Holstein cows were blocked by parity and randomly assigned into a treatment group (MCWF; n=65) receiving 5 mL of Amplimune subcutaneously at enrollment (7±5 days before calving) and at calving (1±1 days in milk), or a control group (CON; n=71) receiving 5 mL of saline solution subcutaneously at the same time points. Blood samples for the immune and metabolic assessment were collected at enrollment, 2 days after enrollment, at calving, and at d 2, 7, and 14 after calving. The odds (95% confidence interval) of presenting clinical mastitis before 30 days in milk for cows receiving MCWF were 0.27 (0.08 0.87) times the odds of control cows (P = 0.029). Cows in MCWF had a significant improvement in overall fertility. No significant effects were found on white blood cell counts, metabolic status, survival or milk yield. In conclusion, the administration of MCWF immunomodulator at the doses and times considered in this study reduced the presentation of clinical mastitis the first month after calving and improved the reproductive performance. Future research on different doses and routes of administration is encouraged.

254 History and Conservation: Re-Mapping Resource Management Through Digital Humanities Methodologies

CRAIG SOMERS

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In this year's Parks as Portals to Learning, a week-long collaborative research project where Rocky Mountain National Park (RMNP) hosts students from CSU's Public Lands History Center, we were tasked with helping the park pinpoint and contextualize changes made since 1971 to one of Rocky's most iconic features, Trail Ridge Road (TRR). Organized into three research groups, we collected geospatial data for 124 roadside pull-offs, sifted through and annotated multiple archival collections, and conducted oral history interviews with two recently retired park staff, effectively compiling three separate data sets from which to analyze the roads history. We then combined our geospatial fieldwork with data compiled from the archival research and oral history interviews into a new database. With these layers of geospatial, archival, and interview data arranged relationallyrather than siloedthe research team could quickly and accurately generate responses to questions regarding change over time on TRR. For RMNP cultural and natural resource managers conducting compliance work as set forth in federal regulations like the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA), among others, having efficient access to accurate and insightful data is essential to managing park resourceslike TRRthat straddle the boundary between nature and culture. With additional investment in data collection, data synthesis, and digital representation, the historical methodologies employed in our project have the potential to not only further aid resource managers to more efficiently conduct resource compliance work, but also to facilitate communication and interaction among disparate fields of knowledge and research.

255 Ouro Mobility: A Model for Sustainable Suburban Carsharing

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COLLEGE: BUSINESS

In the United States, personal vehicles alone account for 17% of the countrys greenhouse gas emissions, which contribute to global climate change. Carsharing has been proven to be a sustainable alternative, as research has shown that every shared vehicle replaces 9-13 privately-owned vehicles. Most carsharing companies, such as Zipcar and Share Now (formerly Car2Go), serve urban metropolitan areas exclusively, since population density and the network effect amass greater economic feasibility than lower-density areas. Consequently, carsharing companies leave out suburban communities, whose residents already lack access to transportation alternatives. Our research has been focused on investigating new opportunities for business model innovation in the suburban carsharing market. Through primary and secondary market research conducted in the Denver Metropolitan Area, our team developed a business model for a carsharing service that will be tailored specifically for new residential community developments. This community-integrated carsharing service will provide developers with a new amenity to promote and provide future residents with access to vehicles and mobility, without the hassles and cost of traditional car ownership. Our team is currently working to further validate the business model and to establish partnerships with housing developers in the Denver area. Our next steps will be to launch our new company, Ouro Mobility, and pilot-test our community-integrated carsharing service. As traffic,

greenhouse gas emissions, and the cost of car ownership continue to rise, we have an opportunity to not only address the gap in the carsharing market, but also to make significant global environmental and social impact.

256 Ecological Drivers of Black Bear Fecundity in an Anthropogenic Landscape

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As the impact of anthropogenic activities intensifies and human populations overlap more extensively with large carnivores, the need to evaluate the consequences of anthropogenic pressure on large carnivore fitness has never been greater. In the northeastern U.S., black bear (Ursus americanus) populations have increased rapidly, more than other portions in the nation, and human-black bear conflicts have steadily been on the rise since the middle of the century. My goal was to identify whether female fecundity had improved over time from the use of human-modified environments (e.g., increased use of garbage). I used 34 years of black bear den surveys (1984-2017) from 414 females in the northwest region of New Jersey to quantify fecundity (i.e., number of cubs produced) and examined the relative effects of anthropogenic change (e.g., annual human population, garbage produced, development), bear characteristics (e.g., age, body condition, behavior), climate shifts (e.g., drought frequency), landscape features, and natural resource availability on fecundity. I found black bear fecundity to be best explained by bear characteristics, landscape features, and variability in natural resources. My results help elucidate the ecological factors driving black bear reproductive dynamics in this region that encompasses both anthropogenic cover and high-quality bear habitat. My results also demonstrate how these reproductive dynamics might further impact human-black bear conflicts in New Jersey, the state with the highest coupled densities of humans and black bears in the country.

257 Disrupting the Balance: Sphingolipid Modulation During Flavivirus Infection

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Sphingolipids have long been regarded for their role in cellular membrane structural integrity. However, sphingolipids have recently emerged as potent, bioactive molecules that mediate several cell-signaling pathways, including the host immune response. Pathogeneses of diseases such as insulin-resistant diabetes, Alzheimers, certain cancers, and several viral infections have been linked to perturbations of sphingolipid homeostasis. We and others have previously shown that dengue viruses (DENVs) significantly alter sphingolipid metabolism in both human and mosquito cells and in human sera from infected patients. Inhibition of sphingolipid -4 desaturase (DEGS), involved in the final step of de novo ceramide synthesis, was shown to significantly reduce viral genome replication and infectious particle release in mosquito cells. In sera collected from patients infected with DENVs, a significant increase in

sphingolipids during the febrile phases and subsequent down regulation during defervescent and convalescent phases has been observed. Decreases in serum sphingosine-1-phosphate by DENVs has also been shown to be a driving factor of the endothelial barrier failure and subsequent vascular leakage observed in severe dengue disease. These observations provide insight into the immunomodulatory effects of these lipids. We hypothesize that certain components of the sphingolipid metabolic pathway are required by DENVs to establish a productive infection, while other components are altered by the host in order to activate the host antiviral response. Here, we will present preliminary data on the mechanisms controlling sphingolipid homeostasis during infection with dengue and Zika viruses, shedding light on virus versus host-specific arms of the pathway that influence flavivirus disease outcomes.

258 Old Data, New Maps: Geospatial Analysis of Archaeological Legacy Data

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COLLEGE: LIBERAL ARTS

In archaeology, the location of an artifact or monument is just as important as its identification. Thus, visual representations of spatial relationships are a common feature of archaeological documentation. Hand-drawn maps and plans have served as the most common format until recently, when archaeologists have turned to Geographic Information Systems (GIS) software to create a more robust and scalable representations their areas of study. Within GIS, different forms of information can be visualized and analyzed in many ways. These more dynamic maps and plans rely on electronically recorded data, which has meant that archaeological projects that collect digital data in the field have a more natural progression into these new techniques.

For older projects where maps and plans on paper are the common form of archaeological documentation, the use of GIS technology may be more complicated, but no less informative. This poster reports on the ongoing effort of the Ohio State University Excavations at Isthmia to build a GIS using a variety of paper-based maps and plans from the past half-century of investigation at the site. Once digitized and anchored to real-world coordinates, the legacy spatial data contained in hundreds of rough sketches in field journals are being used to plot out the locations of artifacts and monuments throughout the larger site. As an ongoing study in the area of the Byzantine fortification already shows, the visualization of artifact scatters is beginning to reveal patterns of use not recognized in the isolated settings of the original excavations.

259 Bottom up Costing Estimates for Fourth Generation Nuclear Reactors

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In recent years the development of nuclear energy has stagnated as high capital cost and long construction schedules have created a barrier between nuclear energy and investors.

Additionally, recent accidents have also increased the perceived risk associated with nuclear energy. To address these issues, the nuclear industry is shifting towards small modular reactors with lower capital cost and generation IV reactors with passive safety features. Most generation IV reactors achieve passive safety by replacing the reactor coolant. This includes, Sodium cooled reactors that operate at atmospheric pressure and have a large temperature difference between the liquid and vapor phases, Helium cooled reactors whos fluid doesnt activate very well, and Molten Salt reactors which operate at low pressure and are unable to experience a meltdown. While the safety features of each design are well known, more work is needed to understand the cost of these reactors. For Sodium cooled reactors, there are general cost estimates exist, but none go into detail on the price of each component or discuss methods to lower the cost. Helium cooled reactors are well studied and detailed cost estimates exist for these reactors. For Molten Salt reactors, the materials needed to build the reactor are known. Our current research is building models of these reactors to provide a cost breakdown for each reactor to identify which reactor offers the lowest cost and to identify which components are the largest driver of cost.

260 Biophysical Characterization of DNA Within a Billion Parallel Nanopores

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COLLEGE: NATURAL SCIENCES

Just as highways allow travelers to visit distant regions, large nanopores allow functional proteins or nucleic acids to access the interior of porous protein crystals. For example, by loading hemoglobin proteins or information-carrying DNA strands into the nanopores, we can create synthetic red blood cells or high-information content barcode particles, respectively. To better engineer materials in this class, we seek an enhanced understanding of how guest molecules move through these 13-nm diameter tunnels, and how they stick to the walls. Ideally, we could describe how guest molecules adsorb into the host crystal in molecular detail, including the confined diffusion rate, as well as binding and unbinding kinetic parameters, with the goal of establishing a predictive model for DNA transport throughout porous protein crystals. Towards this end, host crystals loaded with fluorescently labeled DNA were subjected to multiple, synergistic microscopy techniques to achieve the above goal, including Fluorescence Recovery After Photobleaching (FRAP) and Total Internal Reflection Fluorescence (TIRF) microscopy. Preliminary results include demonstration of photobleaching crystal-bound DNA and visualization of individual DNA molecules within the crystal. Combining ensemble and single molecule experiments allows us to build a predictive model for how guest domains interact with the host matrix. We can then use that model to prepare next-generation storage devices (e.g., information, oxygen) or sensors.

261 Isotope Pool Dilution Reveals Drivers of N2O Consumption in Soils

EMILY STUCHINER

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Nitrous oxide (N2O) is a potent greenhouse gas with ~300x more warming potential than CO2. N2O consumption, the microbial reduction of N2O to N2, is a potentially highly important soil process because it can significantly reduce net N2O emissions. However, this process remains poorly understood because it cannot be quantified using conventional N2O flux measurements. In this study, we examined the importance of N2O consumption in nitrogen (N)-rich and N-poor soils. We used a 15N2O isotope pool dilution approach on soils incubated in the laboratory and amended with either inorganic N (to increase N availability) or with organic carbon (C; to induce microbial N-limitation) to discern how soil N loading impacts gross N2O uptake. We incubated soils from two Colorado ecosystems: Shortgrass Steppe (SGS), a more N-limited grassland, and the nearby Limited Irrigation Research Farm (LIRF), an N-fertilized agroecosystem. All soils were amended with 99 atom percent (AP) excess 15N2O, held at 60% soil water saturation, and incubated for 48 hr. Our study revealed that N2O consumption was stimulated in response to N-limitation in the agroecosystem but not in the grassland. Specifically, LIRF soil amended with organic C consumed nearly 40% of gross N2O produced, whereas SGS soil amended with organic C showed no detectable N2O consumption. Further, DNA assays of nosZ, a gene that regulates N2O consumption, revealed that nosZ is more abundant in LIRF than SGS soil. The results of this study make strides towards better defining the drivers of the poorly understood process N2O consumption.

262 Environmental Impact Assessment of Indoor Versus Outdoor Cannabis Cultivation

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Legal cannabis cultivation within Colorado occurs primarily indoors due to the evolution of the industry as well as current policy restrictions. Growing cannabis plants indoors requires large energy inputs necessary to simulate a healthy growing environment for the plants. These cumulative energy inputs currently represent roughly 5% of Colorados electricity grid, yet an understanding of the full environmental impact of cultivating cannabis is not known. Since legalization of medical and recreational cannabis in 2015, detailed cultivation data have become available. Using the newly available data, this work focuses on quantifying the environmental impacts of cultivating cannabis through lifecycle assessment methodology. Foundational work was developed through a detailed process model, capturing the material and energy requirements of cultivating cannabis in both indoor and outdoor environments. Process model data were combined with life cycle inventory data to characterize environmental impacts of dried cannabis product. A cradle-to-gate life cycle impact assessment was performed using the Ecoinvent 3.4 database combined with TRACI v2.1 methods, generating both hot-spot and comparative results for indoor versus outdoor growth simulations. Comparatively, environmental impacts are significantly higher when growing cannabis indoors versus outdoors primarily due to the energy required for grow lights and climate control. Within the outdoor growth results, hot spot results show the largest contribution to environmental impact from irrigation and nutrient requirements. Results from this work have the potential to influence policy by informing politicians of detrimental impacts due to current regulation.

263 The Days After Colorados Darkest Day: Initial Fieldwork at Julesburg

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Julesburg Station and Camp Rankin are located in northeastern Colorado along the South Platte River. In January and February 1865, they became the focal point of the Cheyenne, Arapaho, and Lakota response to the Sand Creek Massacre. During this period ranches and stage stations along 150-miles of the Overland Trails (North Platte and South Platte rivers) were raided and attacked in response to the massacre. Remarkably, no academic historians or professional archaeologists have studied or worked at the sites. Unfortunately though, the sites have been heavily disturbed by private collectors. Initial work is focused on identifying the exact site boundaries using multiple geophysical methods, ground survey, and limited excavation. Privately collected and museum artifacts are being documented to form a digital repository of site artifacts. The initial work also includes the initiation of tribal consultation with the Cheyenne, Arapaho, and Lakota nations and an active outreach and education program with the local community and the public. This research will allow a more accurate and multifaceted understanding of the events to be developed and will facilitate this forgotten aspect of Colorado's history to be remembered.

264 Soft Robots of Fast and Strong Motion

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Soft robots demonstrate great potential compared with traditional rigid robots owing to their inherently soft body structures. Although researchers have made tremendous progress in recent years, existing soft robots are in general plagued by the main issue: slow speeds and small forces. In this work, we aim to address this issue by actively designing the energy landscape of the soft body: the total strain energy with respect to the robot's deformation. With such a strategy, a soft robot's dynamics can be tuned to have fast and strong motion. We introduce the general design principle using a soft module with two stable states that can rapidly switch from one state to the other under external forces. We demonstrate that a soft gripper that can hold weights more than 8 times its own weight, and a soft jumping robot that can jump more than 5 times its body height. We envision our strategies will overcome the weakness of soft robots to fully unleash their potential for diverse applications.

265 SPS1: A Novel Resistance Factor to Prion Disease Infection

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COLLEGE: INTRA-UNIVERSITY

Prions are infectious proteins which cause fatal neurodegenerative disease in humans and animals. Of concern, the prevalence of chronic wasting disease (CWD), a prion disease affecting deer, elk, and other cervids, is rapidly growing, with outbreaks now in 24 of the 50 United States and additional presence in Canada, Europe and Asia. It is noteworthy then that all prion disease treatments have been unsuccessful. During the pathology, the normal prion protein (PrPC) is converted into the aberrant disease-causing form (PrPSc). Therefore, the majority of treatment strategies center around PrPC. Since the characterization of CWD in the 1960s, no treatments targeting PrP have yielded viable solutions, and thus new approaches must be explored.

Our preliminary data using an in vitro model of CWD has revealed a potential novel resistance factor to prion infection: selenophosphate synthase 1 (SPS1). We have shown elevated levels of SPS1 in cells that are resistant to prion infection, making SPS1 a potential therapeutic target. Little is known of SPS1, barring that it is a selenoprotein with a putative function involving the use of selenocysteine, the 21st amino acid, to synthesize additional selenoproteins. In general, selenium deficiency in humans has implications in heart disease, neuromuscular disorders, cancer, and inflammatory disorders. Most notably, selenium compounds have recently been the focus of treating Alzheimers disease, which is often characterized as a prion-like disease. This work thus proposes to evaluate the relationship between SPS1 and PrP and predicts that treatment with selenium compounds could have neuroprotective effects in CWD.

266 Cortical Inhibition and Turning in Healthy Controls and Multiple Sclerosis

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Background: Healthy aging and diseases such as multiple sclerosis (MS) are associated with a variety of changes affecting neural structures and biochemical processes. For example, motor cortex inhibition known as gamma-aminobutyric acid (GABA) diminishes with age and has been associated with gait coordination in healthy adults. However, it remains unclear if this same association exists for dynamic lower extremity control for tasks such as turning. The purpose of this project was to understand how turning characteristics adapt and how cortical inhibition contributes to turning performance in people with MS (PwMS) and age-matched control participants.

Procedure: Participants were asked to conduct a series of 360 turns in place. Quantification of turning was assessed using wireless inertial sensors, with turn duration, turn error, and turn velocity as outcome measures. After the turning assessment, single-pulse TMS was administered to assess cortical inhibition via the cortical silent period (cSP). This procedure was performed on both cortical hemispheres for every participant.

Results: To date, thirty-two participants (13 HC, 19 MS) have completed the study. Thus far,

no statistical differences between hemisphere or group were found for cSP duration. Stable turning analysis revealed significant differences, with PwMS demonstrating reduced performance for all measures. Additionally, a significant correlation was observed for all turning metrics and cSP duration for the left hemisphere in PwMS such that greater inhibition was associated with better turning performance.

Implications: These preliminary results indicate that inhibition may be a crucial neural mechanism underlying dynamic movements that are strongly associated with fall risk.

267 Parent-Mediated Interventions for Infants With Down Syndrome

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Background: Parent-mediated interventions (PMIs) are becoming increasingly popular but the parents role as the administrator of the intervention, specifically the parental fidelity to an intervention protocol (PF) has yet to be standardized. Early syndrome specific PMIs can influence many domains of development for infants with Down syndrome (DS); however, the impact of PMIs on object exploration for infants with DS has yet to be tested. The current study will examine the impact of parental fidelity to a PMI protocol on object exploration skills in infants with DS.

Methods: The sample for this study consisted of 65 infants (M=9.84, SD=4.05) infants from 4 to 18 months with a confirmed case of Trisomy 21. Infants in the intervention group (n=24) received the Sticky Mittens intervention and infants in the alternative group (n=41) received the object dance activity. Parents were asked to fill out a parent log to track their PF. A repeated-measures ANOVA will be used to test if PF strengthens the relationship between the intervention group and infant object exploration at multiple time points.

Hypothesis: The expectation is that this study will find that PF moderates the effect of the Sticky Mittens intervention on infant object exploration skills, thus increased PF will significantly increase infant object exploration.

Implications: Much is unknown about PMI and these findings better inform researchers about PMIs and the different variables that need to be considered before implementing this kind of intervention.

268 Assessing Influences of UAS Flight Parameters for Forest Structure Characterization

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COLLEGE: WARNER COLLEGE OF NATURAL RESOURCES

Characterization of forest structure is important at all spatial scales for informing management

decision making. As spatially explicit management objectives become more common, observations of forest structure are needed at both finer-resolutions and across larger-extents. In situ measurements are time intensive and limited in extent, while the cost of airborne data acquisition (e.g. LiDAR and aerial imagery) limit frequent temporal monitoring. UAS have emerged as an alternative low-cost method for improving the spatial and temporal resolution of aerial data. Recent literature indicates that UAS can provide very high spatial and temporal resolution aerial imagery that can be converted to point clouds similar to LiDAR through photogrammetric methods. With increasing parameter control in UAS surveys, there is a need to investigate how flight parameters interact with forest structure to impact data quality. This study systematically tests the impact of fight altitude and speed on the quality of point clouds generated from automated photogrammetry workflows across different stand densities. Preliminary results indicate the ability to produce highly detailed point clouds for extracting forest structure characteristics using traditional LiDAR processing workflows. My results indicate that UAS can provide accurate structure data for a fraction of the resources needed for conventional data acquisition methods.

269 How Cognitive Differences Determine Success and Failure in Different Environments

CATHERINE TAIT

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Honeybees are well known for their diverse array of cognitive abilities and have served as a classic model in cognition research, but most of this research has been conducted with the temperate honeybee species, Apis mellifera. There are three other honeybee species found in the tropics, A. cerana, A. dorsata, A. florea, each with a unique natural history and ecology, but with almost no information regarding their distinct cognitive abilities. There has been a substantial interest regarding how life history differences among species can be described and modeled under a theoretical framework known as Pace-Of-Life (POL), in which species fall along a gradient of slow to fast life history that also corresponds with differences in a suite of physiological, behavioral and cognitive traits. In this study, I compared the cognitive profiles of the three honeybee species to determine whether there are any cognitive differences among them that can be correlated to their ecology and if these differences conform to POL predictions. I compared the performance of each species on an array of tests to determine the distribution of different cognitive traits. My results show that there are species level differences in cognitive abilities, specifically that species with a fast pace of life are more similar in terms of their cognitive traits and are also distinct from those with a slower pace of life. In addition, these trait distributions appear correlated to species level differences in nest architecture.

270 A Career Construction Counseling Group for Mid-to-Late Career Unemployed Adults

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This topic presents a career counseling group (5-week format or 2-day workshop) for mid-to-late career adults who have been unemployed for six months or longer. The presentation first addresses the rationale for serving the needs of this population, followed by a discussion of career construction theory as the theoretical framework for the group curriculum. The group curriculum utilizes the My Career Story© workbook as the method to equip participants with readiness tools to approach their situation and job search. An outline of the group is included along with practical considerations for group leaders, along with a discussion of research implications. While data on the efficacy of the group has not yet been gathered, this presentation meets the current gap in scholarly discussion by offering a framework with which to work with unemployed adults providing group career counseling.

271 The Archaeology of Hunter-Gatherer Life on Ancient Shorelines

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Playas are shallow, seasonal water basins which play a significant role in the biodiversity of the Great Plains and formed an integral part of prehistoric hunter-gatherer lifeways. This poster showcases research into the prehistoric occupation of playa lakes in the South Platte River Basin of Colorado. Using GIS and existing wetland datasets, I explore the variation of playa morphology and its relationship with archaeological sites. I hypothesize that the shape and size of playas are an important component of human site choice as these factors determine the ecological diversity of plant species, ability to support migrating animals, and water reliability. This poster will examine over 4,000 playas within the study area to, 1) Analyze playas in Northern Colorado by size class, and 2) To compare regional playa shape and size with the 20 known archaeological sites. Ultimately, this analysis aims to identify broad trends in playa choice as a land-use strategy of prehistoric people in the Colorado Plains.

272 Acetylcholine Mediates Flow-Mediated Vasodilation in Humans

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PURPOSE: The vascular endothelium is a critical regulator of blood flow and oxygen delivery which adjusts arterial tone in response to chemical and mechanical cues. Although endothelial function has important physiological implications and is widely measured as a primary outcome in clinical research, the mechanisms by which endothelial cells facilitate vasodilation in response to increased shear forces along the blood vessel wall have not been elucidated. Interestingly, flow-mediated dilation (FMD) corresponds closely with sensitivity to acetylcholine, and in rodents, endothelial cells can synthesize acetylcholine. Therefore, we tested the hypothesis that acetylcholine mediates FMD in humans. METHODS: We assessed changes in brachial artery diameter in response to elevations in shear stress in healthy

volunteers. Shear rate (SR) was increased in two trials: 1) RH-FMD, in which an occlusive forearm cuff was released to elicit a reactive hyperemic response, and 2) EX-FMD, in which participants performed handgrip exercise to increase forearm blood flow. Following control trials, muscarinic acetylcholine receptors were inhibited via local, intra-arterial infusion of atropine and trials were repeated. RESULTS: Inhibition of acetylcholine receptors substantially blunted RH-FMD (brachial diameter (%) / SR area under the curve: atropine, 1.8 ± 0.3 vs. control, 4.0 ± 1.1; $P < 0.05$) and EX-FMD (brachial diameter: atropine, 10.2 ± 1.4% vs. control, 15.6 ± 1.9%; $P < 0.05$), and the effect was more pronounced in women than men. IMPLICATIONS: These findings reveal a key mechanism underlying endothelial function and elucidate a novel physiological role for acetylcholine in blood flow regulation in humans.

273 Association Between the Built Environment and Active Transportation Among Adolescents

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Because physical activity (PA) is a major determinant of obesity and cardiovascular disease in the US, factors influencing PA are of interest. One opportunity for increasing daily PA is using it as transportation to and from school and/or work. We examined associations between characteristics of the built environment of home neighborhoods and transportation-related PA to/from school or work among youth and emerging adults. Data were from Waves 1 (WI) and 4 (W4) of the NEXT Generation Health Study (n=2780), a nationally representative, longitudinal cohort of US students starting in 10th grade of the 2009-10 school year. Modes of travel were categorized into three groups: active transportation (walking/cycling) (AT), public transportation (PubT), and passive transportation (being driven or chauffeured/driving) (PT). Neighborhood characteristics included land use mix, street connectivity, residence density, park density, recreational density, and walkability. Multinomial logistic regressions were used to examine multivariate associations between modes of travel to/from work/school and neighborhood characteristics for W1 and W4 separately. The analysis accounted for complex survey features including stratification, clustering and sampling weights and covariates (i.e., ethnicity, sex, education, and socioeconomic status). More land-use diversity, street connectivity, residence density, and walkability were significantly correlated with AT in both waves and more park and recreational density were significantly correlated with AT in W1, compared with PT. This suggests city planning officials may consider creating more walkable communities with mixed land use to promote transportation-related PA.

274 Continuous Flow Catalysis of Organic Reactions Using Metal-Organic Frameworks

JON THAI

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Cu3(BTC)2 (BTC: 1,3,5-benzenetricarboxylate) is an established copper-based metal-organic framework (MOF) known for its high porosity and capability to catalyze various organic

transformations. In this research, Cu3(BTC)2 is used to catalyze the reaction between 2-aminobenzophenone and acetylacetone to form 3-acetyl-2-methyl-4-phenylquinoline. The catalysis is done under continuous flow with the MOF directly packed into a high-performance liquid chromatography (HPLC) column. By directly packing the MOF, it is possible this system takes advantage of the high porosity and large surface area offered by MOFs to catalyze the chemical reactions more efficiently than traditional in-solution methods. Direct packing allows for a greater amount of catalyst to be used in the catalyst bed relative to the use of solid-supports. Furthermore, the design of the reactor can allow for the catalyst beds to be easily switched, allowing the reaction being done to be changed using the same reactor system. By recycling the eluent from each instance of the reaction, it is possible to increase the percent conversion of the product to meet industrial standards. The high percent conversion, reusability of the column, and automated design of the column all suggest that it is a more efficient catalytic system than heterogeneous catalysis done in batch conditions. The aim of this project is to expand the ability for MOFs to be implemented as heterogeneous catalysts in industrial and pharmaceutical settings to streamline the process of chemical production, increasing cost-efficiency, and decreasing the time required to complete the synthesis in a more environmentally conscious manner.

275 Machine Learning to Predict Microbial Community Traits Driving Carbon Fixation

JARON THOMPSON

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Microbial communities are ubiquitous and often influence macroscopic properties of the ecosystems they inhabit. However, deciphering the functional relationship between specific microbes and ecosystem properties is an ongoing challenge owing to the complexity of the communities. This challenge can be addressed, in part, by integrating the advances in DNA sequencing technology with computational approaches like machine learning. Although machine learning techniques have been applied to microbiome data, use of these techniques remains rare, and user-friendly platforms to implement such techniques are not widely available. We developed a tool that implements neural network and random forest models to perform regression and feature selection tasks on microbiome data. We applied this tool to analyze soil microbiome (16S rRNA gene profiles) and dissolved organic carbon (DOC) data from a 44-day plant litter decomposition experiment. The microbiome data includes 1709 total bacterial operational taxonomic units (OTU) from 300+ microcosms. After performing significant feature reduction, we leveraged Bayesian network structure learning to model interactions between abundance of selected microbial species and levels of DOC. We applied a Bayesian network model trained on pine litter data to samples from an independent oak litter experiment to show that relationships between microbial species abundance and DOC are conserved across litter types. The Bayesian network model provides insight into potential mechanisms driving carbon fixation in soil, which could have profound impact on combating climate change.

276 Manipulation of Toll-Like Receptor 4 Ameliorates Injury-Induced Osteoarthritis Progression

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Post-traumatic osteoarthritis (PTOA) is a debilitating condition affecting millions of people worldwide. As there is currently no cure for this ailment, novel therapies are needed to suppress the progression of pathology after joint injury. We hypothesize that sterile inflammation mediated via the Toll-like receptor 4 (TLR4) pathway is a principal player in the progression of PTOA. We postulate that TLR4 activation is initiated/perpetuated by damage associated molecular patterns released following joint damage. Thus, knockout of the TLR4 pathway or treatment with a TLR4 antagonist immediately after injury may suppress the development of PTOA. To test this theory, four groups were utilized: (1) 8-week old, wild type mice; (2) TLR4 knockout mice; (3) wild type mice treated with a known TLR4 antagonist; (4) and mice injected with a vehicle control. The right knee of each mouse was scraped with an 18g needle on the midline of the patellofemoral groove to produce a full-depth cartilage lesion. The left knee was used as a sham surgery control. Using a quantitative gait analysis system, we evaluated gait changes over time. Following study completion, animals were harvested, and knee joints were processed for Nanostring® gene expression and pathologic assessment. We found that knockout and systemic antagonism of TLR4 significantly improved relevant gait parameters, implying modification of clinical signs. Additionally, gene analyses showed reduced expression of inflammatory genes in animals treated with the TLR4 antagonist. Structural characterization of knees using histology is underway and will determine if structural changes occurred in our treatment groups of interest.

277 Synthesizing Complex Oxides Through Metathesis Reactions

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Kinetic control in solid-state synthesis is elusive, especially in preparing complex oxides, as reaction temperatures often exceed 1000ºC to overcome solid-state diffusion. Metathesis chemistry, or double ion-exchange, provides low-temperature reactions that can selectively form different polymorphs of yttrium manganese oxides. By changing the product's structure, different material properties are achieved. Characterization of the reaction pathway reveals that kinetic control is dependent on our choice of precursors. By changing the composition of the precursors, different reaction intermediates form, which dictate which product forms. By gaining this control of the reaction pathway, new reactions can be designed for different material compositions. Paired with high-throughput methods to perform these reactions, we can ultimately improve our chances at synthesizing new, functional materials.

278 The Sensitivity of Eyewall Replacement Cycles to Shortwave Radiation

BEN TRABING

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In recent years, Hurricanes Harvey, Irma, Maria, Michael, and Dorian have made landfall on coastal communities with devastating impacts due to a combination of strong winds, heavy rainfall, and storm surge. The size of hurricanes, in terms of its wind field, grows with time due to a combination of factors which includes eyewall replacement cycles (ERCs). Numerical weather prediction models are becoming more advanced and are now able to forecast ERCs; however, different models forecast ERCs at different times and vary the intensity of the hurricanes during the event causing large intensity forecast errors. A recent study showed that shortwave radiation controlled the formation of a secondary eyewall in a simulation of Hurricane Edouard (2014), but a complete examination of the effects of shortwave radiation on ERCs has yet to be completed. This study will assess the role of shortwave radiation on ERCs in an idealized framework by varying the magnitude of shortwave heating over the diurnal cycle. Using the Weather Research and Forecasting model, it is shown that the magnitude of shortwave radiation controls the timing of an ERC but not whether or not it occurs. It is hypothesized that changes to the magnitude of shortwave heating has both a direct effect on the vertical distribution of clouds and an indirect effect on the hurricane thermodynamic environment which acts to modify ERC timing. Comparisons between different radiation schemes across operational forecast models will help determine whether the radiation schemes are a contributing factor to discrepancies in ERC forecasts.

279 Selective Synthesis of Complex Oxide Structures via Controlled Double-Displacement Reactions

THINH TRAN

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The selective synthesis of different structures of the same chemical composition remains a significant challenge in solid-state chemistry. Traditional synthetic methods require high temperature conditions and favor the formation of the most stable products. Solid-state double displacement reactions, also known as metathesis, show promise to bypass the limitations of traditional methods and access new functional materials. Our group recently found that polymorphism or product phases of YMnO3 depend on the choice of precursors. Different polymorphs of YMnO3 form in the assisted metathesis reaction of A2CO3 + Mn2O3 + YCl3, where A = Li, Na and K. Each alkali metal carbonate yields a different Y-Mn-O phase. We have extended our investigation of those reactions to discover other polymorphic relationships. Furthermore, we have used real time x-ray powder diffraction to explore the reaction pathways in these reactions to understand how kinetic control is achieved in these reactions to prepare new functional complex oxide materials.

280 Eating for Two Your Microbes and You

RAJ TRIKHA

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COLLEGE: HEALTH AND HUMAN SCIENCES

Alterations in the microbiota are linked to the development of many common diseases, including cardiovascular disease (CVD). We have previously shown that western diet (WD)-induced vascular dysfunction is accompanied by microbial dysbiosis, and that suppression of the gut microbiota attenuates vascular dysfunction in mice. The purpose of this study is to examine whether obese humans display similar signatures of microbial disruption associated with vascular impairments and to determine if vascular phenotypes are transmissible by transplantation of microbiota from humans to germ-free (GF) mice. These data will provide insight into whether alterations of the microbiota may be causally linked to human vascular dysfunction.

We recruited twenty lean and obese participants, screened for vascular dysfunction, and collected stool samples. We then transplanted the microbiota from a subset of these individuals into GF mice and analyzed the vascular phenotypes at 12 weeks. Future analysis will look at the composition of the gut microbiota and metabolic function of these GF mice.

Measurements of vascular function, blood pressure and pulse wave velocity were significantly lower in lean human donors as compared to obese human donors. Vascular and microbiota data in GF mice are currently being collected and analyzed.

If consistent with our hypothesis, these data will continue to support the microbiota as an important regulator of vascular function in animal models. Additionally, the current study will provide a translational link that may lead to new therapeutic targets for cardiovascular impairments in at-risk individuals.

281 How do Plants Take up Selenium From Soil?

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Selenium (Se) is an essential micronutrient for many species. It is chemically similar to sulfur (S)so far, no transport protein is known in any organism that can distinguish Se from S. Remarkably, however, some plant species can selectively accumulate Se up to 1.5% of their dry weight. These Se hyperaccumulators (HAs) take up Se at much higher rates than related non-HA species, even in the presence of high S concentrations. However, little is known about the molecular mechanisms for this unique Se-specific hyperaccumulation. We are investigating this process in Stanleya pinnata, a Colorado native HA, and its non-HA sister species Stanleya elata. Because most Se and S in plants is absorbed from soil, we hypothesized that the root sulfate (SO4-2) transport protein SULTR1;2 has evolved specificity for selenate (SeO4-2) over SO4-2 in S. pinnata. To test this, SULTR1;2 from either S. elata or S. pinnata was genetically transformed into yeast. Yeast expressing SULTR1;2 will be exposed to various SeO4-2 and SO4-2 concentrations, and samples will be taken at regular intervals to determine the rate of SeO4-2 uptake both with and without competing SO4-2. Se and S accumulation in the yeast will be measured using mass spectrometry. Significantly greater Se accumulation in yeast transformed with the S. pinnata version of SULTR1;2 would

be the first evidence of a transporter with Se specificity, suggesting the value of studying the evolutionary history of SULTRs in hyperaccumulators. Furthermore, evolution of Se hyperaccumulation may serve as a model for genetic adaptation to extreme soils.

282 Effects of Bacteriophage and Bifidobacterium Lactis Intake on Cardiovascular Measures

ROXY TROTTER

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COLLEGE: HEALTH AND HUMAN SCIENCES

Cardiovascular disease (CVD) is the leading cause of death in the US and worldwide (WHO). By 2030 it is anticipated that CVD will claim the lives of more than 24 million people. Throughout the last decade, researchers have investigated the role of the gut microbiota in the development of CVD. In animal models, studies have provided evidence for a positive correlation between Bifidobacterium and vascular function, glucose tolerance, and reduced systemic inflammation. In light of this data, we examined various measures of cardiovascular health after consumption of Bifidobacterium lactis, with and without a cocktail of E.coli-targeting bacteriophages, or a maltodextrin-based placebo in a healthy human population. The study design is a randomized, double blind, placebo-controlled intervention conducted in individuals 18 to 65 years of age with a BMI of 20 to 34.9. The primary outcomes include determining the impact of these interventions on cardiovascular measures (mainly endothelial function and plasma lipids) and establishing B. lactis survivability alone or in combination with the bacteriophages, which have been claimed to act as a prebiotic, enhancing survival of probiotic species. Our hypothesis is that B. lactis, alone or with the bacteriophage cocktail, will improve one or more measures of cardiovascular function, particularly in older or overweight adults.

283 Gas-Phase Diagnostic Studies of H2 and CH4 Inductively Coupled Plasmas

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Plasma-assisted catalysis (PAC) has been investigated as a promising method for pollution control, often for conversion of volatile organic compounds. Hydrogen is a significant component in many PAC-relevant systems; moreover, H2 plasma treatment has been investigated as a preparation method for catalysts used in PAC systems. Yet, an overall lack of understanding of plasma chemistry and plasma-catalyst interactions during plasma processing severely limits the applicability of PAC. We have employed optical emission spectroscopy to investigate gas-phase processes in H2 and CH4 inductively coupled plasma systems. Specifically, rotational temperatures (TR) have been determined for H2 and CH under a variety of plasma parameter conditions. In 100% H2 plasmas, TR(H2) values are ~ 500 550 K whereas generally higher TR(H2) values (~ 500 700 K) are reported for 100% CH4 plasmas. These results highlight the differences in the H2 excitation pathways occurring in each of these two plasma systems as TR can be affected by the mechanism for molecule

formation and excitation within plasma systems. As such, mixed gas CH4/H2 plasma systems were also explored to gain further insight into these mechanistic details. Catalytic TiO2 substrates were also introduced into H2 and CH4 plasmas to investigate the impact of the catalyst on gas-phase chemistry during PAC. Gas-phase studies combined with complimentary materials analyses yield results that provide a more complete understanding of the molecular-level processes occurring during plasma processing. Collectively, these data help to unravel these complex systems by providing valuable insight regarding possible mechanistic phenomena in PAC-relevant systems.

284 A Berry Holistic Approach: Aronia Berries for Improving Endothelial Function

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Cardiovascular disease (CVD) is the leading cause of death worldwide in both men and women. Aging is the primary risk factor for CVD as it leads to impairments in endothelial function, a precursor for atherosclerosis. Consumption of aronia berries (aronia melanocarpa) has been shown to have cardiovascular-protective effects, and thus holds promise in attenuating age-related endothelial dysfunction and thus atherosclerotic plaque development. Due to the high polyphenolic contents of aronia berries, we hypothesize that daily consumption for 6 weeks will improve endothelial function in an aging population. This randomized, double-blind, placebo-controlled, crossover clinical trial investigates the extent to which daily consumption of an aronia berry dietary supplement will improve endothelial function, in a dose-dependent manner, in 28 men and postmenopausal women aged 45-75 years who are otherwise considered healthy. Inclusion criteria includes blood pressure (< 129/80 mmHg), endothelial function as measured by reactive hyperemia index (RHI) < 3, specific blood parameters, and cessation of all other dietary supplements. Participants are asked to take one of three different treatments daily for a 6 week period, in random order, with each treatment period being separated by a 6 week washout period. Treatments include 1) 500 mg aronia berries, 2) 1000 mg aronia berries, and 3) placebo. In addition to the provision of multiple cardiovascular tests and health questionnaires, biological samples including blood, urine and endothelial cells will be collected. If effective, aronia berries may represent a dietary strategy for combating endothelial dysfunction in an aging population at risk for CVD.

285 Effect of Climatic Conditions on Diarrhea Occurrence in Dairy Calves

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Climatic conditions may impact the health and welfare of dairy cattle, especially during early life. Our objective was to assess the effects of the temperature-humidity index (THI) at birth on the time to the first diarrhea event during the pre-weaned life of dairy calves. A retrospective analysis was performed on 420 calves born between June 2017 and June 2018. Diarrhea

events from birth to weaning were obtained from farm records. Temperature and humidity were continuously measured during the study period using automated loggers. In addition, calves were grouped considering the maximum THI at their day of birth into THI1 (cold stress; <55); THI2 (thermoneutral; 55-72); and THI3 (heat stress; >72). Data were examined using time to event analysis for the first diarrhea case up to 80 d of life. Proportional hazard ratios (HR) for diarrhea were calculated by THI categories. Overall, THI at birth had a significant effect on the time to the first diarrhea episode ($P < 0.0001$) with median survival time for calves in THI3 of 12 d, contrasting with THI1 and THI2 (37 d and 33 d, respectively). The HR for diarrhea presentation for calves born in THI3 was 1.76 times the HR of calves born with THI1 ($P = 0.0008$). From this initial analysis, we conclude that THI > 72 at birth influenced the health of calves, increasing the hazard of diarrhea presentation.

286 Understanding the Mechanism of a Neurotoxic Antibiotic

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Metronidazole is a well-known broad-spectrum and broad-use antibiotic utilized in human and veterinary medicine. However, in rare instances, neurotoxicity has been reported as an off-target side effect with the normal use of this drug. The mechanism of this unintended toxicity is largely unknown however clinical cases have shown the toxicity to be reversed with discontinued use. Previously, we utilized computational modeling to reassess dosing regimens in human and equine schemes via physiologically based pharmacokinetic models. Currently, in order to aid in our understanding of this neurotoxicity, we have assessed a human neuronal cell model SY-5Ys with the treatment of metronidazole or the vehicle control with and without differentiation of the cells. Using these exposed cells, we have explored various mechanisms of cellular toxicity such as calcium signaling and mitochondria integrity via flow cytometry. These results will add to human and veterinary medicine by enabling us to understand the proposed mechanisms of neurotoxicity for metronidazole. The ultimate goal of our work is to understand metronidazole as a neurotoxin, and its potential links to neurodegenerative diseases.

287 Assessing Chronic Wasting Disease Strain Differences From Non-Contiguous Outbreaks

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Chronic Wasting Disease (CWD) is an invariably fatal prion disease that infects wild and free-ranging cervids, including deer, moose, elk and reindeer. Since the initial description of the disease in 1967, CWD has spread to 23 states, 3 Canadian provinces, South Korea and Scandinavia. The continued emergence of CWD is alarming, raising concerns for cervid populations and the ongoing concern about a zoonotic transmission event. While CWD is a global concern, very little is known about the diversity of prion strains between non-contiguous outbreaks. To address this knowledge gap, we are analyzing CWD-positive lymph nodes or

brain samples from Michigan, Missouri, Texas and Colorado to elucidate strain differences between and within these non-contiguous outbreaks. Our analysis thus far has included glycoform ratio, electrophoretic mobility and conformational stability assessment. The results of this research have indicated that there is an entirely novel strain of CWD circulating in TX, unlike anything noted to date. There is also evidence to suggest that CWD strains in Michigan and Missouri are different. Finally, some preliminary work has indicated there are strain differences between different cervid species (i.e., white tailed deer and elk). The results from this work have important implications in the understanding of CWD distribution and evolution. Understanding CWD strain diversity will help in the development of improved disease management strategies and further our understanding of CWD transmission among cervids.

288 Sexual Divergence in Prefrontal Regulation of Depression-Relevant Behaviors

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COLLEGE: VETERINARY MEDICINE AND BIOMEDICAL SCIENCES

Depression, a mental illness characterized by decreased motivation and social behavior, accounts for the most years lived with disability worldwide according to the World Health Organization. Depression rates are heavily sexually dependent with females being nearly twice as likely to be diagnosed. Historically, explanations for this gender gap have been largely cultural while neurobiological explanations are lacking. Previous research has demonstrated that the medial prefrontal cortex (mPFC) has altered activity and metabolism in depression patients. We sought to investigate the direct contribution of mPFC neurons to motivation and social behavior. We utilized optogenetics to specifically alter the activity of glutamate-releasing mPFC neurons in rodents during behavioral tests. First, animals were placed in a two-chamber arena where they received stimulation to increase mPFC activity in one room and no stimulation in the other. Males showed a strong preference for the room where mPFC activity was increased but females did not. This demonstrates that overall mPFC activity in males contributes to a positive motivational state but not in females. Animals then received mPFC stimulation while in an arena with a novel object and social interactor. In males, mPFC stimulation increased time interacting socially compared to controls, while in females it had no effect. These results suggest that mPFC glutamate release counters depression-like symptoms in males but not in females. Our future work will further dissect sexually dimorphic neural circuitry to assist in developing novel depression treatments with higher success rates and lower off-target effects.

289 Effects of NRF1-Activation on In Vitro Proteostasis and Mitochondrial Function

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COLLEGE: HEALTH AND HUMAN SCIENCES

Loss of proteostasis and mitochondrial dysfunction are two important hallmarks of aging. As such they are implicated in the underlying etiology of numerous age-related chronic diseases.

Elucidating the mechanisms that contribute to age-related protein dyshomeostasis and the decline in mitochondrial function may provide novel targets for extending healthspan. Nuclear respiratory factor 1 (NRF1) is a transcriptional factor that regulates expression of mitochondrial proteins involved in metabolism. Its activation plays a significant role in both mitochondrial integrity and function which decline with age. Thus, we speculated that NRF1 activation may improve mechanisms of proteostasis and mitochondrial function in cultured C2C12 myoblasts both in unstressed conditions and with an oxidative challenge. Methods: We used a deuterium stable-isotope tracer to assess mitochondrial and cytosolic proteostasis as defined as the ratio of protein to DNA synthesis over a 16-hour time course treatment. Cells were either treated with a control of DMSO or an exogeneous NRF1-activator. High-resolution respirometry was used to assess mitochondrial function using an ADP titration protocol. Results: There were no significant effects of the NRF1-activator treatment on mitochondrial or cytosolic proteostasis during unstressed conditions. Additionally, there were no significant differences in submaximal, maximal, or uncoupled respiration between treatments. Preliminary findings suggest increased mitochondrial proteostasis during an oxidative challenge when coupled with the NRF1-activator. However, more analyses are needed to understand the mechanisms contributing to such improvements in stress resistance with this oxidative challenge. Identifying potential treatments to attenuate age-related decrements in proteostatic maintenance and mitochondrial dysfunction are critical to improving healthspan.

290 Next Generation Information Media: Controllable DNA Storage

DAFU WANG

DEPARTMENT: COLLEGE OF NATURAL SCIENCES
COLLEGE: NATURAL SCIENCES

This proposed technology will enable new possibilities for high-density information storage. With the fast-growing development of biotechnology, especially the application of atomic force microscopy in biology, there are new concepts and broader prospects for the study of protein crystals and their interactions with biomolecules. The purpose of this proposed research is to enhance the understanding and advance the application of DNA interactions with highly porous protein crystals. A protein from Camphylobacter jejuni forms protein crystals (CJ Crystals). These crystals represent a novel type of protein crystal with a highly ordered three-dimensional (3-D) porous morphology. Hexagonal structured nanopores, with a diameter of 13 nm, are uniformly distributed on the surface of CJ protein crystals. The uncommonly large pore structure of CJ crystals provides the possibility for double-stranded DNA (dsDNA), which has a diameter of 2 nm, to be loaded and stably stored within each unit of the 13 nm diameter nanopores. The 13-nm pores are sufficiently large to organize multiple adsorbed dsDNA double helices per unit cell, with space left over for the subsequent introduction of binding partners. Capture of 180 dsDNA base pairs per unit cell would represent an information density of 32 petabytes per cubic millimeter, assuming each base pair represents 2 bits and each unit cell has a volume of 1413 nm^3. At this DNA loading density, a medium-large crystal (400 m diameter, 50 m height) would contain about 3.7 trillion unit-cells, for a theoretical information content of 165 TB (1TB = 1,024 × 2^10 GB).

291 Efficient Tsunami Evacuation Risk Assessment and Probabilistic Sensitivity Analysis

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An accurate tsunami evacuation risk assessment and identification of critical factors that impact the evacuation risk can provide guidance for more effective evacuation through risk mitigation. To obtain these information; however, more realistic details including various uncertainties in the evacuation are required for more accurate simulation, which usually entails significantly computational efforts due to the need to repeat a large number of expensive simulations. This study adopts a simulation-based approach and agent-based modeling (ABM) to perform tsunami evacuation risk assessment and probabilistic sensitivity analysis that can efficiently identify the critical factors in evacuation. The simulation-based approach can reduce the number of simulations significantly for establishing the sensitivity information, which is used to identify the critical factors, e.g, critical links (i.e., which bridges or roads could cause higher evacuation risk due to the seismic damages). This information can be further used to optimize mitigation strategies (i.e., which group of critical links to retrofit) to most effectively improve the tsunami evacuation. Based on the existing simulations, the evacuation risk and critical factors conditional on any given values of any considered factor can be obtained and no additional model simulations are required. To simulate the evacuation more realistically, various uncertainties including the typically neglected seismic damages of the links are considered in the ABM; a novel multi-modal evacuation (i.e., evacuation on foot and by car) is explicitly modeled in which traffic stage transitions and agents (i.e., cars and pedestrians) speed adjustment according to surrounding traffic conditions are concurrently modeled.

292 Modular and Expandable Protein-DNA Co-crystals: Scaffolds for Macromolecular Structure Determination

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Isoreticular Co-crystals (ICC) are a novel class of designed protein-DNA co-crystals. In each ICC, the DNA stacks end-to-end. Furthermore, the crystal symmetry allows expansion of the DNA-DNA interaction without breaking protein-protein contacts, hence providing larger solvent channels for guest diffusion. Due to canonical base-pairing, the DNA inserted for the expansion is modular, providing an interchangeable DNA sequence for scaffold assisted x-ray diffraction studies. The ICC scaffold starts from existing co-crystals of protein and DNA, each selected with custom Python scripts. Candidate structures were narrowed down using PyMOL visualization and experimental convenience to a working list of 20 candidate structures. To experimentally validate ICC scaffolds, molecular biology techniques were utilized: cloning, expression, purification and crystallization. To date, we have grown expanded ICC crystals using sitting and hanging drop vapor diffusion. The crystals grown have a specific binding sequence exposed to the pores for a guest protein of interest. The research presented offers a new approach to scaffold assisted x-ray crystallography. In principle, any macromolecule that binds tightly to a specific DNA sequence may be revealed in the x-ray diffraction pattern of the co-crystal scaffold.

293 The Evolution of Mitochondrial tRNA Gene Loss and Functional Replacement

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The mitochondrial genome is integral to some of the most fundamental biological processes including energy conversion and the origin of species, yet mitochondrial gene content can vary dramatically between taxa. This research aims to elucidate the role of nuclear gene duplication, targeting, and adaptation events has on mitochondrial gene content through exploring the functional replacement of mitochondrial tRNA genes. There exist extreme differences in mitochondrial tRNA gene content across eukaryotes, with some species having far fewer tRNA genes than are necessary for protein synthesis. Maintaining mitochondrial translation thus requires the functional replacement and import of nuclear-encoded tRNA genes. Here, I present tRNA-seq and transcriptomic data from multiple closely related flowering species (angiosperms, genus Silene) that have dramatic differences in mitochondrial tRNA gene content. These data suggest that some of the nuclear-encoded tRNA genes replacing those which have been recently lost from the mitochondrial genome are distinct from the tRNA genes used for cytosolic translation, implying that duplicated nuclear tRNA genes have gained mitochondrial import and facilitated the replacement and loss of the mitochondrial tRNA counterparts. The replacement of mitochondrial tRNAs with anciently divergent nuclear tRNA species raises numerous unanswered questions about the identity and evolution of the enzymes that must process and edit these newly imported tRNAs. Because of Silene s recent and ongoing mitochondrial tRNA gene loss, the system presents an opportunity to investigate what coevolutionary mechanisms facilitate mitochondrial genome variation and the widespread occurrence of functional replacement of mitochondrial tRNAs.

294 Deconstructing the Kinetics of Binding in Structure-Mediated Nucleic Acid Interactions

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All living cells require DNA, RNA, and protein molecules to adopt the correct structural conformations to support biological activities and interactions and to perform cellular processes. These conformational changes, such as the unwinding and rewinding of the DNA double-helix and subsequent DNA-DNA or DNA-RNA binding interactions, are affected by numerous extrinsic properties (e.g., temperature and ionic strength) and intrinsic properties (e.g., the level DNA stress or supercoiling). We propose a simple three-state Markov Chain model to capture DNA unwinding and rewinding and to understand the stochastic binding interactions of oligonucleotide (oligo) probes with DNA plasmids as a function of temperature, salt concentration, and supercoiling level. Using a modified Genetic Algorithm, we fit this model to several different combinations of single-particle, super-resolution microscopy experiments at multiple temperatures, salt concentrations, and DNA supercoiling conditions.

Using leave-one-out cross-validation and Metropolis-Hastings parameter estimation, we quantified the uncertainty of our model parameters given these data sets, and we determined a minimal set of model mechanisms and parameters to capture all experimental conditions simultaneously. Our final identified model describes DNA unwinding and rewinding rates that are dependent upon all three experimental variables, a salt- and supercoiling-dependent oligo binding rate, and an independent oligo unbinding rate. Determining the dependencies of these rates on environmental and genetic influences provides valuable quantitative insight into how the structure of DNA is regulated and how cellular processes are controlled in living cells.

295 Bringing the Symphony to the Nursing Home: Virtual Reality Exploration

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COLLEGE: LIBERAL ARTS

Recent research has begun looking at the usability of Virtual Reality in individuals with cognitive impairments as a means to positively impact active encoding in episodic memory (Plancher et al., 2017), improve visuospatial skills (Hill et al., 2017), and to improve overall quality of life (Moyle et al., 2018). Our pilot study assesses if people with cognitive impairments (PWCI) can tolerate a virtual experiences, and how PWCI respond to a virtual symphonic experience. Thus far, eleven individuals participated in focus groups with two separate virtual reality experiences and short interviews after each, lasting 75-90 minutes. The focus groups were video recorded and analyzed for themes of ability, fear/anxiety, opportunity, desire, and excitement. The focus groups showed that VR engagement is feasible for older adults, as all participants could spend at least 20 minutes in the VR simulation. Participants want something visually clear, interactive, and immersive, viewing virtual reality as giving them the opportunity to overcome limitations, such as traveling, hiking, and skiing. PWCI can use virtual reality, but there is a steep barrier to learning, as the headset not user friendly. We are continuing these exploratory focus groups with older adults to determine feasibility and preference of virtual experience.

296 Modelling Crown Base Height Change in Rocky Mountain Pinus Ponderosa

ALEX WEISSMAN

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Crown Base Height (CBH) is important to wildlife habitat quality, and reflects both inter-tree competition and a forests resistance to crown fire. Currently, the Central Rockies variant of the Forest Vegetation Simulator calculates CBH indirectly using crown ratio (CR). CR is recognized as a valuable proxy for tree vigor and local competition and is used to predict wood quality. CR is estimated assuming any inventoried tree departing from the models allometric relationships should shift slowly until it is compliant with the allometrically defined CR. This approach ignores the effect that current CR has on future changes in CR. We are collecting and analyzing multi-decadal observations from several stem-mapped forest sites across the

Rocky Mountains to develop a CBH model for ponderosa pine. This model will use current CBH, along with overall tree morphology and competition proxies, to predict future CBH. This may result in a new method of modelling crown morphology that could be applied to different species and regions.

297 An Archaeal Transcription Termination Factor

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Multi-subunit RNA polymerases (RNAPs) are essential and conserved in all extant life. RNAPs synthesize RNA during transcription of a DNA template which can be further translated into a protein product. Regulation of RNAP activity is essential for timely and accurate gene expression and given the importance of properly regulated gene expression, many mechanisms are employed to regulate each stage of the transcription cycle (e.g. initiation, elongation, and termination). Regulatory mechanisms and factors differ among the separate domains, but the final control of transcription involves factors that terminate transcription and recycle RNAP. Factor-dependent termination has been described for decades in Eukarya and Bacteria and only recently has been described in Archaea. Here we have discovered and characterized an essential eukaryotic CPSF73 homologue that is conserved in all archaeal genomes that mediates nascent RNA cleavage and termination in vitro. The Factor that terminates transcription in Archaea (FttA) shares mechanistic similarities with bacterial rho-mediated transcription termination and is kinetically coupled to RNAP by the only universally conserved transcription elongation factor, Spt5. FttA preferentially cleaves C- and U-rich RNA and while addition of Spt4/5 tempers sequence requirements, FttA-mediated termination is reliant on the conserved stalk domain retained in eukaryotic and archaeal RNA polymerases. Reduction of FttA expression and inhibition of FttA-mediated cleavage and termination results in altered 3 termini in vivo. Our results provide a missing-link between prokaryotic and eukaryotic transcription regulation and rationalize the evolution of the processing activities involved in RNA 3-end formation.

298 psyphr: R Packages to Wrangle, Visualize, and Analyze Psychophysiological Data

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COLLEGE: HEALTH AND HUMAN SCIENCES

In mid-2019, the National Academies of Sciences, Engineering, and Medicine published a comprehensive report on reproducibility and replicability in science. The authors suggested that open source software could support reproducible research workflows. Currently, researchers across disciplines that incorporate physiological measures (e.g., neuroscience, psychology) vary in their approach to data management, structure, and quality control to a problematic, inconsistent degree. In addition to this procedural variability, entry errors and productivity losses render the generation of reproducible, shareable data unnecessarily difficult. Automation of data management practices in this area is sorely needed. Our suite of

free, public, open source R packages (psyphr) will help researchers organize, visualize, and analyze psychophysiological data from proprietary data collection and processing systems. We will present and discuss the first of the psyphr packages and provide use cases and tutorials. Overall, psyphr has the potential to strengthen the reproducibility, efficiency, and rigor in psychophysiological and social and behavioral research.

299 Calculating Biomass of Angamuco Using LiDAR Data

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COLLEGE: LIBERAL ARTS

Using LiDAR data and high resolution ALOS satellite data I will calculate average tree canopy height located on a malpais land-form located in the Patzcuaro Basin of western Mexico. This area was originally scanned for archaeological research purposes, and data processing revealed a previously unstudied dense urban settlement that we now believe was named Angamuco. The application of LiDAR to archaeology has already begun to transform the discipline, and my project will show that LiDAR scans contracted for one single discipline or another, can have dramatic multidisciplinary scientific impacts. This broad application of LiDAR data will contribute to the importance of this method and help to offset the issues with cost associated with scanning regions that are not easily accessible. Future work with canopy heights from this region can be used to calculate carbon sequestration both present and past, which were surely different considering the density of the archaeological material. It can also provide a base-line model for future comparative models in climatic studies.

300 Pairing Virtual Reality With Motion Capture to Measure Balance Performance

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COLLEGE: HEALTH AND HUMAN SCIENCES

Multiple sclerosis (MS) is a neurodegenerative disease that affects one million people in the United States. MS causes degradation of the myelin sheath within the nervous system and this damage impairs the quality of communication within the central nervous system (CNS). One of the most harmful effects that result from this impaired neural communication is the increased risk of falling. Over half of people with multiple sclerosis (PwMS) will fall within a three-month period which makes them four times more likely to suffer a hip fracture than neurologically healthy adults. PwMS receive sensory feedback from their body later than neurologically typical adults, and it is that delay that is believed to be the primary cause of their balance impairments. The purpose of this project is to understand how the delay in sensory information effects the way PwMS understand where their body parts are in space (i.e. proprioception) and thus, how likely it is that they will fall. With a theoretical framework of Bayesian statistics, we are using virtual reality and motion capture technologies to provide participants varying amounts of visual feedback on the whereabouts of their body parts as they perform balance related tasks. This requires individuals to rely on proprioceptive sensory sources as they perform these goal-directed movements. With this project, we will be able to

understand how PwMS utilize their proprioceptive information when performing balance tasks, providing specific neural targets for mobility rehabilitation within PwMS.

301 Advanced Surfaces for Orthopedic Implants

TARA WIGMOSTA

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COLLEGE: WALTER SCOTT, JR. COLLEGE OF ENGINEERING

Over 1 million total knee and hip replacements are performed annually in the US. While most surgeries are successful, over 60,000 revision surgeries are performed annually due to implant failure. The leading cause of implant failure is aseptic loosening of the implant from the surrounding bone tissue. Our project combines nonotopography and bioactive surface modification to provide an increase in cell recruitment and bone formation at the implant and bone interface. This is accomplished through absorbing polymer layers on titanium nanotubes, allowing for controlled release of biological cues. Current techniques use super-physiological amounts of growth factors. The innovative aspects of this work are the combination of biomimetic presentation of physiologically relevant doses of growth factors with topographical cues. Polymer layers consisted of alternating layers of chitosan and heparin absorbed onto surfaces. Samples consisted of flat titanium and titanium nanotube surfaces with and without the addition of polymer layers. Stem cells were incubated on samples from 1 to 28 days. Then samples were stained to visualize osteocalcin, cell nuclei, and actin to determine cell counts, cell shape and potential for differentiation. Increased cell counts and cell spreading on nanotube surfaces compared to flat titanium, suggest nanotubes are conducive to cell attachment and proliferation even with the addition of polymer layers. Work in progress includes the addition of bioactive reagents to the polymer layers to promote bone formation and additional assays to assess bone formation (calcium deposition and alkaline phosphate activity). We expect the bioactive agent on nanotubes to increase bone formation.

302 Engineering Zika Virus Resistance in Transgenic Aedes aegypti

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COLLEGE: VETERINARY MEDICINE AND BIOMEDICAL SCIENCES

Zika virus (ZIKV) is an arthropod-borne virus (arbovirus) that is an emerging global health threat. The mosquito vector, Aedes aegypti, transmits this virus. Because there are currently no ZIKV vaccines available, controlling mosquito exposure is the best method to prevent transmission. Novel mosquito control strategies, including genetic manipulation of these vectors, are being developed as additional tools to combat arbovirus transmission.

Ae. aegypti exhibit an endogenous small-interfering RNA (siRNA) anti-viral pathway that limits arbovirus replication. Our group has previously exploited this system by developing transgenic Ae. aegypti that express an inverted repeat (IR) targeting the premembrane protein of dengue virus (DENV-2), which triggers the siRNA pathway and blocks DENV2 replication. These mosquitoes continue to be nearly 100% resistant to DENV2. In this project, we aim to develop ZIKV-resistant transgenic Ae. aegypti using a similar system.

Using CRISPR/Cas9, we have developed a homozygous line of transgenic Ae. aegypti that express an IR targeting the NS3/4A coding region of ZIKV. We confirmed that these transgenic mosquitoes encode the IR gene, which is processed into 21 nucleotide RNAs, typical of the siRNA-pathway, complementary to the ZIKV genome. We challenged these mosquitoes with ZIKV (PRVABC59) and quantified viral titers 14 days post-infection (dpi). By 14 dpi, only 3 transgenic mosquitoes (10%) were infected with ZIKV, compared to 57% of control mosquitoes (p=0.005). Transgenic Ae. aegypti refractory to arboviruses could be a significant tool to combat vector-borne diseases.

303 Correlated Amino Acid Substitution Rate Accelerations in Flowering Plant Genomes

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COLLEGE: INTRA-UNIVERSITY

Eukaryotic cells contain multiple genomes, and cellular function is often an intricate collaboration between them. For instance, in plants, the plastid Clp complex core is composed of nine different subunitsone encoded by the plastid (ClpP1) and eight by the nucleus. We found that accelerations in ClpP1 substitution rate have occurred multiple times independently across angiosperms, and that these increased evolutionary rates are highly correlated with accelerations in nuclear-encoded Clp core subunits. This result highlights the importance of coevolution between the plastid and nuclear genomes, particularly because we found that a highly divergent ClpP1 still assembles into the Clp core.

304 Dust Exposure and Inflammatory Response Among Northern Colorado Dairy Workers

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Dairy farm workers are exposed to numerous environmental stressors during their shifts, including dust and its constituents (beta-glucans and endotoxins). These stressors may induce an inflammatory response. However, there is little evidence about differences in inflammation on work and non-work days, and the relationship between work days and various factors, including dust exposure. We measured personal dust exposures and measures of inflammation for 36 workers across four dairy farms in Northern Colorado in a repeated measures study with up to four days of measurements for each person. Markers of inflammation included cytokines IL-6, IL1B, IL8, IL10, TNF-, and IFN-. We fit linear mixed models that accounted for outcomes censored below the level of detection to test for a workday effect on cytokine levels. Further, we examined the effects of various individual demographic variables, including gender, race, ethnicity, smoking status and age. Finally, we considered the workday effect of biological exposures (dust, beta-glucans, and endotoxins) on workers cytokine levels. Preliminary results identified increased inflammation on work days. Some workday differences in cytokine levels were seen when separating based on demographic factors, including a positive workday effect based on gender and race for the

cytokine IL-6.

305 Tissue-Specific Transcriptional Dynamics in the Developing Caenorhabditis elegans Intestine

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COLLEGE: NATURAL SCIENCES

The Caenorhabditis elegans intestine -- a clonally-derived, 20-cell organ -- is a powerful model of organogenesis owing to its relative simplicity. We seek to understand how key transcription factors that specify this organ work together with auxiliary transcription factors and chromatin to first initiate the differentiation of cells in the developing intestine. ELT-2 is an intestine-specific GATA transcription factor necessary and sufficient for C. elegans intestinal development. Despite extensive study, it is still not well understood how ELT-2 engages different sets of target genes over time and how it competes with, cooperates with, or stimulates other transcription factors to execute stage-specific transcriptional outcomes within the intestine.

Transcriptome profiling through RNA sequencing (RNA-seq) was performed on hand isolated embryo and adult intestine. Chromatin Immunoprecipitation and sequencing (ChIP-seq) was used to characterize direct targets of ELT-2 changes over intestine development. Future efforts will utilize accessible chromatin profiling to identify intestine-specific regulatory loci.

RNA-seq identified 1196 embryonic specific intestine transcripts and 4241 adult specific intestine transcripts. Of these transcripts, 33 are embryo specific transcription factors and 231 are adult specific transcription factors. ChIP-seq has identified stage specific and stage shared targets of ELT-2 binding.

RNA-seq has revealed that the intestine transcriptome expands over developmental time, overturning the assumption of a static intestine gene regulatory network. The compliment of RNA-seq and ELT-2 ChIP data will serve as a lead for investigating how intestine specific ELT-2 target transcription factors work with or in parallel to ELT-2 to drive the C. elegans intestine gene regulatory network.

306 Stress Response in Rice: A Transcriptional Perspective

SERE WILLIAMS

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COLLEGE: INTRA-UNIVERSITY

Rice accounts for over 25% of the calories that humans need every day and because standard practices use flood irrigation, rice uses 80% of Asias fresh water. Just as humans experience stress, plants experience stress when their environment is unfavorable. Extreme temperatures, nutrient imbalance, or water imbalance induce stress response in plants. Drought stress causes severe decreases in rice yield. Stress response occurs at the level of transcription, where genes are expressed at differing levels to reprogram the cell to handle

the unfavorable environment. To better understand how we can grow more rice in varying (and stressful) environments, I have looked at the transcriptional state of two varieties of rice in well-watered and drought conditions. Rice displays a unique signature of gene expression in response to drought stress. Interpreting these transcriptional responses will help scientists breed stronger, more stress-tolerant varieties of rice to feed a growing population.

307 Recyclable Nano-Material Assemblies of Gold Nanoclusters

PHILLIP WINDOW

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COLLEGE: NATURAL SCIENCES

Gold nano-material assemblies allow interesting tunable properties since the monomers or building blocks can be carefully selected for the desired products properties. In this work, gold nanoclusters have been assembled into super-clusters and analyzed using Dynamic Light Scattering. Control over the formation of these assemblies has been shown with kinetic and thermodynamic growth trends over the size of the super-clusters. In the future, more precise control of these assemblies will be sought along with permanent formation of super-clusters through covalent bonding interactions.

308 Translation and mRNA Localization in the Early C. elegans Embryo

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COLLEGE: NATURAL SCIENCES

In the early embryo, cells rely on post-transcriptional regulation to ensure differential protein production that directs cell fate specification and development. Post-transcriptional control of mRNAs is of particular importance in early development due to nascent transcription being paused at this stage. Using single-molecule Fluorescence In Situ Hybridization (smFISH), we identified two mRNA transcripts, imb-2 and erm-1, that co-localize with their encoded proteins (cell cortex and nuclear periphery, respectively). How these two transcripts reach their subcellular destination, and how mRNA localization interplays with translation regulation, remains unclear. Co-translational tethering by the nascent peptide sequence is one potential mechanism for localization to their respective compartments. However, the transcript could be dependent on an RNA binding protein (RBP) mediated through the 3UTR or another region of the transcript for its localization. We aim to better understand the dependence on translation by using multiple methods of translation inhibition, through either drugs, stress or genetic depletion of translational machinery. Preliminary results indicate inhibiting translation initiation is sufficient to disrupt the localization of imb-2 to the nuclear periphery whereas the localization of erm-1 to the cell cortex is less dependent on active translation. By deciphering mechanisms that localize mRNAs to specific subcellular compartments, we can further our understanding of how protein production is spatially and temporally regulated.

309 Early Fracture Healing Prediction by Non-Invasive Multi-Location Direct Electromagnetic Coupling

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Purpose:
Bony fracture healing outcomes remain variable, with some fracture types seeing failure rates of 38%. Poor fracture healing takes several months to diagnose; resulting in medical cost accumulation and decreased patient quality of life. Current diagnostic modalities, such as radiographic imaging, demonstrate limited efficacy in predicting bony healing outcome. To address this clinical deficit, we have developed an antenna system (DEC) which predicts fracture healing outcome by measuring orthopaedic hardware deflection (RRF) to quantify temporal changes to a healing fractures stiffness.

Methods:
An ovine (n=4 sheep) in vivo bone fracture was produced by removing a 5mm section of bone from the metatarsal midspan and fixing via orthopaedic plating. The metatarsals received weekly biplanar radiographic imaging and biweekly DEC evaluation. DEC evaluation consisted of placing the limb in a custom loading fixture which applied a bending load (5-15lbs in 2.5lb increments; n=5 replicate cycles) as the RRF from the antennae were measured. Healing progression was monitored by radiographic and DEC diagnostics for eight weeks, at which time the animals were sacrificed.

Results:
The fracture stiffness was determined from the antennae sensitivities which were calculated as the slope of the RRF-load curves. For all specimen, the average weekly antenna sensitivity decreased throughout the healing progression.

Discussion:
The decrease in antennae sensitivity reflected indications of fracture healing demonstrated by the radiographic images, such as increased radiopacity and cortical bridging. The results support the hypothesis that DEC successfully measures temporal changes to the fracture stability and may potentially predict fracture healing outcome.

310 Exploring the Cardiovascular Effects of Wild Blueberries in Middle-Aged/Older Men

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Cardiovascular disease (CVD) is the leading cause of death in the United States (US). Though nutrition, environment, and other lifestyle habits contribute to CVD, aging is the primary risk factor. As humans age, excessive oxidative stress and chronic inflammation can occur, leading to vascular dysfunction including arterial stiffening and a decline in vascular

endothelial function. Another contributor to CVD is chronic high blood pressure (BP), or hypertension, and about 1/3 of US adults has been diagnosed with hypertension. Diets rich in phytochemicals has been shown to alleviate some CVD risk factors. In particular, blueberries have demonstrated positive effects on BP and arterial stiffness in postmenopausal women with pre- or stage 1 hypertension; however, little research has been done in men. Therefore, the purpose of our study is to determine antihypertensive and vascular-protective effects of wild blueberries in middle-aged/older adults between ages 45 and 70 years with elevated BP or stage 1-hypertension, and who also have endothelial dysfunction. Participants must have systolic BP between 120 mmHg and 139, and a diastolic BP less than 90 mmHg, as well as a reactive hyperemia index (RHI) (measure of endothelial function) less than 1.67. Participants will be randomized to receive either 22 g/day of freeze-dried wild blueberry powder or 22g/day of control powder for a total of 12 weeks. Throughout this period, anthropometrics, BP, endothelial function, and arterial stiffness will be assessed. With this randomized, double-blind, placebo-controlled, parallel-arm clinical trial, we expect to see a decrease in BP and an improvement in vascular function.

311 Antibiotic-Free Chicken Production: A Characterization of Bacterial Resistome

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Identification of antimicrobial resistance genes within genomic data relies on the DNA sequencing method used and the depth of sequencing. Short-read technologies have dominated high throughput sequencing since 2005 by decreasing sequencing time and increasing depth of coverage. Short-read approaches are limited by the pure computational problem of assembling a genome using short segments of DNA and the repetitive sequences in genomes. To overcome these limitations new technologies have been developed to produce significantly longer reads. However, these technologies have yet to reach the high accuracy of short-read approaches. To combat this problem, new bioinformatic tools have been developed to leverage the strengths of both types of sequencing using a hybrid assembly approach. We used this method to reveal the genetic context of antibiotic resistance, metal resistance and virulence genes (resistome) carried by Escherichia coli (E. coli) strains collected from broiler chickens raised with no antibiotics in feed or water administered. These E. coli strains were isolated from the ceca of chickens and/or the bedding material (broiler litter) the chickens were raised on. Whole genome sequencing was done on both Illumina MiSeq and Oxford Nanopore MinION platforms to obtain short and long reads. The hybrid assembly accurately separated the resistome carried on plasmids from that carried on the chromosome. Whole genome and resistome characterization was done using various annotation and gene detection software. Using this approach we were able to show that the resistome of poultry associated E. coli evolved from horizontal transfer events involving plasmids and bacteriophages.

312 Effect of Acute Lipopolysaccharide Challenge on AoAH KO Mice

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Cardiovascular disease (CVD) has been the leading cause of death worldwide for more than a century. Recent studies have linked deleterious changes in the gut microbiota, termed dysbiosis, to increased systemic inflammation and cardiovascular disease risk. Dysbiosis compromises the epithelial mucus layer, leading to increased translocation of bacterial-related products into the bloodstream. One such product, lipopolysaccharide (LPS), a component of Gram-negative bacteria, initiates an inflammatory cascade leading to increased arterial stiffening and CVD risk.

The general goal of the current study was to examine the role of LPS in cardiovascular health and to test whether the inability to inactivate LPS results in enhanced systemic inflammation and CVD risk. We hypothesized that mice lacking acyloxyacyl hydrolase (AoAH -/-), an enzyme which inactivates LPS in circulation, would display increased inflammation and arterial hardening when challenged with an acute LPS load. In order to test this hypothesis, we injected AoAH -/- mice and wild type (WT) mice, via intraperitoneal (IP) injection, with an acute bolus of LPS and monitored their health and behavior over a 4-day period. Upon termination, we collected plasma and tissues for analysis of inflammatory markers and arterial stiffening. If data support our hypothesis, future studies will examine whether AoAH-/- mice display enhanced susceptibility to chronic LPS challenge or a western style high fat, high sugar diet.

313 Chinas Seafood Processing Zone: Rural Community Reform and Labor Migration

YUE XU

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COLLEGE: LIBERAL ARTS

This research will explore how the seafood processing zone and new industrial cluster be established under certain state policy and geographical, social and cultural circumstances in Zhoushan island, China. Through examining the reform of local rural community and seasonal labor migration pattern within the trend of industrialization and urbanization in the east coast of China, this study will discuss how the penetration of capitalist logic and commodification foster a huge transformation in local rural communities within the new economic engine - changes from land consolidation, resource concentration to further social relation, culture and indigenous resident's livelihood reconstitution. It is interesting to see these changes through the lens of globalization and political economy with the special consideration of the role played by Chinas local government in this area. Preliminary research including semi-structured interview and passive public observation has been completed at Zhoushan island. This research intends to provide new insights on how managed capitalism facilitate rural development in both positive and negative ways, as well as unveil potential risk and crisis associated with the rise of seafood processing zone in Zhoushan island, China - from environmental concern to the threaten on cultural heritage and traditional lifestyle. This study also could contribute to existing literatures of Chinas seafood processing zone and provide comparative discussion on the general pattern of challenges faced by rural communities with

the rise of export-oriented seafood processing zone in most developing countries.

314 Trans Men and Women in China: Darkness and Resilience

YAN XUE

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COLLEGE: LIBERAL ARTS

This research project investigates how the lived experiences of Chinese transgender people are shaped in part by a socialist political context and a cultural environment that is currently in flux in regard to perspectives of transgender people, and the resiliency of transgender people in China. I hope to shed insight into the following three areas: how their lives are affected by Chinese political structures and sociocultural norms; the strategies they have developed to resist the repression and trauma they experience; and the roles played by transgender community in affecting their resilience. This study employs mainly qualitative research methods, including participant observation, and semi-structured interviews of 20 transgender people, with balanced number of trans men and trans women, as well as 4 key informants, who work as doctor, lawyer and LGBT organization personnel. On an academic level, it is hoped that this study will attract and facilitate more research that will look into trans men and womens lives in China, and that it will fill gaps in the literature on transgenderism, in terms of our understanding of the resilience and agency of transgender people. On a practical level, it is hoped that this study will contribute to improving the legal, health and social services that are available to transgender people, and aiding in raising transgender people's awareness of their own strength and robustness. Eventually, I hope it can contribute to the linking of the domestic community with activists and scholars outside the country.

315 Examining Listening Skills for French as a Foreign Language Learners

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COLLEGE: LIBERAL ARTS

This study is at the beginning stages. The experiment has been designed, and the literature review is 90% complete. The IRB will be completed by 01 October 2019. A pilot study will begin in November 2019 and the larger study will begin in mid-January 2020. This study looks at whether the effects of noise and unfamiliar accented speech can be diminished if intermediate learners of French as a foreign language receive short-term training on a domain specific lexis in an authentic learning environment which includes exposure to speech-shaped noise and unfamiliar accented speech. The study will have participants who are currently learning French as a foreign language and who have intermediate proficiency for listening comprehension. The participants will be divided into 2 groups. Group 1 will receive training on different combinations of vocabulary and phrases used in the diplomatic lexis. Group 2 will receive this training along with exposure to speech-shaped noise and unfamiliar accents. Both Groups will receive a post test. The expected result is that there will be a statistically significant difference in the listening comprehension of unfamiliar accented speech in a noisy

environment, where Group 2 will outperform Group 1.

316 Advanced Manufacturing of Fiber-Reinforced Polymer Composites

MORTEZA ZIAEE

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COLLEGE: WALTER SCOTT, JR. COLLEGE OF ENGINEERING

Fiber-reinforced polymer composites (FRPCs) based on thermoset resins are an emerging class of lightweight and high-performance structural materials that have attracted a great deal of attention in industrial sectors; however, their applications are limited mainly due to the expensive and time-consuming fabrication process. The goal of my research is to develop a novel 3D printing-based manufacturing approach for rapid, energy-efficient manufacturing of composite objects to overcome the limitations of conventional manufacturing techniques. In our research, we use a new technique that simultaneously cures the matrix resin of composites during the printing process and eliminates the need for manual layup preparation and energy-intensive curing in ovens or autoclaves.
The early stage of this project has focused on developing a new curing strategy that is suitable for mass production of FRPCs composites. This curing technique rapidly transforms a liquid resin to a solid polymer in less than a second. This technique enables us to 3D print FRPCs at a high printing speed (15x faster than commonly used 3D printers). In the next stage, we plan to combine this curing technique with 3D printing process to fabricate 3D objects with complex shapes and geometries. We envision this new technique will pave the way for digital manufacturing of FRPCs in a wide range of industrial applications.

317 The Impact of Chilling Method on Chicken Microbiome and Quality

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DEPARTMENT:
COLLEGE: AGRICULTURE SCIENCES

During chicken production, many practices impact the microbial community, or microbiome, including the method by which the carcass temperature is reduced (air chilling; AC, or water chilling; WC), fabrication, and storage time. The objective of this project was to assess the consequences of different practices on the chicken microbiome, physiochemistry, and spoilage state and the relationship between microbiome and spoilage. It was conducted using a 2x2x2 factorial design to evaluate the impacts of chilling (AC vs WC), fabrication (bone-in vs boneless; BI vs BL), and cold storage period (7 vs 14 days) on chicken breasts using nine treatment groups (Hot Carcass (HC), AC-BI, AC-BL, WC-BI, WC-BL tray-wrapped for 7- and 14-day storage). Microbiome and compositional analysis (moisture, fat, protein) were generated following standard practices. Results suggest that WC may have a greater impact on the microbiome than AC early in processing. Microbial communities from both groups became less diverse after chilling, but after seven dark storage days, AC had a higher diversity than WC ($P<0.05$). Over more storage and display time, the diversity became similar. Initial

communities were composed of many bacterial families, but over time they became dominated by Pseudomonadaceae, with WC communities dominated earlier than AC. There were few compositional differences, though AC had higher protein values ($P<0.05$) that tended to increase over time. Overall, this implies that while there may be differences in the spoilage patterns of AC vs WC carcasses early in the shelf life, these differences become smaller with longer storage times and retail display.