NCUR 2021 Proceedings

Exploring the Utilization of Mineralized Fibers to Improve the Toughness of Cement

Engineering - Time: Tue 5:00pm-6:00pm - Session Number: 821
Michael Espinal, and Dr. Chelsea Heveran, Department of Engineering, Montana State University Bozeman, Culbertson Hall, 100, Bozeman MT 59717
Michael Espinal

Cement is a binder in concrete, a common building material, but it also has several problems. One is that the production of cement releases harmful carbon emissions. Another is that cement is strong but not tough. Thus, cement is very susceptible to crack propagation, especially during freeze-thaw cycles in cold winter climates. We aimed to mimic the complex hierarchical structure found in bone, which is excellent at stopping crack propagation, by creating complex mineralized shapes from cellulose fibers. We also investigated if silane-functionalized and biomineralized cellulose fibers could be engineered for toughening cement. An enzyme induced mineralization method was used to cause calcium carbonate (CaCO3) crystals to nucleate on the fiber. When implemented into the cement matrix, we expect that CaCO3 may form a strong bond to the cement. The fibers then underwent a silane coating process under vacuum to functionalize them. Functionalizing the fibers with silane is expected to cause the fibers to have hydrophobic properties which may cause the formation of complex fiber geometries. This process could toughen the cement and increase its service life, leading to a decrease in cement production. The use of optical and electron microscopy showed that the fibers were able to be successfully mineralized. Hydrophobicity tests showed that the fibers do exhibit hydrophobic properties, but they do not yet create complex geometries. This could be from the high surface tension caused by the hydrophobic silane on the fiber which caused the fibers to straighten when wet. The next steps are to implement the silane-functionalized and biomineralized fibers as a percent replacement of cement in cement mortar specimens and conduct mechanical testing on them. Further investigations into biomineralizing non-cellulose materials such as plastic waste will be conducted to explore a more environmentally friendly cement.

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The Significance of a Name: Personal and Societal Ties to Character Names in Jane Austen's Works

English & Literature - Time: Tue 2:00pm-3:00pm - Session Number: 644

Sheridan Pena, Dr. Marvin Lansverk, Department of English, Montana State University Bozeman, 100 Culbertson Hall, Bozeman MT 59717
Sheridan Pena

Jane Austen is a renowned author whose works have captured the public's attention throughout generations. Her novels display an immense intelligence of societal standards and captures history within their pages. The characters, settings, and plot devices Austen utilizes all contribute towards the creation of complex, engaging stories. The purpose of this research is to delve into the reasons behind why Austen decided to provide a number of her characters with the same names. One theory revolves around a correlation between Austen's relations possessing the names of several individuals within the novels. She may have imbued some of these particular characters with similar characteristics to her immediate and extended family. An examination into the meaning behind certain names may provide substantial background information. This research is supported by articles published by the Jane Austen Society of North America. A couple articles—one published about 20 years ago and the other a decade ago—detail the power of a name. Historical research is the chosen approach for this project that analyzes 19th century literature and popular practices of the time period in England. The anticipated findings include Jane Austen selecting specific titles for a few characters in order to give more depth to her works. Looking to real world qualities is helpful when attempting to create an entertaining fictional world, and Austen could have added this tool to her repertoire.

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A Fungal-Bacterial Bioreactor: Multi-Domain Biofilm Defacement of Building Materials

Biological & Chemical Engineering - Time: Mon 3:00pm-4:00pm - Session Number: 2526
Gretchen Gutenberger, Camryn Dubois, Dr. Erika Espinosa-Ortiz, Dr. Robin Gerlach, Center for Biofilm Engineering, Montana State University, 366 Barnard Hall, Bozeman, MT 59717
Gretchen Gutenberger

Under certain conditions of favorable light, humidity, and temperature, microbes can colonize building materials, resulting in biofilm formation and material degradation. In addition to creating aesthetically unpleasing structures, biofilms can cause quality issues and accelerated weathering of the materials. The purpose of this project is to develop repeatable and consistent procedures for cultivating multi-domain biofilms and to utilize these systems to evaluate microbial defacement of common building materials. We investigate the formation of multi-domain biofilms comprised of the fungus *Aureobasidium pullulans*, alga *Chlorella vulgaris*, and cyanobacteria isolated from soil, which are common microbial species found in biofilms collected from outdoor environments. A biofilm reactor operated at room temperature and >90% humidity was supplied with media daily using a spraying system. Changes in microbial defacement were analyzed weekly over a period of four weeks. This analysis was performed using two methods: color segmentation to quantify defacement based on the changes in coloration observed on the materials caused by microbe-produced pigmentation, and confocal microscopy to observe interspecies associations. Coated and uncoated wood panels were used for these experiments. From previous experiments, when concurrently inoculated, establishment of fungi is usually observed first and then algae and cyanobacteria seem to be able to colonize fungal structures. This system will allow us to continue assessing how to replicate natural growth of biofilms on different building materials including glass and wood with various coatings.

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Accelerating Graph-based Geometric Data Analysis

Mathematics - Time: Tue 12:30pm-1:30pm - Session Number: 522

Xingzi Xu, Griffin Smith, and Dr. Dominique Zosso, Department of Mathematical Sciences, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Xingzi Xu

We are interested in studying the *shape of data* in the form of point clouds: a collection of individual samples (documents, images, individuals...) represented as points in a high-dimensional feature space. A fundamental premise of data science is that such high-dimensional datasets contain simple underlying geometric structure. For instance, in linear regression, we assume a linear inherent structure within a cloud of high-dimensional points. Here, we develop a framework and algorithm allowing geometric inferences about the underlying shape, which is helpful for downstream machine learning and data analysis.

Our framework studies integro-geometric properties (such as perimeter, surface area, mean width) of a union of virtual balls placed around each of the data points in the cloud. Estimating these features for a wide range of ball-radii informs us about the evolution of geometric properties across scales as a proxy to learn more about the geometry of the structure from which the points were sampled.

We have successfully developed an algorithm realizing geometric inferences; our naive first implementation, however, is too slow to be practical. At the core of this algorithm, we need to repeatedly compute intersection volumes between multiple virtual balls, which is extremely time consuming. To identify relevant computations more quickly, we now utilize an induction method to efficiently calculate the Vietoris–Rips complex of the point cloud as a preliminary data representation. Also, for each simplex degree, we train a neural network to learn the intersection volumes of multiple virtual balls, just based off relative ball distances and radii. We can then use the trained networks instead of tedious computations to estimate the integro-geometric properties of the point cloud shape.

Preliminary results show that our method is able to robustly estimate geometric features (area, perimeter, and Euler–Poincare characteristic) from two-dimensional point clouds and distinguish between various shapes.

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Analysis of Environment and Behavior on Heart Health in Ukraine

Global Health - Time: Tue 3:30pm-4:30pm - Session Number: 5082
Madysen Gromer and Dr. Margaret Eggers, Department of Microbiology and Immunology, Montana State University, P.O. Box 173148 Bozeman, MT 59717-3148
Madysen Gromer

Analysis of Environment and Behavior on Heart Health in Ukraine

Ukraine has extreme rates of cardiovascular disease and deaths associated with this disease. From University of Washington's VizHub database, it was noted that Ukraine has the most extreme rate of deaths due to this disease in the region. This research investigated why this disease is so prevalent in Ukraine and to find probable causes or links. Finding the connection is critical in understanding potential sources that contribute to the problem globally and how to correct the problem to prevent further issues in Ukraine. Information was obtained through literature reviews and data analysis from VizHub and real time air quality maps. There appears to be significant connections between air pollution and smoking rates to cardiovascular diseases in Ukraine. It was found that 10% of women and 57% of men are smokers in Ukraine and 7% and 21% of were former smokers, respectively, ranking Ukraine at 5th place in countries with the highest tobacco use. Ukraine was also found to have air quality that ranges from moderate to unhealthy due to burning organic materials directly in the city, increased humidity, and many industrial factors. Looking at the data, it is apparent that these two factors in Ukraine begin to explain the prevalence. It is pertinent to continue finding explanations behind the extreme rates such as genetic connections or other lifestyle choices, but it does give researchers and health care professionals a great starting point. Through education and putting policy in place to reduce air pollution by regulating industry and smoke pollution, this problem may begin to be resolved.

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Analysis of Trump Administration's Approach to US Opioid Epidemic

Global Health - Time: Tue 3:30pm-4:30pm - Session Number: 5081
Erin Peck and Dr. Margaret Eggers, Department of Microbiology and Immunology, Montana State University, P.O. Box 173148 Bozeman, MT 59717-3148
Erin Peck

This research compares data regarding opioid abuse and public health emergencies to the approach to the opioid epidemic taken by the current United States presidential administration. From 1999 to 2017, overdose deaths caused by opioids rose by almost 600% in the United States. In response to this trend, President Donald Trump directed for a national state of public health emergency to be declared in late 2017. This classification showed promise for change regarding the escalating opioid epidemic. However, it remains crucial to analyze the administration’s approach to the issue holistically. To do this, information was collected through a comprehensive literature review on previous approaches to public health crises and an analysis of global health data on opioid use. While Trump has done more to address the public health crisis than previous presidents, misdirected statements and approaches to the issue continue to incorrectly convey the root of the issue and potential solutions. By identifying the strong and weak points of the Trump Administration’s approach to one of the deadliest public health crises in recent American history, it is possible to initiate a change at the citizen-level and direct improvements in American health from the bottom up. With nearly 50,000 deaths due to opioid use occurring in 2017, a rate 3.5 times higher than most other high-income countries, there is a clear call for change at the national level in order to save hundreds of thousands of lives in the coming years.

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Analyzing Balanced Reduction/Oxidation Status in Liver Cells Under Extreme Stresses with Vector-Mediated Genome-editing

Biology - Time: Mon 3:00pm-4:00pm - Session Number: 2604
Julia Houston, Dr. Ed Schmidt, Microbiology and Immunology, Montana State University, Schmidt

Laboratory, MSU, M&I Department, PO Box 173520, Bozeman MT 59717
Julia Houston

This project aims to develop a vector-mediated genome-editing system for genetic analyses of how liver cells tolerate extreme stresses that can disrupt the normal processes cells use to maintain a balanced reduction/oxidation status ("redox homeostasis"). Whereas most organisms require the activities of either glutathione reductase, thioredoxin reductase, or both to sustain redox homeostasis, our laboratory showed that liver cells can use, alternatively, a third pathway fueled by catabolism of the essential amino acid methionine. To define how this pathway works, we are developing a system to genetically target candidate genes associated with this pathway in individual cells within the livers of live mice. My project generates control vectors for this system. Briefly, vectors encoding genome-editing cassettes for disrupting internal positive-, negative-, and conditional-control genes will be developed to lay the foundation for future pathway analyses. Positive controls will disrupt genes encoding activities essential in all cells, such as for transcription or translation. Delivery of one of these vectors to a subset of cells within a mouse liver should specifically cause those cells to die and disappear, along with the vector that targeted them, from livers of any genotype. Negative controls will target genes that are nonessential in all cells. In this case, we expect the vectors to persist in livers of all genotypes. Finally, as "conditional-controls," we will target two genes, cystathionase and glutamate-cysteine ligase, that we know are essential for the methionine catabolism pathway, but nonessential in wild type (WT) cells. These vectors should persist in WT livers but be lost from the livers of mice dependent on methionine catabolism for redox homeostasis. This project will allow us to precisely define the strategies that will be used in future studies to define how methionine catabolism can sustain redox homeostasis during extreme stress conditions.

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Antiracist Bridge-Building: Sources and Solutions to U.S. Discomfort with Multilingualism

Interdisciplinary Studies - Time: Tue 5:00pm-6:00pm - Session Number: 5508

Tiana Vargas, and Dr. Doug Downs, Department of English, Montana State University, P.O. Box 172300 Bozeman, MT 59717-2300
Tiana Vargas

In the U.S., racism is often overlooked due to progressive social movements, transitioning from direct violence, like segregation or genocide, to indirect forms. These indirect forms look like excusing racist remarks or jokes and practicing a tolerance for xenophobia, just to name a few; however, while indirect forms may not seem malicious, they often lead to similarly violent conclusions. The racism in America today is often categorized as "gentle racism" or "micro-aggressions," and manifests in social conditioning that normalizes these forms of violence as nonviolent. My focus is on the impact of racist language that creates stigmas, specifically, the American discomfort with multilingualism. My research uses language demographics and interviews highlighting issues that minority groups face because of multilingualism and the hegemonic resentment caused by speaking Spanish in English spaces. I acknowledge that not everyone speaks a second or third language, but for Spanish speakers, we must recognize the racist and violent frameworks facing those whose first language is not English.
Along with demonstrating the latent racism in U.S. attitudes toward multilingualism, I present a potential solution involving advocacy for second-language education during early primary levels. There is a distinct inequality in the U.S. push to ensure English proficiency in foreign-born children, compared to its complete disinterest in English-speaking children learning a second language. These disparate methodologies disregard inclusivity and reciprocity, which limit the ways English-speaking and non-English speaking students might otherwise be able to aid in the others' mutual understanding. Strong research such as Liane Brouillette's (2012) study offers insight into possibilities for multilingual instruction; she provides an incredible example of how to teach an unfamiliar language to a child, through stimulating art that limits fear of learning a foreign language, which could shape foreign language classes for English speakers. My presentation considers such approaches for their antiracist value.

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Applying Elements of the Suzuki Method to Private Music Lessons Over Video

Music - Time: Tue 12:30pm-1:30pm - Session Number: 525
Naomi H. Vliet and Dr. Beth Antonopulos, Department of Music, Montana State University, Bozeman MT 59715
Naomi Vliet

This project explores a non-traditional application of the Suzuki Method looking at the feasibility of applying teaching elements to real-time video lessons with beginning middle school orchestra students. There has been some research into the efficacy of video lessons and some research into the Suzuki method, but there has not yet been research pairing the two. In this project, beginning middle school students in Washington State receive weekly lessons on violin, viola, or double bass. Many elements of the Suzuki method are applied in these lessons. In addition, interviews will be conducted with private teachers who have experience giving lessons over video to gain perspectives on the challenges of and adaptations for teaching over video. I hope to find that elements of the Suzuki method can be effectively applied to video lessons, allowing students to gain skill and confidence playing their instrument even if they live in remote areas. The results will be discussed by looking at challenges and successes of the lessons, and what ways the Suzuki method was applied.

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Assessing pH Conditions on Urease Enzyme Activity

Biological & Chemical Engineering - Time: Mon 4:30pm-5:30pm - Session Number: 304
Anna Martinson, Arda Akyel, Dr. Robin Gerlach,and Dr. Adrienne Phillips College of Engineering Montana State University Bozeman 237 Norm Asbjornson Hall, Bozeman, MT 59717, United States
Anna Martinson

Urease Induced Calcium Carbonate Precipitation (UICP) has been shown to seal sub-surface fractures by catalyzing hydrolysis of urea to promote mineral precipitation. The applications for UICP could be useful in carbon capture and storage (CCS) to fix or prevent leaks at the sites. CCS sites tend to have low pH due to supercritical CO2 and water mixing. The purpose of this study is to investigate urease's ability to withstand exposure to pH conditions less than 6 and at temperatures as high as 60˚C to broaden the applications UICP could be used in because enzyme activity may be inhibited by low pH or high temperature conditions. To study urease kinetics after exposure to low pH and high temperature conditions jack bean meal (JBM) urease was prepared two ways, a suspended mixture and immobilized on a ceramic proppant. These were exposed to pH conditions between 3.7 and 7 at 22˚C and 60˚C. After

exposure to low pH for 1 hour, the pH was increased to 7 and a batch kinetic study was run for 48 hours at 22˚C to measure the ureolytic activity. Suspended JBM urease remained active after exposure to the condition of pH 4.2 at 22˚C and immobilized urease remained active after all pH exposures, though slower at pH 3.7. When exposed to low pH and 60˚C, the suspended JBM showed ureolytic activity after exposure to 4.7 and the immobilized JBM had minimal ureolytic activity after exposure to pH 4.1. This suggests that UICP could be used in CCS applications.

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Associations Between Self-Compassion and Mental Health: a Literature Review

Psychology - Time: Wed 3:00pm-4:00pm - Session Number: 7046
Jenaya L Burns Monica Skewes Ph.D, Julie A. Gameon MS, Department of Psychology Montana State University P.O. Box 173440 Bozeman, MT 59717-3440
Jenaya Burns

Self-compassion is an idea that came from Buddhist philosophy and has been studied extensively in recent years as a predictor of mental health outcomes. Self-compassion has been described as being kind to oneself, being mindful of one's feelings, and not over-identifying with one's feelings. The purpose of this study was to review the psychology literature on self-compassion and identify future directions for research. A search was completed using various combinations of the following keywords: self-compassion, mental health, depression, anxiety, posttraumatic stress disorder, substance use, substance use disorder, and trauma. This search yielded a total of 18 sources, including 16 empirical research articles and two review articles. The articles were broken down into four different sections: original self-compassion articles, self-compassion measurement issues, self-compassion and substance use, and finally self-compassion, trauma, and mental health. Results showed that self-compassion is statistically associated with higher levels of positive characteristics such as happiness, curiosity, exploration, and optimism. Self-compassion was also significantly associated with lower levels of negative mental health issues such as depression, substance use disorder, and suicidal ideation. Issues with the measurement of self-compassion have been identified. Since the self-compassion scale measures both positive and negative items, it appears that it is measuring two different constructs: self-compassion and self-criticism. With the three main aspects of self-compassion this concept could be a vital resource in treating mental health disorders as well as substance use disorder. By having a patient realize that the issue they are seeking help with is valid and that they are not alone in their struggles can help aid their recovery process. With this, further research is needed to investigate whether

self-compassion provides better mental health outcomes, or if already having better mental health is the reason some score higher on the self-compassion questionnaire.

Self-compassion is an idea that came from Buddhist philosophy and has been studied extensively in recent years as a predictor of mental health outcomes. Self-compassion has been described as being kind to oneself, being mindful of one's feelings, and not over-identifying with one's feelings. The purpose of this study was to review the psychology literature on self-compassion and identify future directions for research. A search was completed using various combinations of the following keywords: self-compassion, mental health, depression, anxiety, posttraumatic stress disorder, substance use, substance use disorder, and trauma. This search yielded a total of 18 sources, including 16 empirical research articles and two review articles. The articles were broken down into four different sections: original self-compassion articles, self-compassion measurement issues, self-compassion and substance use, and finally self-compassion, trauma, and mental health. Results showed that self-compassion is statistically associated with higher levels of positive characteristics such as happiness, curiosity, exploration, and optimism. Self-compassion was also significantly associated with lower levels of negative mental health issues such as depression, substance use disorder, and suicidal ideation. Issues with the measurement of self-compassion have been identified. Since the self-compassion scale measures both positive and negative items, it appears that it is measuring two different constructs: self-compassion and self-criticism. With the three main aspects of self-compassion this concept could be a vital resource in treating mental health disorders as well as substance use disorder. By having a patient realize that the issue they are seeking help with is valid and that they are not alone in their struggles can help aid their recovery process. With this, further research is needed to investigate whether self-compassion provides better mental health outcomes, or if already having better mental health is the reason some score higher on the self-compassion questionnaire.

Automatic Detection of Fish Using Airborne Lidar and Machine Learning

Electrical & Computer Engineering - Time: Tue 2:00pm-3:00pm - Session Number: 4528
Joseph Aist, Kyle Rust, Jackson Belford, Bradley M. Whitaker, Department of Electrical and Computer Engineering, Montana State University, 610 Cobleigh Hall, Bozeman, MT, 59718
Joseph Aist, Joseph Aist, Jackson Belford, Kyle Rust

In 1994, invasive lake trout (Salvelinus namaycush) were found to be feeding on the native cutthroat trout (Oncorhynchus clarki bouvieri) in Yellowstone Lake, threatening the native species' existence and the ecological balance in Yellowstone National Park. In September 2004, an experiment exploring the feasibility of using airborne LIDAR for mapping lake trout spawning areas in Yellowstone Lake was successfully conducted. The success of this experiment led to its repetition in 2015 and 2016. However, the algorithms that exist to map fish in the open ocean failed due to the highly cluttered underwater environment of Yellowstone Lake. Therefore, experts manually examined the data, which was not time- or cost-effective. In this work, we applied machine learning algorithms to identify lake trout in Yellowstone Lake using LIDAR data from prior studies. Of all the tested algorithms, Support Vector Machines were most effective at identifying regions of lake trout in Yellowstone Lake. Our results can provide biologists with a map of lake trout spawning sites that can be used to help maintain the ecological balance of Yellowstone National Park. Based on the success of this project, similar machine learning algorithms were tested on data from LIDAR flights over the Gulf of Mexico. The results from the Gulf of Mexico identified regions of interest and areas where fish had not previously been detected from manual inspection of the data. As work continues through the winter semester, the algorithms will be tested on similar airborne LIDAR data from the Oregon coast.

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Characterization and Comparison of the Microbiome of African Carnivores

Microbiology - Time: Mon 4:30pm-5:30pm - Session Number: 331
Will Rogers, Department of Ecology, Montana State University, 310 Lewis Hall, Bozeman, MT, 59717 USA; Seth Walk, Department of Microbiology & Immunology, 109 Lewis Hall, Montana State University, Bozeman, MT, 59717, USA; Scott Creel, Department of Ecology, Montana State University, 310 Lewis Hall, Bozeman, MT, 59717 USA; Matt Becker, Department of Ecology, 310 Lewis Hall, Montana State University, Bozeman, MT 59717, USA / Zambian Carnivore Programme, P.O. Box 90, Mfuwe, Eastern Province, Zambia
Will Rogers

Many of the microbes living within a host's gastrointestinal tract (the microbiome) and the host share a symbiotic relationship – the host provides microbes with nutrients and microbes assist the host with digestion and immune function. However, the role of the microbiome with regard to its effect on the fitness of a host and the effect of host traits (diet, phylogeny, geographic location, social organization, spatial distribution, etc.) on the microbiome are largely un-studied under natural conditions in wild populations. We characterized and compared gut microbiomes of several species of African predators in several ecosystems to better understand how host niche breadth was reflected in gut microbial diversity and structure. To do this, we collected fecal samples from African wild dog (*Lycaon pictus*), spotted hyena (*Crocuta crocuta*), cheetah (*Acinonyx jubatus*), and African lions (*Panthera leo*) in three national parks (Kafue, South Luangwa, and Liuwa Plain National Parks) in Zambia in 2018 and 2019. Initial sequencing efforts of 16S ribosomal RNA present in fecal material established that individual host species were visually distinguishable using a principal components graphical analysis. Further, alpha diversity of fecal microbiota was strongly predicted by host species (GLMM $\chi 2(3)= 10.75$, p-value= 0.01316). With further sequencing and analysis, we expect to find a strong relationship between host niche and fecal microbial community diversity. We will present the results of current sequencing and modeling efforts along with our conclusions regarding the role of host niche in influencing microbiome diversity and structure.

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Characterization of a Portable, Customizable, Low-cost Temperature Control System for Amplification and Quantification of Specific Nucleic Acids in Microfluidic Devices

Biological & Chemical Engineering - Time: Tue 11:00am-12:00pm - Session Number: 403
Mikayla Wood, Pablo Martínez Crus, Reha Abbasi, and Dr. Stephanie McCalla, Department of Chemical and Biological Engineering, Montana State University, 306 Cobleigh Hall, Bozeman, MT, 59717, United States of America
Mikayla Wood

The ability to detect and quantify specific nucleic acids from patient samples is critical to the early diagnosis of many diseases, such as cancer. Current methods to quantity these specific nucleic acids require expensive, bulky equipment to control temperature during DNA amplification reactions. The aim of this research is to enhance and characterize the low-cost temperature control system developed in our lab, and to validate the system using a DNA amplification reaction to specifically detect a target nucleic acid sequence with a microscope. The temperature control system includes a holder that allows a microfluidic device to be continuously imaged and monitored under the microscope. The connection of the two thermocouples to the system were altered to improve the user interface and each thermocouple was calibrated individually to improve accuracy. The system controlled the temperature on a device made from a standard glass slide and PDMS, allowing a standard DNA amplification reaction (PCR) with 40 thermal cycles to be run. The difference between the initial and final fluorescence of the sample under the microscope were compared to the results obtained from the same sample in a commercially available temperature control system (Biorad CFX thermal cycler). A PCR reaction will be run and monitored in real time to obtain microscope images of a device throughout the amplification using the temperature control system. These results will confirm that the temperature control system can perform DNA amplification reactions as needed to detect and quantify specific nucleic acids. Future work includes using the temperature control system in conjunction with a 3D printed microfluidic device made without PDMS. Both of these technologies combined will allow for low-cost, compact, and robust temperature-dependent operations on microfluidic devices.

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Characterizing Multiple Mechanisms of Superinfection Exclusion in Pseudorabies Virus Infection

Biology - Time: Mon 3:00pm-4:00pm - Session Number: 2576

Jonathan Einterz Owen and Dr. Matthew P. Taylor, Department of Microbiology and Immunology, Montana State University, 100 Culbertson Hall, Bozeman MT 59717
Jonathan Owen

Pseudorabies Virus (PRV) is a neuroinvasive herpesvirus of lower-order mammals which is frequently used as a model organism for Herpes Simplex Virus (HSV). Both viruses can cause severe neurological damage, but normally result in the establishment of a lifelong, latent viral reservoir in host neuronal ganglia. HSV and PRV are capable of a phenomenon known as superinfection exclusion (SIE), a virally mediated process by which an already-infected cell becomes refractory to a second infection, or superinfection. This process is predicted to influence the rate of viral recombination and thereby impact the genotypic diversity of viral populations. SIE presents intriguing prospects for treatment and control of a herpesvirus infection – if SIE's underlying mechanisms can be understood, it may be possible to harness them to prevent an initial infection.

PRV and HSV possess two known mechanisms for establishing SIE – one mediated by the viral glycoprotein gD, and a gD-independent mechanism whose effector proteins have not been determined. The interactions between these two mechanisms are unknown, as is the relative importance of each. We hypothesized that the impact of each mechanism would depend on the multiplicity of infection (MOI – the number of virions attempting infection per cell). To address this question, we used cell culture experiments to evaluate PRV's SIE phenotype in response to varying MOIs. Our results show that SIE can be overcome when the MOI of superinfection is greater than the MOI of the initial infection, regardless of the primary or secondary MOI. Additionally, we are testing if this MOI dependence of SIE requires gD expression through infections with a gD-null PRV mutant.

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Combining Signals of Dissolved Oxygen and Carbon Dioxide to Infer Whole-stream Metabolism

Environmental Science & Sustainability - Time: Tue 2:00pm-3:00pm - Session Number: 4647
Abigail Northrup, Dr. Robert Payn, and Meryl Storb, Department of Land Resources and Environmental Science, Montana State University, 334 Leon Johnson Hall P.O. Box 173120, Bozeman MT 59717-3120
Abigail Northrup

Stream metabolism measurements are fundamental indicators of the connection between water quality and watershed processes because they define the foundation of carbon movement through the aquatic ecosystem. Data sets utilizing these measurements can reflect the results of land management decisions, and thus provide a useful tool to monitor the integrity of aquatic ecosystems under the pressures of climate change, land use change, and anthropogenic nutrient loading. Stream metabolism has conventionally been estimated from dissolved oxygen data, but the recent development of reliable automated dissolved carbon dioxide sensors may provide another window into stream metabolic processes. We are designing and testing software to infer whole-stream metabolic rates (gross primary production and ecosystem respiration) based on high-frequency measurements of both dissolved oxygen and carbon dioxide. Inferences from initial models and data sets suggest that dissolved oxygen and carbon dioxide do not result in similar inferred estimates for gross primary production (GPP) and ecosystem respiration (ER). This research tests different modeling scenarios to suggest the most likely reasons for this discrepancy. For example, our top priority is to understand how the assumed photosynthetic quotient (the relative effect of GPP on oxygen vs. carbon dioxide) may influence the inference of metabolism from oxygen and carbon dioxide together. We expect that results from this research will contribute to the ability to extract additional information about whole-stream metabolic measurements via the technological advances in measuring additional dissolved metabolite gasses.

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Determining Optical Transmittance Spectra of 3D Printing Materials

Electrical & Computer Engineering - Time: Tue 2:00pm-3:00pm - Session Number: 4529
Shannon M. Hamp, Riley D. Logan, and Joseph A. Shaw, Department of Electrical and Computer Engineering, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Shannon Hamp

Three-dimensional printing technology is increasingly prevalent in academic and professional settings; however, it is less common in optical systems due to limited knowledge of 3D printing material optical properties. Aside from the discovered degradation that acrylonitrile butadiene styrene (ABS), a common 3D printer material, experiences when exposed to UV rays for extended periods of time, no published research exists on the light transmittance of various 3D printing materials. To aid the use of 3D printed parts in optical systems, this research aims to answer the question: what are the optical transmission spectra of common 3D printing materials? Common printing plastics come in different colors and can be printed in thicknesses as low as 20 microns. Transmittance through the material changes depending on the selected color and thickness of the printed design. A 3D “stair-step” design to allow for data collection of varying thicknesses of each material, in 1-millimeter increments, has been developed that can be printed with the Ultimaker 2+ and the FormLabs Form 2 printers utilizing common materials including PLA, ABS, and various resins. The prints are then placed in front of an integrating sphere with a spectrometer probe positioned on the opposing side to measure the amount of light that passes through the material at each wavelength from 400 to 2500 nm (visible to short-wave infrared). Various materials can be printed in different colors and thicknesses, so the transmission of light through the material is predicted to rely more on the thickness and color selections, rather than the material: where lighter colors and reduced thicknesses will transmit more light than darker colors and greater thicknesses. The experimental results will be organized in a comparative table to demonstrate the transmittance of each material selection to aid in the use of 3D printing for future optical applications.

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Determining the Role of Aquaglyceroporin-3b in Convergent Extension During Xenopus Gastrulation

Biology - Time: Mon 3:00pm-4:00pm - Session Number: 2577

Zachary Mayne, Dr. Jennifer Forecki, and Dr. Christa Merzdorf; Department of Microbiology and Immunology; Montana State University; Culbertson Hall, 100, Bozeman, MT 59717
Zachary Mayne

The *apq3b* gene codes for an aquaglyceroporin, a type of transmembrane channel that facilitates the cell's permeability to glycerol and other small, polar molecules in addition to water. This aquaglyceroporin plays key roles in gastrulation, when the embryo forms the ectoderm, mesoderm, and endoderm layers, and in neurulation, when the neural tube forms. During early gastrulation, dorsal mesoderm cells on the embryo’s exterior move interiorly and undergo convergent extension, whereby they form into a long, thin band of tissue. Injecting morpholino oligonucleotides to prevent Aqp3b protein translation in the dorsal mesoderm cells prevents convergent extension in gastrulation. In my experiments, I am assessing whether it is the water or polar-solute permeability from Aqp3b expression that is necessary for convergent extension. Preliminary data from control experiments, where dorsal mesoderm cells of *Xenopus* embryos were injected with morpholino oligonucleotides targeting *aqp3b*, have reconfirmed that Aqp3b expression is required for convergent extension. Exogenous mRNAs will be co-injected with morpholinos targeting *aqp3b* to replace it with alternative aquaglyceroporins, which are permeable to water and polar solutes, or strict aquaporins, which are permeable only to water. My hypothesis is that other aquaglyceroporins will rescue Aqp3b function while strict aquaporins will not, which would indicate that permeability to polar solutes such as glycerol is required for convergent extension. If this hypothesis proves true, further investigation will determine which polar solutes are required and what role they play in the molecular mechanisms of convergent extension. My subsequent hypothesis is that glycerol permeability is required to mediate endocytosis events and cytoskeletal rearrangements that are necessary for convergent extension.

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Developing an Aptamer Against Acetaminophen to Detect Acetaminophen Toxicity at the Point of Care

Biological & Chemical Engineering - Time: Mon 3:00pm-4:00pm - Session Number: 2527

Matthew Magoon and Dr. Stephanie McCalla, Department of Chemical and Biological Engineering, Montana State University, PO Box 173920, Bozeman MT 59717
Matthew Magoon

Acetaminophen toxicity is a leading cause of acute liver failure, and the diagnosis and treatment of this condition are based heavily on laboratory findings. While there are several antibody-based and enzymatic assays available for detecting acetaminophen toxicity, they have several drawbacks. These include the special shipping and storage requirements needed to preserve the proteins' integrity, and the fact that they must be performed in a clinical lab which can increase the turnaround time or create a barrier in settings where a clinical lab is not available. An alternative, which is particularly well suited to limited resource settings, could be to use DNA aptamers, or short strands of DNA that bind to a specific target. For this project, work is being done to design a new DNA aptamer through an in vitro technique called Systematic Evolution of Ligands by Exponential Enrichment (SELEX). The goal of this project is to evolve an aptamer that specifically binds to acetaminophen in human plasma, and then to incorporate the aptamer into a lateral flow assay that can rapidly provide results at the point of care. The advantages to using DNA aptamers instead of antibodies or enzymes are that aptamers are more durable than proteins in terms of their ability to withstand denaturing conditions like heat, aptamers are easier to produce in large quantities because of DNA's ability to be replicated, and aptamers are less expensive than proteins. By incorporating DNA aptamers into a lateral flow assay with gold nanoparticles, it should ultimately be possible to design a simple, inexpensive, point of care diagnostic test with visual detection that has less rigorous shipping and storage requirements than existing tests. This can increase access to testing for acetaminophen toxicity, which is a prevalent and widespread condition that can be effectively treated if it is caught early.

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Development of a Supervised Injection Site in Dayton, Ohio Based on Previous Site in Vancouver, Canada

Global Health - Time: Tue 3:30pm-4:30pm - Session Number: 5083
Susanna Sovde, Mari Eggers, Microbiology & Immunology, Montana State University 366 Barnard Hall P.O. Box 173980 Bozeman, MT 59717-3980
Susanna Sovde

Could a supervised injection site (InSite) like the one in Vancouver, British Columbia, be helpful in reducing opioid use disorders in Dayton, Ohio? Dayton has one of the highest opioid use disorder rates in America. Vancouver, BC, had a similar issue ten years ago. This paper looks into how Vancouver used a controversial idea to make progress with their community overdose issue, and how the same idea could be implemented in Dayton. The methods used to conduct this research were a detailed literature review and data analysis using several different types of sources. This includes peer reviewed journals, news articles, and raw opioid use data. The findings of this analysis were that this InSite could be effective in Dayton, but it all depends on how it well it is executed by the project planners and organizers. The supervised injection site is great in theory, but very specific requirements need to be met in order to make it effective. These requirements are different for each city, so more research would need to be conducted in order to truly map this out in a way that would be cost effective.

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Drought and Beetle induced Monoterpene Defenses in Pinyon Pine Seedlings

Plant Sciences - Time: Mon 1:30pm-2:30pm - Session Number: 143
Franklin Alongi, Danielle Ulrich, Department of Ecology, Montana State University Bozeman,

Culbertson Hall, 100, Bozeman, MT 59717
Franklin Alongi

In 2002, drought led to a mass mortality event in pinyon pine (*Pinus edulis*) across four Southwestern US states, leading to the loss of an estimated 350 million trees. With a changing climate, droughts such as these are expected to become more frequent and more severe. On top of drought stress, weakened pinyon pine trees are also targeted by bark beetles. Many mechanisms exist for plant defense. Resin produced by a tree can effectively "pitch out" attacking beetles, as well as expose them to chemical defenses. Some tree species have been shown to detect defense compounds of a neighboring tree, allowing for a tree to prime its defenses before it is attacked itself. Aditionally, some pine species have been shown to directly detect an herbivore by the herbivore's volatile emissions, allowing the tree to prepare for an attack. These mechanisms have not yet been tested in pinyon pine, and the ability for plants that have these chemical detection mechanisms to function under drought stress is largely unknown. In a greenhouse experiment, we subjected pinyon pine seedlings to drought, chemical defense compounds, and beetle pheromones. We measured defense volatile emissions in order to experimentally determine if pinyon exhibits these chemical detection mechanisms, as well as to determine if drought stress limits any such ability. The results of this experiment will be discussed within the overall context of plant defense mechanisms and the future of pinyon pine in the face of a changing climate.

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Empire and Exploration in the Antarctic: A Shift from the Horizontal to the Vertical

History - Time: Tue 3:30pm-4:30pm - Session Number: 729
Travis Carioscia, Michael Reidy, Department of History and Philosophy, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Travis Carioscia

Antarctica has long been a continent shrouded in mystery, intertwined with Imperial expansion and scientific advancement. This paper will show how Antarctic exploration shifted from horizontal exploration fueled largely by British heroism and Imperial glory, to vertical exploration in the name of scientific advancement and adventure tourism. It will do so by looking through the lenses of multiple Antarctic expeditions. From James Ross' seafaring expedition in 1840 through the "Golden Age of Antarctic Expeditions" in the early 1900s with Robert Falcon Scott and Ernest Shackleton, all the way up to modern tourism and scientific expeditions into the mountains of ice with Conrad Anker. The shift

from horizontal to vertical orientation is important not only because it portrays a change in ideology, but also because it helped foster changes in international political policy in the form of the Antarctic Treaty System of 1961. As a result of these new policies, Antarctica is currently a center of International scientific cooperation with over thirty countries sending personnel to various research bases on the continent. It has also seen an increasing commercialization of its landscape as a destination for extreme climbing. By viewing the exploration of Antarctica through its vertical rather than horizontal dimension, a new understanding is gleaned of its past history and present significance.

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Empire and Exploration in the Antarctic: A Shift from the Horizontal to the Vertical

History - Time: Tue 5:00pm-6:00pm - Session Number: 829

Travis Carioscia, Michael Reidy, Department of History and Philosophy, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Travis Carioscia

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Equitable Obstacle Race

Architecture & Interior Design - Time: Mon 1:30pm-2:30pm - Session Number: 2048

Rebecca Hennings, Farli Boden, Atticus Cummings, Henry Weaver, Eleanor Bernard, Madelyn Townsend, and Brian Brush, Department of Architecture, Montana State University, 160 Cheever Hall, 59717

Rebecca Hennings, Farli Boden, Atticus Cummings, Henry Weaver, Eleanor Bernard, Madelyn Townsend

The Blueprint Obstacle Adventure Race (BOAR) will be an obstacle course race run as a fundraiser for Montana Human Resources Development Council (HRDC). The vision is for a broad community adventure race designed to reduce stigma around youth experiencing homelessness. The race will be an inclusive event that allows people with many levels of physical ability to compete together. We plan to create obstacles that reflect the struggles faced by many homeless youths. Given the nature of the proposed race and the variation of physical abilities among potential participants, each obstacle will prove easier for some participants than others. The key issue we hope to address in our research is whether it is possible for people with a wide array of athletic ability to compete together on a single racecourse in a manner that respects each individual's physical ability and creates a thought-provoking experience around homelessness. The research will occur over the spring 2020 semester as a design-build project. Collaborating with our mentor Brian Brush and local HRDC leadership, we plan to explore potential forms for original and safe obstacles. The research will be directed toward designs that achieve an equitable spectrum of challenge levels while maintaining a safe environment. Our goal is to design three to ten obstacles that will be placed along a 5k racecourse for the HRDC fundraising race in late summer 2020. If our research proves successful it could launch a new kind of race with the potential to grow in popularity similar to Spartan Races. This proposed race will democratize the age-old concept of the obstacle course, while engaging participants to understand issues that homeless youth encounter today. Our hope is that our designs will provide a template for other similar projects that could be used as fundraisers by HRDC and other nonprofits nationwide.

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Explosive Seed Dispersal of Leafy Spurge

Plant Sciences - Time: Mon 1:30pm-2:30pm - Session Number: 143
Caitlin Carmody and Dr. James Wilking, Center for Biofilm Engineering, Montana State University, P.O. Box 173820, Bozeman, MT 59717-3820
Caitlin Carmody

Leafy spurge, an invasive weed found throughout North America, outcompetes native grasses and is poisonous to cattle and horses. Managing leafy spurge is expensive, and the estimated economic costs total more than $100 million annually between Montana, Wyoming, and the Dakotas. Leafy spurge spreads by explosive rupture of seed pods, which can launch millimeter-scale seeds up to 15 ft from the plant. To explore the physics of seed dispersal, we use high-speed imaging, force measurements, and microscopy. We find that the shells have a layered composite structure with layers that deform anisotropically in response to changes in humidity. Intriguingly, capillary forces in the cells of the shell appear to play an important role, and the shell deformation generated by drying is reversible. These ongoing experiments may lead to new strategies for managing and eradicating leafy spurge infestations.

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Faunal Remains from the Bergstrom Site (24JT0893): A Late Prehistoric Bison Kill in Central Montana

Anthropology & Archeology - Time: Mon 1:30pm-2:30pm - Session Number: 2020
Tristan Huxtable, Brian Carr, Georgia Scott, Danielle Buchanan, and Conor Bianchi, Dr. Neeley, Department of Sociology and Anthropology, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717

Tristan Huxtable

Bison hunting was an important part of precontact subsistence practices in the Northwestern plains as is evident by the numerous archaeological sites that document this activity. In 2019, as part of the Montana State University archaeological field school, excavations were conducted at the Bergstrom site (24JT0893), a multicomponent, late prehistoric bison kill in central Montana. The fieldwork resulted in the collection of a large assemblage of bison remains from nine different excavation units representative of both early (Besant, 2000 to 1500 years before present) and late (Avonlea, 1700 to 900 years before present) phases in stratified contexts. The aim of this project is to understand how precontact peoples hunted and used bison at the site over a span of nearly one thousand years. Methodologically, the faunal remains are analyzed following standard archaeological procedures with an emphasis on identifying the number of animals represented (using the frequency of bone elements), seasonality (tooth eruption patterns in mandible and maxilla elements), and patterns of butchering (cut marks and patterns of bone breakage). In addition to identifying spatial and temporal patterns at the site level, the results will be placed within a regional perspective by examining patterns from other similar aged sites in the Northwestern plains. This will enable us to better contextualize the behaviors of these past hunter-gatherer peoples.

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Groundwater Quality and Related Health Risks in the Upper Missouri Watershed, Madison County, Montana

Environmental Science & Sustainability - Time: Tue 2:00pm-3:00pm - Session Number: 4639
Jordyn Cook, Emma Lauchner, Olivia Schwintek, William Monaghan, Taylor Saturday, and Dr. Margaret Eggers, Department of Microbiology and Immunology, Montana State University, 173520 Bozeman, MT 59717
Jordyn Cook

Water quality data for various Montana water resources are managed by the Montana Ground Water Information Center (GWIC). This publicly available online source provides sufficient data to assess various water contaminants and water quality characteristics for each watershed. For the Ruby River Basin, the GWIC groundwater data was analyzed to examine which water contaminants pose the greatest risks to public health. The results of this analysis may be included within a public report to be made available to Montana residents in order to improve the overall understanding of water quality

related health risks. The groundwater data analysis started [M1] by excluding all GWIC data taken from site types other than wells, streams, and springs. Averages of contaminant levels and counts of contaminants exceeding their respective Environmental Protection Agency (EPA) standards, along with cumulative risk assessments of primary contaminants, were calculated. It was found that arsenic, manganese and thallium posed the greatest health risks for the three site types within the Ruby River Basin. Lithium was also found to be of concern. Wells showed the highest averages for each contaminant, as well as the highest cumulative risk values with an average cumulative risk of 1.357 with 32 samples above a value of 1. Testing for well water contamination and properly disinfecting home wells are the responsibility of the well user. Access to comprehendible data on the quality of groundwater is crucial for communities with limited knowledge and financial resources to adequately assess their groundwater.

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Historical Loss: Implications for Health of American Indians in the Blackfeet Community

Psychology - Time: Wed 3:00pm-4:00pm - Session Number: 7047

Dr. Neha John-Henderson & Dr. Benjamin Oosterhoff, Department of Psychology. Dr. Jason Carter, Department of Health and Human Development. Dr. Alexandra Adams, Director and Principal Investigator of The Center for American Indian and Rural Health Equity. Montana State University-Bozeman, Culbertson Hall, 100, Bozeman, MT 59715.
Taylor Kampf

Background: Historical loss in American Indians (AIs) is believed to contribute to high incidence of mental health disorders. **Purpose:** To investigate whether frequency of thought about historical loss predicts risk factors for chronic physical health conditions in an AI community. **Methods:** Using

Community Based Participatory research (CBPR) and Ecological Momentary Assessment (EMA), we measured frequency of thoughts about historical loss in 100 AI adults residing on the Blackfeet reservation. Participants completed a one-week monitoring period, during which ambulatory blood pressure and daily levels of psychological stress were measured. At the end of the week, we collected a dried blood spot sample for measurement of C-reactive protein (CRP). **Results:** In a hierarchical linear regression controlling for demographics and depressive symptoms, greater frequency of thoughts about historical loss predicted higher average daily psychological stress, and higher average ambulatory systolic and diastolic blood pressure. In a separate hierarchical linear regression controlling for the same covariates as well as Body Mass Index (BMI), greater frequency of thought about historical loss predicted higher levels of CRP. **Conclusions:** Interventions which positively affect historical loss may help to reduce risk for common chronic diseases on the Blackfeet reservation including diabetes and CVD.

Background: Historical loss in American Indians (AIs) is believed to contribute to high incidence of mental health disorders. **Purpose:** To investigate whether frequency of thought about historical loss predicts risk factors for chronic physical health conditions in an AI community. **Methods:** Using Community Based Participatory research (CBPR) and Ecological Momentary Assessment (EMA), we measured frequency of thoughts about historical loss in 100 AI adults residing on the Blackfeet reservation. Participants completed a one-week monitoring period, during which ambulatory blood pressure and daily levels of psychological stress were measured. At the end of the week, we collected a dried blood spot sample for measurement of C-reactive protein (CRP). **Results:** In a hierarchical linear regression controlling for demographics and depressive symptoms, greater frequency of thoughts about historical loss predicted higher average daily psychological stress, and higher average ambulatory systolic and diastolic blood pressure. In a separate hierarchical linear regression controlling for the same covariates as well as Body Mass Index (BMI), greater frequency of thought about historical loss predicted higher levels of CRP. **Conclusions:** Interventions which positively affect historical loss may help to reduce risk for common chronic diseases on the Blackfeet reservation including diabetes and CVD.

Hiv/Aids and the Virgin Cleansing Myth in South Africa

Global Health - Time: Tue 3:30pm-4:30pm - Session Number: 5085
Tatjana Groenewald, Margaret Eggers, Microbiology and Cell Biology, Montana State University-Bozeman, Culbertson Hall, 100, Bozeman, MT 59717
Tatjana Groenewald

In South Africa, rates of Child rape and Child Human immunodeficiency virus (HIV) infections are closely correlated. One anthropological reason that children are frequently specifically targeted is a cultural myth found throughout Africa, called the virgin cleansing myth. Simply put, it is believed that intercourse with a virgin will cure HIV/AIDS (acquired immunodeficiency syndrome). This study investigates the virgin cleansing myth as a significant contributor to the high rates of HIV/AIDS in South Africa. Due to shame or lack of reporting, the myth is likely more prevalent than current research shows. Data were gathered using UW IHME Vizhub. The data regarding children vs. adult rapes in South Africa was obtained at Science in Africa. Information on the myth was researched within EBSCOhost, Social Explorer, and ProQuest databases, by searching for virgin cleansing myth, sexual myths in South Africa, and case studies on virgin cleansing myths. Some information was obtained directly from an organization helping children who had been raped. Further research is needed to firmly ascertain this myth as a significant reason for the spread of HIV/AIDS. This research is one step toward addressing this socially devastating issue. This research concluded that a reason HIV/AIDS rates are

high in South Africa is that the virgin cleansing myth is more prevalent than currently thought. The myth's impact on children needs to be established, and community-based solutions determined.

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How Does the Inhibition of Aquaporin 3b Affect the Calcium Signals Transmitted in the Neural Plate of Xenopus laevis Embryos?

Biology - Time: Mon 3:00pm-4:00pm - Session Number: 2592

Zachary Hurt, Dr. Christa Merzdorf, Department of Microbiology and Cell Biology, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Zachary Hurt

A critical component of embryonic development is the construction of the central nervous system; the neural plate is one of the first tissues formed in this process. Without proper formation of the neural tube, neural tube birth defects result, such as anencephaly and spina bifida. Apical constriction (AC), the principal mechanism that drives neural tube closure, requires the presence of aquaporin 3b (aqp3b) in order to close properly. The cells that make up the entire neural plate do not apically constrict in the absence of Aqp3b despite the protein only being expressed in the cells of the outer edge. My research focuses on the mechanism associated with the communication of Aqp3b to the neural plate cells that do not express the protein. Calcium is a common intracellular signaling molecule and is able to pass through gap junctions; I have hypothesized that calcium ions may allow Aqp3b to act from the edge of the neural plate to affect all neural plate cells. By injecting Xenopus embryos with RNA for the calcium sensor GCaMP6, I am able to use NIS-Elements software to image the calcium propagation that occurs in the neural plate, both in space and in time. A morpholino oligonucleotide is co-injected to inhibit the expression of aqp3b. I have used time lapse imaging to compare control groups and aqp3b inhibited groups. I am in the process of comparing the calcium events (by observing wave function characteristics), which should tell me whether or not the inhibition of aqp3b is associated with changes in the characteristics of calcium waves that are occur in the neural plate.

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Hydrogen and Methane Storage in Densified Zeolite-Templated Carbons

Chemistry - Time: Tue 11:00am-12:00pm - Session Number: 3533

Seth Putnam, Atsushi Gabe, Hirotomo Nishihara, Nicholas Stadie, Department of Chemistry and Biochemistry, Montana State University, 103 Chemistry and Biochemistry Building, PO Box 173400, Bozeman, MT 59717
Seth Putnam

Zeolite-templated carbons (ZTCs) are a class of porous carbons that have a designable structure with a high surface area and gravimetric storage capacity. However, for practical purposes volumetric storage capacity is a more important metric. To investigate this metric, we have worked with collaborators at Tohoku University to explore a novel densification procedure to remove interparticle space. ZTCs have been reported to demonstrate high mechanical strength and a resistance to pore deformation. The objective of this work is to understand how varying the compaction procedure affects the hydrogen and methane binding interactions within the ZTCs. This technique could improve the storage capacity beyond that of pure hydrogen or methane gas compression. The goal of my project has been to collect, model, and analyze adsorption equilibria on these unique samples by collecting measurements between 25 K and 298 K. This data has been collected using a custom Sieverts apparatus constructed for the purpose of performing high pressure isotherms. The Sieverts apparatus utilizes volumetric measurements by recording temperature and pressure changes between two well calibrated volumes. Using this data, the change in moles attributed to uptake by the sample can be measured. Compacted ZTCs seem to show a significant, reversible uptake of hydrogen; meaning they could be a candidate as an effective hydrogen storage material for mobile applications.

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Identifying and Understanding the Function of CRISPR Leader-Repeat Sequences

Microbiology - Time: Tue 5:00pm-6:00pm - Session Number: 5628
Pushya Krishna, Andrew Santiago-Frangos and Dr. Blake Wiedenheft, Department of Microbiology and Immunology, Montana State University, 100 Culbertson Hall, Bozeman MT 59717
Pushya Krishna

Clustered Regularly Interspersed Short Palindromic Repeats (CRISPR) and associated genes (cas) are essential components of diverse adaptive immune systems that defend bacteria and archaea from viral and plasmid infection. During CRISPR adaptation, newly encountered viral and plasmid DNA is integrated as a new spacer into the “leader” end of the CRISPR locus. In Type I-E CRISPR systems, the Integration Host Factor (IHF) binds to and kinks the leader, recruiting an upstream motif that helps dock the Cas1-2 integrase complex onto the first repeat of the CRISPR locus. To determine the prevalence of this IHF-dependent mechanism of CRISPR expansion, I used bioinformatic methods to analyze 15,274 CRISPR leader sequences for the presence of conserved IHF binding sites and upstream motifs. Results from these experiments demonstrate phased distribution of IHF and upstream motif sites in subsets of I-E, I-F, I-C and II-C leaders. Furthermore, *in vitro* biochemical assays reveal that motif phase, rather than motif proximity to the leader-repeat junction, is critical to CRISPR evolution.

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Imaging Microbial Communities on Treatment Wetland Plant Roots

Civil Engineering - Time: Tue 11:00am-12:00pm - Session Number: 3632
Dr. Ellen Lauchnor, Dr. Otto Stein, Paul Karcher, Department of Civil Engineering, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Olivia Prewitt

With the rise of the idea of a more sustainable world, natural treatment systems for treatment of water and wastewater have become progressively popular around the world. For natural treatment systems, such as engineered wetlands for wastewater treatment, to be successful a microbial community is needed to perform the treatment. These microbial communities aid the removal of organic carbon, nitrogen, and sulfur compounds from wastewater that are fed into the system. The objective of this study is to measure

the root diameter of wetland plants and the biofilm layer that is composed of microbial communities within laboratory-scale wetland treatment reactors. The reactors will be given two different types of synthetic wastewater (one having high chemical oxygen demand (COD) and the other without it), the goal is to identify the relationship between the biofilm layer and the water quality of the treated synthetic wastewater, with also looking at the impact of seasonal temperature changes on the biofilm layer. The column reactors contain wetland plants designed to treat wastewater on a mesoscale (medium scale). The biofilm layer that grow on the roots will provide insight on how the microbial communities behave with different plant species and varying types of synthetic wastewater. This project will provide needed data on microscopic depth, the distribution of the biofilm, and the root size, to a study the microbial reaction rates that drive wastewater treatment. Cryosectioning and staining the microbial community will provide a clear image of the configuration and the size of the biofilm that develops on the roots at a cellular level. By using dry ice and an embedding compound to freeze the samples it will minimize any ice crystal formation and allows to cut the root in equal cross sections.

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Immunological Response to the Influenza Vaccine

Biology - Time: Mon 3:00pm-4:00pm - Session Number: 2625
Emiliano Hernandez, Julia Wellham, Neha John-Henderson, Laura L. Johns, Agnieszka Rynda-Apple, Department of Microbiology and Immunology, Department of Psychology Montana State University, Bozeman, MT 59718
Emiliano Hernández, Julia Wellham

This project focuses on determining how social hierarchy influences the body's response to the annual influenza vaccine. A group of sixty students who received the influenza vaccine in 2017 participated in the study. A survey was administered to measure how students viewed their social standing. Blood samples were taken at timepoints zero (prior to receiving the vaccine), one month, and three months. Additional surveys were completed by the students at the one month and three-month timepoints to judge their overall health. The relationship of interest in this study was that between the immunity induced by the seasonal influenza vaccine and the participants' perceived social standing. Researching this component of influenza immunity offers a more holistic approach to future influenza prevention and

treatment. The scope and pathogenesis of influenza infection may be further elucidated by drawing on factors (e.g. perceived social standing) that may influence immunity to influenza virus. The goal of the project is to begin preliminary research on how one's social hierarchy might impact the efficacy of the seasonal influenza vaccine. This was determined by measuring antibody titers (immunoglobulin G) of serum samples with ELISA (enzyme linked immunosorbent assay). In addition, hemagglutination inhibition assays (HAI) were performed on serum samples to obtain HI (hemagglutination inhibition) titers. Immunoglobulin G (IgG) antibodies specific to each of three influenza strains (based off the three inactivated strains within the trivalent 2017-2018 vaccine) was targeted with ELISA and each component of the trivalent vaccine was tested with HAI. Data collected thus far display a variety of trends. For ELISA, the most recurrent trend is a low antibody titer at time zero and a sudden increase in seroconversion at one month and three months. Correlating immunity with survey responses is under progress.

This project focuses on determining how social hierarchy influences the body's response to the annual influenza vaccine. A group of sixty students who received the influenza vaccine in 2017 participated in the study. A survey was administered to measure how students viewed their social standing. Blood samples were taken at timepoints zero (prior to receiving the vaccine), one month, and three months. Additional surveys were completed by the students at the one month and three-month timepoints to judge their overall health. The relationship of interest in this study was that between the immunity induced by the seasonal influenza vaccine and the participants' perceived social standing. Researching this component of influenza immunity offers a more holistic approach to future influenza prevention and treatment. The scope and pathogenesis of influenza infection may be further elucidated by drawing on factors (e.g. perceived social standing) that may influence immunity to influenza virus. The goal of the project is to begin preliminary research on how one's social hierarchy might impact the efficacy of the seasonal influenza vaccine. This was determined by measuring antibody titers (immunoglobulin G) of serum samples with ELISA (enzyme linked immunosorbent assay). In addition, hemagglutination inhibition assays (HAI) were performed on serum samples to obtain HI (hemagglutination inhibition) titers. Immunoglobulin G (IgG) antibodies specific to each of three influenza strains (based off the three inactivated strains within the trivalent 2017-2018 vaccine) was targeted with ELISA and each component of the trivalent vaccine was tested with HAI. Data collected thus far display a variety of trends. For ELISA, the most recurrent trend is a low antibody titer at time zero and a sudden increase in seroconversion at one month and three months. Correlating immunity with survey responses is under progress.

Impact of 12-weeks of Lentil Consumption on Visceral Adipose Tissue in Overweight and Obese Adults.

Health & Human Development - Time: Tue 3:30pm-4:30pm - Session Number: 5110
Sofia R. Whitefields, Kaitlyn Weinheimer, Stephanie Wilson, Marcy E. Gaston, Mary P. Miles, Ian Dyson, Health and Human Development (HHD),Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Sofia Whitefields, Kaitlyn Weinheimer

Increased visceral adipose tissue (VAT) is associated with elevated risk for cardiovascular disease. Fiber offers protective benefits and is inversely related to VAT volume. Fiber-rich and low-fat, lentils may be

an ideal dietary strategy to benefit populations most at-risk for developing chronic disease. In this preliminary analysis, we hypothesize that long-term fiber intake via lentil consumption in heavier adults reduces VAT volume. Adults (n=8) with a waist circumference greater than 35 and 40 inches for women and men participated in a 12-week dietary intervention. Participants received 7 mid-day meals with 0 (control) or 3 cups of total lentils each week, but were otherwise asked to maintain normal diet and exercise patterns. VAT was measured pre- and post-intervention using the SECA mBCA 515 analyzer. Participants also completed an online diet history questionnaire pre-and post-intervention to quantify habitual added sugar, fiber, and total caloric intake. Average time in moderate to vigorous physical activity (MVPA) was assessed through an accelerometer worn for 7 days during the first and last intervention week. Changes in VAT were assessed through a mixed-effects model accounting for average MVPA, habitual added sugar and, total caloric intake. The volume of VAT did not differ between lentil and control groups after 12-weeks of receiving mid-day meals ($p=0.43$), after accounting for MVPA, total caloric intake, and habitual added sugar consumption. Habitual added sugar ($p=0.19$) and caloric intake ($p=0.24$) did not impact VAT volume. Similarly, average MVPA did not impact VAT ($p=0.50$). While we accounted for interindividual differences in VAT, our preliminary analysis had a small sample size which makes it difficult to detect potential diet-induced changes. More participants may provide us with more conclusive evidence. Investigating long-term fiber intake may have important applications for reducing chronic disease risk.

Funding supported by USDA-ARS Pulse Crop Health Initiative 58-3060-9-040

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Funding supported by USDA-ARS Pulse Crop Health Initiative 58-3060-9-040

Inhibition of Human Inflammatory Responses by Methicillin Resistant Staphylococcus aureus (MRSA)

Microbiology - Time: Tue 5:00pm-6:00pm - Session Number: 5631

Alexander Parks, Jennifer Dankoff, Kyler Pallister, Dr. Tyler Nygaard, and Dr. Jovanka Voyich, Department of Microbiology and Immunology, Montana State University, 109 Lewis Hall, Bozeman MT 59717
Alexander Parks

Methicillin resistant *Staphylococcus aureus* (MRSA) is a common human pathogen that causes a wide range of diseases and is known to be able to evade killing by human neutrophils. The SaeR/S two component system of *S. aureus* controls secretion of proteins that disrupt neutrophil function. It has been previously demonstrated that suppression of the NF-κB inflammatory pathway is linked to SaeR/S through an unknown mechanism. In the current study, we investigate the hypothesis that inhibition of the pro-inflammatory NF-κB pathway in human neutrophils is due to a SaeR/S-regulated secreted factor. To assess the inhibitory effects of SaeR/S secreted proteins, human blood was inoculated with filtered (0.2µm) supernatant from overnight cultures of both wild-type (USA300) and isogenic mutant strains including: Δ*saeR/S*, Δ*agr*, and knockouts of select toxins regulated by SaeR/S. Ongoing experiments are investigating NF-κB activity in neutrophils using an anti-NF-κB antibody (NF-κB p65) and activity is being evaluated using flow cytometry. Preliminary studies indicate a secreted factor regulated by SaeR/S, and not Agr, reduces NF-κB activity by ~40%. This activity is no longer seen when supernatant undergoes protein digestion with Proteinase K, indicating the secreted factor is a protein. This trend of SaeR/S-mediated NF-κB repression is conserved between two clinically relevant *S. aureus* strains, USA300 and USA400. Additional experiments are ongoing using methods to measure membrane permeability, size exclusion assays, and a comparison of additional clinically relevant strains to assess conservation of this protein. In conclusion, the inhibition of NF-κB signaling pathways in neutrophils is caused by a SaeR/S mediated protein. Future work includes identifying the gene coding for this inhibitory protein and generating a knockout strain to confirm it. Identifying the mechanism behind NF-κB inhibition could provide novel MRSA treatment options as well as therapeutics for inflammatory disorders.

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Investigating Transitions of Transition Metal Doped Materials at Wavelengths Close to 1550nm for Quantum Information Applications

Physics/Astronomy - Time: Wed 12:00pm-1:00pm - Session Number: 937
Z. Noble, K. Olson, A.D. Marsh, P.J.T. Woodburn, C.W. Thiel, and R.L. Cone
Zoe Noble

The energy level structure and relaxation dynamics of transition metal ions doped into crystal and semiconductor host materials were investigated using optical spectroscopic techniques to identify materials with transitions in the 1.5 micron telecommunication wavelength band for quantum information science (QIS) and photonic signal processing. Emerging applications in QIS, such as quantum memories, require materials that provide optical and spin transitions with long lifetimes, narrow linewidths, and ultra-low quantum decoherence, particularly at telecom wavelengths compatible with existing optical fiber networks. Past research into materials for these applications has focused on rare-earth ions doped into crystals due to their well-established and well-understood properties. These traditional materials, however, are often incompatible with existing chip-scale integrated optical and electronic architectures. In contrast, transition metal ions can be readily incorporated into many existing semiconductor materials ideally suited for the fabrication of integrated devices. With that motivation, we conducted a large-scale spectroscopic investigation of the infrared optical transitions of transition metal ions in a range of potential materials. Absorption and fluorescence spectroscopy were used to investigate materials such as Fe:LiNbO3 at temperatures down to 4K to identify promising transition metal ion and crystal host material combinations with narrow linewidths near 1.5 microns. The fluorescence lifetimes and quantum decoherence of selected materials were investigated using techniques such as time-dependent fluorescence and photon echoes to investigate the compatibility of these materials with quantum device applications. These studies identified several promising material systems and demonstrated that some of the previously unexplored ions can offer transitions in technologically important wavelength ranges.

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Investigation of Complete Groundwater Denitrification Utilizing an Environmentally Relevant Bacterial Co-culture

Biology - Time: Mon 3:00pm-4:00pm - Session Number: 2627

Uve Strautmanis, Heidi Smith, Sara Altenburg, and Matthew Fields, The Center for Biofilm Engineering and The Department of Microbiology and Immunology Montana State University, Bozeman MT, 59717
Uve Strautmanis

Primary motivations for studying the subsurface are to expand what is known about Earth's microbial diversity and the subsurface microorganisms under low nutrient conditions that significantly impact C, S, N, P and mineral cycles. One such biogeochemical cycle of importance to groundwater systems is microbial denitrification, the reduction of nitrate (NO3-) from organic and inorganic sources back to atmospheric nitrogen (N2). However, little is known about the extent of microbially-mediated denitrification in groundwater environments. The key to harnessing microbial potential is to find the optimal set of parameters that promotes enhanced rates of denitrification, which is what this work aims to accomplish. In anaerobic environments, oxygen is not readily available for respiration, therefore microbes must use alternative electron acceptors such as NO3- to respire, reducing NO3- to N2. To investigate the environmental parameters that influence denitrification this work uses a co-culture of Rhodanobacter sp. R12 and Acidovorax sp. 3H11 that when grown together, can complete full biotic denitrification. Batch experiments mimicking field conditions were run using the Rhodanobacter sp. R12 and Acidovorax sp. 3H11 co-culture under varying pH values (5 and 7), dissolved oxygen concentrations (anaerobic, 2mg/L, and 5mg/L), carbon sources, and amino acids. Samples were analyzed for growth performance, nitrate reduction, and single cell analysis including the integration of stable isotope probing with Raman Microspectroscopy and the identification of individual microbial cells and fluorescent in-situ hybridization (FISH). This will quantitatively track the abundance of individual organisms across treatments. Higher rates of denitrification are expected to occur when the organisms are grown together and in anaerobic conditions at a pH of 7.

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Investigation of Graphitic Coatings as an Anticorrosive on Copper and Nickel Foils

Physics/Astronomy - Time: Wed 1:30pm-2:30pm - Session Number: 1032
Elizabeth Vinson, Breanne Hodgson, Nathaniel Rieders, Recep Avci Physics Department Montana State University P.O. Box 172000 Bozeman, MT 59717-2000
Elizabeth Vinson

The anticorrosive effects of various thicknesses of graphitic coatings on copper and nickel foils were evaluated using scanning electron microscopy, auger spectroscopy, and x ray photospectroscopy. To observe these effects, the foils were placed in bioreactors with aerobic and anaerobic bacteria and removed after various times of exposure. The foils were then examined for biofilm growth and corrosion with the naked eye and then under cryostage and standard scanning electron microscopy. The surface composition was then analyzed using both auger spectroscopy and x ray photospectroscopy. The spectra were compared to discern any changes in surface composition over the exposure time. These changes were compared between the various coating thicknesses. On nickel foils, the graphene coating limited the growth of biofilms, suggesting possible protection against biocorrosion. On copper foils, extensive corrosion was observed on the uncoated foil, intergranualar corrosion was observed on the 6-8 layer graphene coated sample, and no significant degradation was observed on the monolayer graphene coated foil. Additional experiments seek to obtain electrochemical measurements while the foils are in the biocorrosion reactors to gain further insight into the rate of corrosion during exposure. The corrosion rates are expected to be slowest on monolayer coated samples as long as it maintains its integrity. This research is of commercial interest as the vast cost of corrosion to global economies has driven a demand for an understanding of fundamental processes and prevention strategies. Of particular concern, is microbial influenced corrosion (MIC), whereby micro-organisms accelerate the rate of corrosion. (Dall'Agnol et al, 2014) The use of single and multilayer graphene as an anticorrosive coating has recently attracted attention within the corrosion science community. This is in part due to the varied and unique properties of graphitic materials. (Ye et al, 2015)

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Lamar Buffalo Ranch Micro-District

Mechanical & Industrial Engineering - Time: Tue 5:00pm-6:00pm - Session Number: 5598
Megan Oaklief, Kevin Amende, Mechanical and Industrial Engineering, Montana State University, Bozeman, Mt, 59715
Megan Oaklief

The picturesque Lamar valley in Yellowstone National Park (YNP) houses the Lamar Buffalo Ranch (LBR), a small off-grid educational campus serving as a test site for renewable energy systems with the goal of becoming fossil fuel free.

The LBR site was chosen due to its small population of buildings and lack of connectivity to power and gas grids. In 2014, YNP partnered with MSU to develop power and gas metering system for a new battery array put in to the ranch. This array was designed to be charged by a micro-hydro generator and photovoltaic solar panels. The final system will include a user interface for facility users to monitor building energy consumption and production as well as data visualization and analysis capabilities. This analysis will be ultimately utilized by LBR to enact appropriate changes to the system to become fossil fuel free in energy production.

Over the course of my internship at LBR I have acquired the skills necessary to both analyze and find effective solutions for a micro-district system. I learned how to program web interfaces to employ data collection software such as MangoEs, DTS310, and DTSSMX. By knowing how the software for each of these devices worked, I was able to cross reference the collected data with the metered production. For example, inconsistencies between past and current campus consumption data were discovered. The process for determining the cause involved proving the accuracy of production data from the micro-hydro, solar array, and propane tank. These inconsistencies were usually found to be caused by loose wiring, incorrect coding, or misplacement of monitoring equipment.

Ensuring accurate data collection for both consumption and production is important for informed decision-making. This new system will allow the Yellowstone National Park facility to move towards solely relying on renewable energy resources.

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Ensuring accurate data collection for both consumption and production is important for informed decision-making. This new system will allow the Yellowstone National Park facility to move towards solely relying on renewable energy resources.

Mars Glider Swarm Design and Testing at NASA Armstrong Flight Research Center

Engineering - Time: Tue 5:00pm-6:00pm - Session Number: 821
Alex Healy, Dr. Angela Des Jardins, Department of Physics, Montana State University, Bozeman, MT, 59715
Alex Healy

Mars Glider Swarm is a spinoff of the PRANDTL-M (Preliminary Research AerodyNamic Design To Land on Mars) project. PRANDTL-M investigated the concept of a glider design using the proven wing twist technology from the PRANDTL-D (Preliminary Research AerodyNamic Design To Lower Drag) project that could be flown in the atmosphere of Mars. In the summer of 2019, the team was tasked with finding the spread and payload of a swarm of gliders sent to Mars, given a set launch mass. To investigate this, past glider designs were modified and flight tested to gain familiarity with the system and to put bounds on the controllability of the aircraft, and a new glider was designed and flight tested to find the spread and payload of a glider swarm. The new glider must fit in a small enclosure, unfold, and carry as much payload as far as possible in the thin atmosphere of Mars. It was designed with the wing twist necessary to create proverse yaw, which allows it to fly without a vertical tail and be folded into a smaller package. It must be thin enough to fly in the thin atmosphere of Mars while containing the components necessary to control its flight. The data obtained from flight testing will inform future research into the possibility of flying fixed-wing gliders on Mars.

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Mathematical Modeling of a Disease Detection Assay

Mathematics - Time: Tue 5:00pm-6:00pm - Session Number: 5566
Shannon Murphy, Dr. Tomas Gedeon, Dr. Stephanie McCalla, Deparment of Mathematical Sciences, Montana State University, Bozeman, MT, 59717
Shannon Murphy

Disease detection is greatly aided by detection of biomarkers specific to that disease. In the past decade a new
class of biomarkers has been discovered. These microRNA (miRNA) are RNA molecules that consist of only about
22 nucleotides. Because of their small size and very low concentration in the bloodstream, it is necessary to first
amplify it, i.e make a large number of copies. A new amplification method called UDAR was created to detect
these biomarkers, and it is necessary to create a mathematical model of the reaction to quantify the process and
understand what levels correlate with the presence of a biomarker. Through the composition of a system of
differential equations and the use of Matlab, reaction rates are being fit to experimental data.

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Middle Cambrian Trilobites of the Horseshoe Hills, Montana: Taxonomy and Taphonomy

Geography/Geology - Time: Tue 3:30pm-4:30pm - Session Number: 5068
Hunter C. Olson, and Dr. David Varricchio, Earth Science Department, Montana State University, 226 Traphagen Hall, Bozeman, MT 59717-3480
Hunter Olson

Although Cambrian outcrops are extensively exposed in western Montana, relatively few studies have been conducted on the trilobites from these strata. The last thorough description of the trilobites of Montana was published by Charles F. Deiss in 1939 and focused on specimens from the northwestern part of Montana. Since that publication, many taxa have been synonymized or reclassified. Here, I present new information on the trilobite fauna known from the Middle Cambrian rocks near the town of Manhattan in southwestern Montana. The composition of 174 samples in the paleontology collection at

the Museum of the Rockies, Montana State University includes three orders (Corynexochida, Agnostida, Ptychopariida) and four families of trilobites (Dolichometopidae, Dorypygidae, Alokistocaridae, Ptychopariidae). These trilobites, though typically found as shed elements, are generally well preserved, facilitating identification. The quality of preservation and coloration of these trilobite shells exhibits some variation due to mineral replacement. In addition to trilobites, brachiopods, a scenellid mollusk and one sponge are also represented. These trilobites and other organisms were deposited on a shallow marine shelf, on the western margin of the North American craton. The dataset includes species indicative of the Bathyuriscus-Elrathina biozone and are comparable to those of the Wheeler Shale in Utah, the Spence Shale in Utah and Idaho, and the Burgess Shale in British Columbia. As Montana is situated between the well-explored Middle Cambrian strata of northwestern Canada and the southwestern United States, these specimens are crucial to understanding faunal and biogeographical transitions between these regions.

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Montana Culinary History During the Great Depression

History - Time: Tue 3:30pm-4:30pm - Session Number: 729
Emily O'Brien, Mary Murphy, Department of History and Philosophy, Montana State University Bozeman, Culbertson Hall, 100, Bozeman MT 59717
Emily O'Brien

The “America Eats” project of the Federal Writers’ Project provides a window into American foodways during the Great Depression. My project seeks to explore how the Depression affected foodways in Montana, how food traditions persisted and what economic hardships changed. Additionally, this research paper is my senior Capstone project, prior to my graduation with degrees in History and English from MSU. This paper combines Montana history and literary analysis of how writers told the stories of Montana food. My oral presentation is based on extensive research in primary source documents from the Montana State University archives, the digital archives at the Library of Congress and the “What America Ate” website run by Michigan State University. The goal of this government project was to publish a book on American foodways (as designated by five distinct regions) but due to the outbreak of WWII, the project was cancelled. The documents at MSU are a record and history of

foodways in the Far West region, which included Montana. Unemployed writers wrote in a story-telling format, including recipes collected throughout the region. I also draw upon secondary literature of the Federal Writers' Project and the Great Depression. At this time, there is no published writing on the Montana "America Eats" project, so my work makes an original contribution to this subject. The data and information in my research, including that of the archival records suggest that Montana had a rich culinary history that contributed to the region's palate. These stories also highlight Montana writers, whose background often came from writing local literature and history and who (in the context of this project) became pioneers of the food writing genre. This substantive research paper will offer a detailed look into Montana food history during the Great Depression era.

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Nutritional Supplementation to Increase Fertility and Pregnancy in Montana Yak

Agriculture & Extension - Time: Mon 1:30pm-2:30pm - Session Number: 2002
Naomi Redfield, Bob Sager, Department of Animal and Range Sciences, Montana State University-Bozeman, PO Box 172900, Bozeman, MT 59717
Naomi Redfield

Estrus is a recurring period of sexual receptivity and fertility in females, (commonly referred to as heat). The purpose of this nutritional research on female Yaks is to test the hypothesis that increased nutrition fed for 45 days before breeding will increase estrus and therefore, increase fertility rates for a Yak herd near Kalispell, Montana. The pregnancy rate directly influences productivity and economics in this herd. Previous fertility rates of this Yak herd had a less than 30% success in pregnancy four months after breeding. Pregnancy was determined by progesterone assay from blood collected at 4-5 months gestation. This year a custom cake ration was formulated and fed to the female Yaks 45 days before breeding and continued throughout the breeding cycle of 50 days. The custom cake feed was formulated with nutrients designed to increase estrus for the female Yaks. The cake was fed at a rate of one pound per head per day and increased at a rate of 10% weekly until an intake of 3.5 pounds was fed daily. The cake that was formulated to be composed of wheat middling (30%), corn cracked (24%), DSS (distillers solubles at 20%), molasses, a custom mineral, and soy hulls (combined at 26%). The custom

mineral and cake were formulated by a nutritionist, based on a forage and water analysis from the ranch and designed to supplement the needed requirements of the female Yak. Breeding started July 15, 2019 and continued until after September 5, 2019. Positive pregnancy testing was determined by a blood progesterone assay that was completed in December 2019. The expected increased pregnancy rates were to be a 50-60% improvement over the previous years following progesterone results. The final result from the progesterone assay was 71% of the female Yaks were pregnant.

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Phenological Shifts in Monarch Nectar Resources

Biology - Time: Wed 1:30pm-2:30pm - Session Number: 1004
Nathan Morrow, Dr. Diane Debinski, Department of Ecology, Montana State University, Bozeman, MT 59717-3460
Nathan Morrow

Anthropogenic climate change has led to a measurable rise in annual temperatures over the past two centuries, resulting in shorter, warmer winters and earlier arriving summers. Such changes have been determined to affect the timing of life history events (phenology) in plants and animals across the globe. In this project, we will test for phenological shifts in nectar species availability for Midwestern Monarch butterflies from 1858 to the present. We will categorize life stages (vegetative, buds, buds and flowers, flowers, flowers and fruit, fruit) for thousands of historical herbarium records dating back to the mid 19th-century using archived online photos. Analysis to determine the extent to which prairie plant phenology is shifting will be done using species-specific linear regressions and comparison of data trends before and after climate change effects became manifested. We will examine a baseline time period prior to anthropogenic climate change (t1: 1858-1975) and a recent time period during which climate changes were large (t2: 1985-present).

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Photogrammetric Reconstruction of Roof Snow Load

Geography/Geology - Time: Tue 3:30pm-4:30pm - Session Number: 5064
Madeline Beck, Roxanne Holmes and Eric Sproles, Department of Earth Science, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Madeline Beck, Roxanne Holmex

In March 2019, two flat-roofed recreational gyms of the Marga Hosaeus Fitness Center at Montana State University collapsed. While the accumulated snowpack was above average at that time, these collapses were not expected based on the current understanding of total load capacity. Therefore, our innovative project is designed to provide facilities management with accurate snow load and depth measurements on a selection of flat-roofed buildings around campus to complement their existing systems of measuring roof collapse risk. This project uses Unmanned Aerial Vehicles (UAVs) to measure snow depth using photogrammetric reconstruction. UAV technology is still new and has not yet been applied to monitor rooftop snow. To gather the data, UAV flights are conducted over the buildings of interest and a series of geo-located photos are taken in a predetermined flight path. Photogrammetric processing of the photos constructs a 3-D model of the buildings and their roofs without snow. Later 3-D models with snow present provide maps of snow depth on the rooftops at sub-meter resolution. The snow depth maps are combined with snow density measurements from a rooftop snow scale and snow depth sensor to provide a map of snow load for the buildings selected. This map is shared with facilities management through a web-based interface to identify if, when, and where snow mitigation is necessary on existing buildings.

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Real-Time Auditory Nerve Modeling Using System-On-Chip Field-Programmable Gate Arrays

Electrical & Computer Engineering - Time: Tue 2:00pm-3:00pm - Session Number: 4530
Matthew Blunt, Dr. Ross Snider, Department of Electrical and Computer Engineering, Montana State University, Bozeman MT USA 59717
Matthew Blunt

For well over forty years, numerous researchers have provided meaningful contributions to auditory nerve research. This research has culminated in a phenomenological model of the synapse between the inner hair cell and auditory nerve. However, the latest version of this model replicates the behavior of only a single auditory nerve in MATLAB. Therefore, to simulate multiple auditory nerves, researchers are limited to running multiple models sequentially. As the number of auditory nerves increases, these simulations become infeasible due to long runtimes. To address this problem, we are developing a hardware-accelerated version of the auditory nerve model that runs on an open source System-on-Chip (SoC) Field Programmable Gate Array (FPGA) development platform. Due to the inherently parallel nature and low, deterministic latency of FPGAs, our approach allows for multiple auditory nerve models to run simultaneously in real-time. We demonstrate multiple auditory nerve responses to live audio signals running on our hardware platform in real-time. Modeling multiple auditory nerve fibers in real-time will provide important insight into model accuracy under more realistic conditions. In addition, our hardware-accelerated model will allow researchers to edit model parameters and view differences in nerve responses in real-time, enabling faster development of better auditory nerve models. In the future, the open-source SoC FPGA platform will provide auditory researchers with a low-cost, high-performance tool with which to develop and test new models and algorithms.

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Senior Capstone Courses as Undergraduate Research Groups

FAN - Faculty Only
Gregory Young, School of Music, Montana State University, 182 Howard Hall, Bozeman MT 59717
Gregory Young

To better integrate undergraduate research into the curriculum, the most effective approach is to require it for graduation. We have all heard of think tanks and research groups, and I recommend converting capstone courses as such. Like a hybrid course that combines independent study and team collaboration, students can meet once a week as a class with the faculty mentor, check in either online or in person once a week with that professor, and get full course credit for completing a research project. This required course ensures that every student has the experience, and the professor gets teaching load credit. Much like some universities whose administrators tally independent study mentoring and give a course release for about 9 independent projects, this formalizes that arrangement, as long as a maximum limit of 9-12 students per class is enforced. The students can be given a choice of helping with a faculty research project or choosing their own topic. Examples will be shown of both of these models, the former resulting in published scholarship, and the latter resulting in presentations at national and international conferences. Referring to the Routledge Undergraduate Research Series that this presenter has co-authored, discussions will be encouraged that explore the practical implementation of this model in a variety of disciplines.

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Staphylococcus aureus and Human Neutrophil Interactions

Microbiology - Time: Tue 5:00pm-6:00pm - Session Number: 5636
Sarah Mad Plume and Dr. Jovanka Voyich, Department of Microbiology and Immunology, Montana State University, 109 Lewis Hall, 59717-3520
Sarah Mad Plume

Staphylococcus aureus is a major human pathogen that can colonize in superficial wounds and can even invade deeper into the human body and cause life threatening infections. The clinical significance of *S. aureus* has dramatically increased over the years due to the emergence of antibiotic resistant strains, making it harder to treat patients infected with this pathogen. Bacteria have virulence genes that are controlled by the SaeR/S two-component system, and Dr. Voyich's lab has preliminary data that indicates a mutation in this system could alter its gene expression. We investigated how mutations in the SaeR/S system of *S. aureus* impact its virulence gene expression. Although the pandemic interrupted our research, it was determined through previous studies and literature reviews that the SaeR/S two-component system in *S. aureus* is vital for the evasion of human neutrophils. The findings in this study could potentially lead to more insight on how to treat these infections caused by this bacteria.

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Stories and Solidarity: A Public History Exhibit

History - Time: Tue 5:00pm-6:00pm - Session Number: 829

Morgan Craig, Dr. Molly Todd, Department of History and Philosophy, Montana State University, P.O. Box 172320, Bozeman, MT 59717-3440
Morgan Craig

In this historical research project I combined independent research with digitized photographs and documents from The Project Solidarity Archive at Montana State University to create an online exhibit about the history of solidarity in El Salvador. This project focuses on the relationship between the United States and El Salvador beginning with the El Salvador Civil War and continuing into solidarity work in the present day. This research is in collaboration with a nonprofit solidarity organization, US El Salvador Sister Cities (USESSC) as well as a graduate student in history. The project will provide the USESSC organization with educational material for their outreach and work both in the United States and El Salvador. Through this project I am cultivating historical research skills, curation skills, and technological skills by building an exhibit with a digital exhibit platform. This project has a significant impact on a large community. It applies historical thinking by connecting past stories with the present outside of a traditional academic setting. The work also shares photographs and historical documents with the public. Photographers and members of USESSC donated these materials with the hope that they could contribute to educating a larger community. The focus of my presentation will be the process of researching, curating, and presenting an online public history exhibit as well as the transnational collaboration of the project. Overall, the exhibit intends to contextualize the events of the El Salvador Civil War and the role of solidarity through community histories and personal testimonies with the intention of reaching new audiences and showcasing the power of public history.

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The Influence of Predation History on Bobwhite Quail Reproductive Behavior

Ecology - Time: Tue 12:30pm-1:30pm - Session Number: 4082

Will Rogers, Department of Ecology, Montana State University, 310 Lewis Hall, Montana State University, Bozeman, MT 59717, USA; Theron Terhune, Tall Timbers Research Station and Land Conservancy, 13093 Henry Beadel Drive, Tallahassee, FL 32312, USA; Scott Creel, Department of Ecology, Montana State Univerisity, 310 Lewis Hall, Montana State University, Bozeman, MT 59717, USA.
Will Rogers

Nesting success is a powerful limiting factor of population growth in many avian species. In landscapes with heterogeneous risk of nest failure, individuals are thought to maximize fitness by selecting nest sites with minimal relative risk.; however, the relationship between nest site selection and the risk of predation remains poorly understood. We analyzed multiple course-scale attributes over successive, within-year nesting events of northern bobwhite quail (*Colinus virginianus*) to answer whether individuals alter nest site selection and reproductive behavior in response to past nest predation. From 2000 to 2017, we documented all instances of within-year, successive nesting attempts by radio-tagged quail (N=342), recording clutch sizes of nests, date of incubation initiation, date of nest failure or hatch, and predation type. We also assigned habitat-level attributes using geospatial methods after data collection. Initial logistic modeling efforts provided evidence that bobwhite quail did not alter habitat selection of second nest sites based on predation of first nests (z = 0.282, p-value = 0.772). However, strong behavioral responses to predation were suggested by linear models of shifts in clutch sizes (F(1,275) = 7.624, p-value= 0.006) and distances between first and second nests (F(1,272) = 4.076, p-value = 0.044). We are now using Bayesian resource selection functions coupled with multi-state models to further analyze how nest site selection differs between nesting attempts and if such differences are attributable to predation responses. We will provide the results of current modeling efforts and our conclusions regarding the relationship of nest site selection and predation risk, where we expect that predation of first nesting attempts relates to differences in resource selection of successive nesting attempts.

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Toward the Synthesis of Nano-Zeolite-Templated Carbons

Chemistry - Time: Tue 11:00am-12:00pm - Session Number: 3527
Kaitlin Garman, Erin E. Taylor, and Nicholas P. Stadie, Department of Chemistry, Montana State University, PO Box 173400, Bozeman, MT 59717.
Kaitlin Garman

Zeolite-templated carbons (ZTCs) are carbon framework materials with short-range disorder and long-range pore-to-pore order with many interesting properties. ZTCs are typically synthesized by impregnating a micron-scale, commercially available, faujasite-type zeolite template with furfuryl alcohol, pyrolyzing the material at high temperatures, and removing the template in acid. The resulting materials are locally amorphous and carbon packing is lower than predicted by pore-filling, indicating imperfect carbon templating. Instead, the synthesis and templating of nano-sized zeolites could yield zeolite-templated carbons with more accurate templating as a result of shorter diffusion pathways between pores, resulting in more homogenous precursor filling and less pore-blocking leading to undesirable outer particle graphitic deposition. Herein, we demonstrate the synthesis and characterization of monodisperse zeolite nanoparticles and subsequent synthesis of nanoscale ZTC.

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Untargeted Metabolomic Analysis of AMPKalpha1 knockout mouse knees reveals sexual dimorphism in osteoarthritis progression

Biological & Chemical Engineering - Time: Mon 3:00pm-4:00pm - Session Number: 2532
Soumilee Chaudhuri,Dr.Ru Liu-Bryan and Dr. Ronald K. June,Department of Mechanical & Industrial Engineering, Montana State University Bozeman, 220 Roberts Hall, Bozeman MT- 59715 *Dr. Ru*

Liu-Bryan, Divison of Rhuematology,Allergy, and Immunology ,UC San Diego School of Medicine, 9500 Gilman Drive, mail code 9111K, San Diego, CA 92093
Soumilee Chaudhuri

Osteoarthritis (OA) is a chronic degenerative disease of articular cartilage and other joint tissues. It is highly prevalent, affecting more than 27 million individuals in the United States. Being a chronic ailment, there is currently no cure for osteoarthritis, although treatments are available for partial management of symptoms and for relief. Sex-specific and metabolic associations in the origin and severity of osteoarthritis have been matters of extensive research, and OA is more prevalent in women than men. The goal of this project is to explore metabolism in osteoarthritis by studying the sex-specific differences in metabolomic profiles of Wildtype (WT) and AMPKalpha1 mutant (KO) mice, as AMPKalpha1 is a master regulator of metabolism. Metabolomic profiling detects metabolites derived from biological processes, and the analysis of the metabolites from these samples provides critical information about metabolic pathways that are perturbed during OA development. The results of untargeted metabolomic study of whole joint tissues of Wild-Type (WT) and AMPKalphal knockout (KO) mice established a connection between energy metabolism pathways and joint aging. Global metabolomic profiles were generated based on 2157 metabolite features detected in the whole-joint extracts of wild-type and alpha-Ampk KO mice.Metabolism of essential amino acids (arginine, proline,etc) was higher in female KO mice;female mutant mice also showed a cluster of low intensity metabolites.These data provided insight into AMPK function in aging joints and revealed elevated metabolic pathways in female mutant mice; this implied sex-specific differences in the prognosis of OA, and an intricate connection amongst AMPK mutation, sex, and osteoarthritis development. A comprehensive understanding of OA pathogenesis in female AMPK mutant mice, would be instrumental in developing targeted novel therapies for prevention of osteoarthritis. The long term goal is to identify disease biomarkers and engineer appropriate therapeutic interventions to slow the development of osteoarthritis.

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Using Glycopolymers to Study the Role of Galectin-3 in Cancer Progressions for Applications in Ovarian Cancer

Biochemistry - Time: Mon 1:30pm-2:30pm - Session Number: 2132
Samantha Hansen, Hazal Evans, and Dr. Mary Cloninger Department of Chemistry and Biochemistry, Montana State University 103 Chemistry and Biochemistry Building Bozeman, MT 59717
Samantha Hansen

Treating ovarian cancers has become increasingly more difficult, as many ovarian cancer cell lines appear to have gained resistance to the platinum-based chemotherapeutic agents that are the current standard of care. Galectin-3 is a protein with strong implications in the progression of cancer, including tumor growth, angiogenesis, and metastasis. Expression of this protein in ovarian cancer has been correlated with the grade, clinical stage, recurrence, and platinum resistance. We intend to use lactose-functionalized PAMAM glycopolymers to bind and inhibit galectin-3, ultimately restoring the function of these chemotherapeutic agents. Our goal is to develop nontoxic glycopolymers which divert the protein from its targets of action, thereby overcoming resistance to platinum-based chemotherapeutic agents in treatment of ovarian cancer. Toward this aim, we are studying several cancer cell lines with varying amounts of endogenous galectin-3. Cancer cellular proliferation, cytotoxicity, and cellular viability in the presence of glycodendrimers, and chemotherapeutic agents are being studied. These assays will be performed using only the endogenous galectin-3 as well as with added galectin-3 to assess the impact of galectin-3 on processes involved in cancer progression. Understanding the role of galectin-3 as it functions in cancer cells during current standard-of-care therapies has the potential to dramatically improve the treatment of ovarian cancer.

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Using Hasse Diagrams to Compute a Gradient Vector Field

Computer Science - Time: Tue 12:30pm-1:30pm - Session Number: 4044
Dr. Brittany Fasy, Ben Holmgren, Brad McCoy, and Dr. David Millman, Department of Computer Science, Montana State University, Culbertson Hall, 100, Bozeman, MT 59717
Benjamin Holmgren

In computational geometry and topology, simplicial complexes are widely used structures that model abstract spaces. A simplicial complex is a set of n-dimensional generalizations of triangles, called simplices. Discrete Morse functions assign real numbers to each simplex in a simplicial complex. One of the goals of Discrete Morse Theory is to generate gradient vector fields along the mappings of a function on a simplicial complex. These gradient vector fields use vectors on a simplicial complex to display how function values change throughout the complex. As a result, gradient vector fields can be thought of as indicating the "flow" of a simplicial complex. To add intuition, we can imagine a mountain range as a simplicial complex, with a corresponding Morse function acting as a map to different heights in that mountain range. That complex's gradient vector field tells us where water would flow on that mountain range if we were to drop a bucket of water at any point. Constructing gradient vector fields is also extremely useful when studying the topology of a simplicial complex. However, we hypothesize that prevailing algorithms generate gradient vector fields with doubly exponential time complexity. We are proposing new algorithms that can compute gradient vector fields with improved time complexity. To do so, we have utilized Hasse Diagrams, a data structure that is convenient for storing a simplicial complex. Our algorithms make use of memoization techniques in a Hasse diagram in order to limit repetitive recursive calls prevalent in prior algorithms. Lastly, we are in the process of providing a thorough analysis of the time complexity of our algorithms alongside an analysis of current algorithms. In doing so, we expect to find novel contributions in understanding the time complexity of gradient vector field computation, alongside our addition of new algorithms to do so.

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Using Surface Plasmon Resonance to Measure Cooperative Binding of DNA

Biological & Chemical Engineering - Time: Mon 3:00pm-4:00pm - Session Number: 2533

Zachary Imel, Esther Stopps, Dr. Stephanie McCalla, Chemical and Biological Engineering, Montana State University, 211 Strand Union Bldg, Bozeman, MT 59717
Zachary Imel

Cooperative binding is an event that can occur in systems where more than one species can bind to a receptor. Binding in a system is positively cooperative if the binding of the first molecule improves the affinity of the binding of the second molecule. This change in affinity makes the second molecule binding event thermodynamically favorable. Many companies and laboratories know about the thermodynamics of positive cooperative binding and use this phenomenon in biosensors and in synthetic biology, but very little is known about the kinetics of positive DNA cooperative binding.

We are measuring the kinetics of cooperative binding of DNA molecules using surface plasmon resonance (SPR) with varying parameters of analyte concentration, looped vs non-looped DNA, and the species of analyte. The SPR sensor is a glass chip coated in a thin layer of gold nanoparticles, upon which a ligand DNA molecule is immobilized. Once the DNA is immobilized to the sensor surface, analyte DNA is added and binds to the multiple binding sites of the ligand DNA. A shift in the refractive index of light occurs when the analyte interacts and binds the ligand and is recorded by the SPR machine. Association and dissociation rates of the ligand and analyte can be calculated from the shift of the refracted index. We will use mathematical models to calculate kinetic rate constants of cooperative DNA binding. The mathematical models have applications in DNA circuits, DNA amplification reactions, and synthetic biology.

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Utilizing Selective Plane Illumination Microscopy to Investigate Cellular Mechanotransduction

Engineering - Time: Tue 2:00pm-3:00pm - Session Number: 4574

Joseph Marugg and Dr. Ronald June, Department of Mechanical and Industrial Engineering, Montana State University, 220 Roberts Hall, Bozeman MT 59718
Joseph Marugg

Osteoarthritis is a painful joint condition currently affecting more than 50 million Americans. It is caused by deterioration of cartilage and changes in cells, known as chondrocytes. Chondrocytes, through mechanotransduction, respond metabolically to mechanical stimulation experienced by cartilage during exercise. Moderate exercise has been strongly linked to better joint health and reduced risk of osteoarthritis. However, the biological mechanisms of chondrocytes driving tissue and joint homeostasis

are not well understood yet. The purpose of this work is to investigate the response of chondrocytes to mechanical stimulation and how that response might be utilized for medical treatment.

Currently, chondrocyte mechanotransduction remains a somewhat mysterious process. This is due to the difficulty involved with imaging living chondrocytes during and immediately after compressive loading. Selective plane illumination microscopy (SPIM) has not been applied to this field of study yet, but several aspects of SPIM make it promising here. First, using a thin sheet of light to illuminate an entire sample cross-section will facilitate rapid, large-scale imaging while minimizing out-of-focus light. Second, the light sheet will be scanned through layers of the sample to obtain three-dimensional data. Third, the SPIM setup sample chamber will have controlled temperature, fluid environment, and carbon dioxide level along with a method for applying cyclic compression to the chondrocytes being imaged. These three aspects will combine to enable real-time imaging of living chondrocytes responding to mechanical stimuli.

This method of observing cellular mechanotransduction will likely reveal mechanisms of how chondrocytes respond to compression. These data will utilize various fluorescent dyes to examine different signaling pathways in chondrocytes. The results of this work will be discussed within the context of what is already understood about chondrocyte mechanotransduction and how these effects may be utilized medically to restore damaged joint tissue.

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Zic Genes Involved in Convergent Extension

Biology - Time: Mon 3:00pm-4:00pm - Session Number: 2626

Jocelyn Waggoner, Christa Merzdorf and Jennifer Forecki, Montana State University, Culbertson Hall,

100, Bozeman, MT 59717
Jocelyn Waggoner

Convergent extension is a cellular movement during embryonic development, in which cells intercalate along an axis to allow changes in tissue shape. This lateral-to-medial movement of cells in a plane is required for gastrulation and neural tube closure. During gastrulation, cells migrate into the interior of the embryo at the dorsal lip of the blastopore. Knockout of zic transcription factors in mice results in defects in gastrulation, however, it is not understood by which mechanism mutations in zic genes cause these defects. The aquaporin 3b gene acts directly downstream of Zic transcription factors and is required for convergent extension. Based on published data in mice, I hypothesized that zic2 and zic3 regulate convergent extension via aqp3b. In Xenopus laevis, all five zic genes are expressed in dorsal blastopore tissue while it undergoes convergent extension. Dorsal mesoderm ('Keller') explants from gastrula embryos allow analysis of convergent extension in an isolated tissue. A knockdown method (using morpholino oligonucleotides) for each of the 5 zic genes was combined with the Keller explant method to study which of the very similar zic genes is required for convergent extension. Explants in which any one of the five zic genes was inhibited showed normal elongation/extension. Inhibition of zic1 or zic4 resulted in constriction defects in less than 35% of explants, and zic5 showed no constriction defects. However, inhibition of zic3 or zic2 resulted in 78.3% and 75.7% constriction defects respectively. This indicated that zic3 and zic2 expression is required for convergence cell movements, which has not been previously shown for zic genes. Furthermore, convergence defects caused by zic3 MOs and zic2 MOs were rescued with aquaporin 3b mRNA (reducing constriction defects to 29% and 19% respectively), suggesting that both zic2 and zic3 act through aqp3b to affect convergence. Future experiments will further explore this relationship.

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