TABLE OF CONTENTS

STUDENT RESEARCH CELEBRATION | SPRING 2023

MORNING POSTER PRESENTATIONS

MORNING POSTER PRESENTATIONS

SUB Ballrooms
9:30 a.m.–12:30 p.m.
—

Primary Author, Department; Mentor(s) ***Title***	**Poster**	**Page**
Anapaula Astorga Bedoya, College of Agriculture Mentor(s): Jennifer Lachowiec and Racheal Upton ***Analyzing Sustainable Nitrogen Levels for an Efficient Camelina Production***	01	21
Jaemarc Lumba, College of Agriculture Mentor(s): David Baumbauer ***The Performance of 10 Unique Crops Under Different Supplemental Greenhouse Lighting Solutions***	02	24
Mei Ling Wong, College of Agriculture Mentor(s): Jason Cook ***Validation of a quantitative trait locus for grain number per spike in spring wheat***	03	25
McKenna Hanford, College of Agriculture Mentor(s): Manbir Rakkar ***Montana's Newly Discovered Problem: Soil Acidity***	04	22
Adam Fuller, College of Arts & Architecture Mentor(s): Jennifer Woodcock Medecine-Horse ***An Examination of Contemporary Native American Graphic Art: Invention and Adaptation in Comicbooks***	05	30
Emma Strobel, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Respect and Mourning: Indigenous Horse Effigy Dance Sticks***	06	35
Josephine Parry, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Jewelry as a Tool of Empowerment and Protection***	07	34
Kendall Mckissock, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine horse ***Views of Contemporary Native North American Art***	08	32
Elizabeth Workman, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Horses: The symbols used and treasured in Indigenous North American horse regalia***	09	37
Raef Smalley, Gallatin College Mentor(s): Jennifer Woodcock-Medicine Horse ***Native American Bells***	10	35
Rachel Ingle, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Horse Imagery in the Ledger Art of Terrance Guardipee and Joh Isaiah Pepion***	12	31
Bri Mango, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Contemporary Aleut Jewelry Utilizing Traditional Methods: Denise Wallace***	13	32

Carol Chang, College of Letters & Science Mentor(s): Jennifer Woodcock-Medicine Horse ***Harrison Begay - Studio Style Artist***	14	29
Janice Kai, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Steven Paul Judd***	15	31
Norah Mish-Flanagan, College of Letters & Science Mentor(s): Jennifer Woodcock-Medicine Horse ***Steven Paul Judd: Reimagining Native Art as a Vehicle for Social Change***	16	33
Libby Brockie, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine ***Charlene Teters***	18	28
Makayla Sterbick, College of Arts & Architecture Mentor(s): Jennifer Woodcock Medicine Horse ***Native American Horse Regalia History and Symbolism***	19	35
Julia Gentry, College of Letters & Science Mentor(s): Martin Lawrence ***Investigation of Small Molecule Inhibition of Dual-Specificity Tyrosine Phosphorylation Regulated Kinase 1-A in treatment of Alzheimer's Disease***	20	42
Matthew Waldum, College of Education, Health, & Human Development Mentor(s): David Graham ***Understanding the effect Reactive Balance Training has on joints through biomarker analysis of IL-6, Osteopontin, CTX-I and CTX-II.***	21	42
Jordan Pauley, College of Letters & Science Mentor(s): Brian Bothner ***Novel Mechanism of Methane Synthesis***	22	50
Ashlyn Baird, College of Education, Health, & Human Development Mentor(s): James Becker ***Influence of Shoe Cushioning on Skeletal and Muscular Contributions to Leg Stiffness Pre and Post Long Hilly Run***	23	47
MeghanSpears, College of Education, Health, & Human Development Mentor(s): Mary Miles ***Relationship Between Body Composition and Inflammation in Individuals at Risk for Metabolic Syndrome***	24	51
Morgan Chamberlin, College of Education, Health, & Human Development Mentor(s): Mary Miles ***Anthropometric Predictors Of The Postprandial Triglyceride Response In A Metabolically At-risk Cohort***	25	48
Kaylan Wait, College of Engineering Mentor(s): Scott Monfort ***Effects of Prior ACLR and Cognitive Challenge on Postural Control following a Medial Side Hop***	26	52
Riley Williams, College of Engineering Mentor(s): Clemente Izurieta ***GraphQL in Enterprise Architecture***	27	60
Macy Schowalter, College of Agriculture Mentor(s): Andrew Fallin How cyber capabilities impact military offensive operations on the battlefield and what the United States is likely to see in future conflict.	28	58

Ethan Skelton, College of Engineering Mentor(s): Clemente Izurieta ***OnWater Fish Measuring***	29	58
Cameron Wilcox, College of Engineering Mentor(s): Clemente Izurieta ***Eight:18 Sponsor Application***	30	59
Kate Stallbaumer, College of Engineering Mentor(s): Clemente Izurieta ***Brightvine Mortgage Valuation Proposal***	31	59
Hailey Finch, College of Letters & Science Mentor(s): Madison Myers ***Age Dating Dacites from the Greater Yellowstone Region***	32	64
Michelle Leonard, College of Agriculture Mentor(s): Adam Sigler ***Analysis of Behavior and Health Outcomes for Volunteer Well Water Testing***	33	65
Russell Conti, College of Agriculture Mentor(s): Adam Sigler ***The Effect that Nitrogen-Fixing Cyanobacteria have on Nutrient Cycling in an Alpine Lake***	34	63
Elsa O'Neill, College of Agriculture Mentor(s): Mari Eggers ***Cumulative-risk assessment of exposure to well water contaminates, Boulder River Sub Basin, Jefferson County, Montana***	35	65
Grace Miller, College of Agriculture Mentor(s): Danielle Ulrich ***Response to Drought in Whitebark Pine***	36	71
Timothy Jones, College of Letters & Science Mentor(s): Danielle Ulrich ***Stomatal trait differences between geographically distinct foxtail pine populations***	37	70
Tristan Burlingame, College of Agriculture Mentor(s): Danielle Ulrich ***Comparison of wood density, biomass allocation, and carbon isotope ratios between three high-elevation pines***	38	69
Jackson Connors, College of Letters & Science Mentor(s): Andrea Litt ***Relationship Between NDVI and Soil Moisture in Yellowstone National Park***	39	69
Josephine Willard, College of Letters & Science Mentor(s): Ada Giusti ***Introducing Morality to Children thorough Literature in French and Senegalese Cultures***	40	78
Danielle Linehan, College of Education, Health, & Human Development Mentor(s): Karie Orendorff ***Adventures in Rural Teaching***	41	78
Maximus Marceau, College of Engineering Mentor(s): Randal Larimer ***Controlled Venting of Helium for High Altitude Balloons***	42	88
Steven Watson, College of Engineering Mentor(s) : Chelsea Heveran ***Spatial Variance of Bone Quality Measures Influenced by Age and Diet in C57BL/6 Mice***	43	91

Emma Hollis, College of Engineering Mentor(s): Ryan Anderson ***Spatially Resolved 3D Desaturation Model of a Gas Diffusion Layer with Comparison to Synchrotron Computed Tomography Data***	44	85
Garrett Kennedy, College of Engineering Mentor(s): Yaofa Li ***An Experimental Study of Liquid Droplet Deformation and Removal in a Microchannel***	45	86
Micah Hickethier, College of Engineering Mentor(s): Elizabeth Sandvik ***Quantification of ISS Isolate Fungal and Bacterial Biomass***	46	84
Matthew Bryant, College of Engineering Mentor(s): Sarah Morris ***VORTEX RING GENERATION VIA BIO-INSPIRED FLEXIBLE ORIFICES***	47	82
Ryan Dowdy, College of Engineering Mentor(s): Paul Gannon ***Analysis of Chromium Condensation Dependency on Water Vapor Concentration***	48	84
Abigail Ross, College of Engineering Mentor(s): Randy Larimer ***Small-Scale Zero Pressure Balloon: A Method to Increase Testing and Data Collection***	49	90
Emily Augustine, College of Engineering Mentor(s): Stephanie Wettstein ***Upgrading Lignocellulosic Biomass into Platform Chemicals for the Synthesis of Green Plastics***	50	81
Elliot Papendorf, College of Engineering Mentor(s): Sweeney Windchief ***Furthering Engineering Education through CFD Analysis of a Tipi***	51	89
Kyndra Buglione, College of Engineering Mentor(s): Joseph Shaw ***Contrast Enhancement of Underwater Objects with Polarization***	52	82
Madeline Conrad, College of Agriculture Mentor(s): Anja Kunze ***MECHANICALLY ATTENUATING CHEMOTACTIC NEURITE OUTGROWTH***	53	83
JacksonGolden, College of Education, Health, & Human Development Mentor(s): James Becker ***EFFECTS OF MANUAL MOBILIZATIONS ON FOOT KINEMATICS AND MUSCLE ACTIVITY***	54	49
Riley Hagger, College of Education, Health, & Human Development Mentor(s): James Becker ***EFFECTS OF MANUAL MOBILIZATIONS ON FOOT KINEMATICS AND MUSCLE ACTIVITY***	55	49
Kaitlyn McKibben, College of Education, Health, & Human Development Mentor(s): James Becker ***Acute Effects Of A Weekly Long Run On Metatarsal Bone Loads***	56	50
Sophia Hojnacki, College of Education, Health, & Human Development Mentor(s): J. Mitchell Vaterlaus ***Life Course Perspectives on Exercise: Examining Interpersonal Relationships Influences on Physical Activity***	57	96
Tae'Sha Red Hat, Other/None Mentor(s): Jennifer Woodcock-Medicine horse ***Sterilization of Native Women***	58	103

Caroline Chea, Gallatin College Mentor(s): Jennifer Woodcock-Medicine horse ***The Legand of Mato Tipila***	59	101
Abbigail Sparks , College of Education, Health, & Human Development Mentor(s): Kalli Decker ***The influence of Parent-Child Interaction Therapy on families and their children***	60	105
Ann Warren, College of Agriculture Mentor(s): Christa Merzdorf ***Asymmetric Protein Distribution in Zic3 MO-Injected Embryos***	61	116
Reed Noyd, College of Agriculture Mentor(s): Ed Schmidt ***Optimization of adeno-associated virus 8 (AAV8) for induction of hepatocellular carcinoma in mouse liver***	62	114
Zea Cain, College of Agriculture Mentor(s): Seth Walk ***Gut Microbiome Residency of Bacteroides Species***	63	113
Nicole Krysiak, College of Letters & Science Mentor(s): Christine Foreman ***Developing a Novel Tool to Image Organic Matter in Soil and Ice Samples***	64	114
Paige Schlegel, College of Agriculture Mentor(s): Anthony Kohtz ***Isolation and characterization of Pyrosphaera: a novel genus of thermophilic Crenarchaeota***	65	115
Ann Morris, College of Agriculture Mentor(s): Steve Stowers ***Dual Neurotransmitter Neurons in Drosophila***	66	121
Gianna Migliaccio, College of Agriculture Mentor(s): Cara Palmer ***Beta Intrusion during N2 Sleep is Negatively Associated with Nocturnal Heart Rate Variability in Healthy Adults***	67	121
Sydney Romero, College of Engineering Mentor(s): Nicholas Stadie ***Effects of Ball-Milling and Calendering on the Electrochemistry of Lithium Iron Phosphate as a Lithium-Ion Cathode Material***	68	125
Sara Cochella, College of Engineering Mentor(s): Nicholas Stadie ***Tuning NMM Cathodes for Sodium-Ion Batteries***	69	125
Lars Savage-Leuchs, College of Letters & Science Mentor(s): Randy Babbit ***Double Sided Vibrating Target and Interferometer for Position Detection***	70	130

Logan Aro, College of Letters & Science Mentor(s): Aleks Rebane ***Si-Stilbene fluorescence spectra and delay time properties***	71	129
Katie Fasbender, College of Letters & Science Mentor(s): David Nidever ***Exploring the Solar System with the NOIRLab Source Catalog***	72	130
Tessa Skirsky, College of Letters & Science Mentor(s): John Sample ***Defining Electron Microbursts Through Analysis***	73	131
Arthur Battaglin, College of Letters & Science Mentor(s): Nicholas Borys ***Configurable Strain Lattices in WSe2***	74	129
Josiah Shirley, College of Letters & Science Mentor(s): Brandon Scott ***Cooperation and Perceived Intelligence: An Exploration of Perception's Effects on Cooperation***	75	137
Jaime Rush, College of Letters & Science Mentor(s): Keith Hutchison ***Attentional Control and Reaction Time in Deception***	76	137
Julia Horst, College of Agriculture Mentor(s): Cara Palmer ***Bidirectional associations between sleep and emotion regulation in rural youth and adolescents***	77	136
Nievalinda Strong, College of Letters & Science Mentor(s): Neha John-Henderson ***Reward Sensitivity and Its Connection to Chronic Dieting***	78	138
Mikayla Bullman, College of Letters & Science Mentor(s): Neha John-Henderson ***Urban vs. Tribal Residence: Discrimination and Mental Health in American Indians***	79	135
Edison Woodward, College of Letters & Science Mentor(s): Michelle Meade ***Differences in Collaborative Process Variables Across Working Memory and Recall Performance***	80	138
Isabelle Carnes, College of Letters & Science Mentor(s): Kaylin Greene ***Substance use and mental health among LBGTQ+ individuals and Racial/Ethnic minorities during the COVID-19 pandemic***	81	141
Atticus Cummings, College of Letters & Science Mentor(s): Cody Warner ***A social analysis of the incorporation of green building technologies in Gallatin County***	82	142

AFTERNOON POSTER PRESENTATIONS

AFTERNOON POSTER PRESENTATIONS

SUB Ballrooms
1:30 – 4:30 p.m.

—

Primary Author, Department; Coauthors Mentor(s) ***Title***	**Poster Number**	**Page**
Samuel McMaster, College of Agriculture Mentor(s): David Baumbauer ***Indoor Agriculture at the Winifred School***	1	24
Bridget Doyle, College of Letters & Science Mentor(s): Michelle Flenniken ***Investigating the Relationship Between Virus Abundance and Honey Bee Health***	2	21
Taylor Jarrett, College of Agriculture Suchismita Mondal ***PPO Analysis of Winter Wheat***	3	23
Alexandria Fox, College of Agriculture Mentor(s): Jennifer Thomson ***Molecular Mechanisms in the Liver Impacting Meat Quality and Carcass Characteristics***	4	22
Jared Lile, College of Agriculture Mentor(s): Jason Cook ***Fine Mapping a Wheat QTL for Productive Tiller Number***	5	23
Erin Archard, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Nanibah "Nani" Chacon***	6	28
Emmett Thorsen, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Addressing the issue of violence against Indigenous Women***	7	36
Collin Enders, College of Arts & Architecture Mentor(s): Jennifer Woodcock ***Native American Horse Regalia***	8	30
Declan Merrion, College of Arts & Architecture Mentor(s): Jennifer Woodcock Medicine Horse ***Native American Regalia Through Letterwork and Beadwork***	9	32
Annamarie Thomas, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***T.C. Cannon: The Spaces Between***	10	36
Sean O'Neill, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Allan Houser***	11	34
Kagan Clark, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Jolene Yazzie, a development of personal style***	12	29
Lydia Truman, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Women in Metalsmithing: Native Innovation***	13	36

Sophie Larsen , Other/None Mentor(s): Jennifer Woodcock-Medicine Horse ***Instruments used in Native American Music***	14	31
Erica O'Borsky, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Nanibah Chacon***	15	33
Ali Rysted, College of Arts & Architecture Mentor(s): Jennifer Woodcock-Medicine Horse ***Traditional Native American Art Forms in Contemporary Settings***	16	34
Max Zapata, Gallatin College **Mentor(s): Jennifer Woodcock-Medicine Horse** ***Native American Instruments***	17	37
Bailey Collins, Gallatin College Mentor(s): Jennifer Woodcock-Medicine Horse ***Native Americans instruments***	18	29
Kenai Wilson, College of Letters & Science Mentor(s): Martin Lawerence ***Inhibition of DYRK1a with Novel Compounds***	19	43
Emily Fuchs, College of Letters & Science Mentor(s): Paul Gannon ***Integration of Indian Education for All into Highschool Science Classrooms***	20	41
Tyler Delridge, College of Engineering Mentor(s): William Walls ***Antiarenaviral activity of radical kinase RiPP natural products***	21	41
Connor Devine, College of Engineering Mentor(s): Stephen Martin ***Rapamycin Does not Alter Bone Microarchitecture or Flexural Properties in Young Adult and Early Old Age C57BL/6 Mice***	22	48
John Boone, College of Engineering Mentor(s): Chelsea Heveran ***Creating An Algorithm to Study Osteocyte Lacunar Canalicular Bone Remodeling as We Age***	23	47
Brendan Silvia, College of Engineering Mentor(s): Scott Monfort ***Effect of unanticipated constraint on lower extremity energy absorption during jump landings following ACL reconstruction***	24	51
Matthew Phillips, College of Engineering Mentor(s): Randy Larimer ***Continued Work on Raspberry Pi Camera System***	25	56
Michael Buffington, College of Engineering Mentor(s): Ann Marie Reinhold ***Improving rural emergency services via systematic assessment of historical response and participation data.***	26	55
Mason Reyher, College of Engineering Mentor(s): Clemente Izurieta ***The Farm Owl***	27	57
Erin Scheunemann, College of Engineering Mentor(s): Clemente Izurieta ***MilTech Capacity Plan Database***	28	57

Connor Parrott, College of Engineering Mentor(s): Clemente Izurieta ***Neurodynamik***	29	56
Cole Milne, College of Engineering Mentor(s): Clemente Izurieta ***Spanish Lab - An interactive Spanish education app for children and teachers***	30	55
Daniel Engen, College of Agriculture Mentor(s): Anthony Hartshorn ***Ten-thousand years of fire and soil evolution in the Northern Rockies***	31	63
Lucas Jepsen, College of Letters & Science Mentor(s): Colin Shaw ***Mapping Crystal Ice Deformation with EBSD***	32	64
Joshua Naudet, College of Engineering Mentor(s): Meredith Hecker ***Species Distribution Modeling for Aquatic Invasive Species***	33	72
Zoe Schoop, College of Letters & Science Mentor(s): Christine Verhille ***Analyzing Body Shape of West-slope Cutthroat Trout to Predict Individual Fish Performance in a Hatchery***	34	72
Sabrina Morgan, College of Letters & Science Mentor(s): Laura Burkle ***Plant Seed Set Response to Stigma Pollen Load***	35	71
Naomi Vliet, College of Education, Health, & Human Development Mentor(s): Danielle Ulrich ***Effects of drought stress on xylem anatomy of juvenile foxtail pine***	36	73
Ansel Fiddaman, Other/None Mentor(s): William Dyer ***Fungal Associacions in Montana's Native Orchids***	37	70
Kendall Fowler, College of Education, Health, & Human Development Mentor(s): Karie Orendorff ***The Benefits of a Home School Practicum***	38	77
Landon Kiker, College of Education, Health, & Human Development Mentor(s): Karie Orendorff ***Lesson Learned Organizing a Community Event***	39	77
Wyatt Theard, College of Education, Health, & Human Development Mentor(s): Karie Orendorff ***Archery – Not Just for Robin Hood***	40	78
Christopher Long, College of Engineering Mentor(s): Michael Walach ***MAVERICK***	41	87
Tasnia Javin Nur, College of Letters & Science Mentor(s): Roberta Amendola ***Frictional properties at tool-ply interface during forming of continuous vs stretch broken carbon fiber prepreg***	42	89
Sarah Shenk, College of Engineering Mentor(s): Lori Ray ***Disposing Toxic Waste in Brain Tissue with Noninvasive Intervention***	43	91
Kylee Rux, College of Engineering Mentor(s): Adrienne Phillips ***Experimental Investigation of Modular Building Materials: Producing the New Generation of Greener and Reusable Building Materials***	44	90

Rhyan Klostermeyer, College of Engineering Mentor(s): Bernadette McCrory ***Process Development for Ergonomic Assessment of Laparoscopic Surgery Training Tasks***	45	87
Alixandra Huhta, College of Engineering Mentor(s): Kirsten Matteson ***Analysis of the Effects of Microorganism Nutrient Broth on Hempcrete Strength***	46	85
Lexia Dauenhauer, College of Engineering Mentor(s): Chelsea Heveran ***The Early Subchondral Bone Response to ACL Injury Depends on Age in C57Bl/6 Mice***	47	85
Kristin Wurst Comeaux, College of Engineering Mentor(s): Erick Johnson ***Educational Heart Model***	48	144
Matthew Netley, College of Engineering Mentor(s): Yaofa Li ***An Effective Implementation of Molecular Tagging Velocimetry in Microfluidic Systems***	49	88
Ruby Jackson, College of Engineering Mentor(s): Stephan Warnat ***Impedance Spectroscopy Sensors to Detect Biofilm in Maple Sap***	50	86
Christopher Brizzolara, College of Arts & Architecture Mentor(s): Andrew Vernooy and Jordan Zignego ***A New MSU Tower-Dorm Design Proposal***	51	81
Mason Naomi, Gallatin College Mentor(s): Jennifer Woodcock-Medicine Horse ***Native Americans Mental Health***	52	97
Jocelynn Coley, College of Education, Health, & Human Development Mentor(s): Daniel Heil ***ACCURACY OF A WRIST-WORN CLINICAL ACTIVITY MONITOR FOR PREDICTING WALKING ACTIVITY ENERGY EXPENDITURE***	53	95
Nicole Holt, College of Education, Health, & Human Development Mentor(s): Miranda Margetts ***An Investigation of the Availability and Suitability of Patient-Centered Material for Patients with Müllerian Anomalies in Rural Communities***	54	96
Andee Baker, College of Agriculture Mentor(s): Michelle Grocke-Dewey ***Farm and Ranch Workers Stress Survey***	55	95
Katy Kropatsch, College of Education, Health, & Human Development Mentor(s): Mary Miles ***Anthropometric Determinants Of HOMA-IR In A Metabolically At-risk Population***	56	97
Jack Connolly, Gallatin College Mentor(s): Jennifer Woodcock-Medicine ***Government Policies During the Native Boarding School Era***	57	102
Torsten Raichlen, Gallatin College Mentor(s): Jennifer Woodcock-Medicine Horse ***Indigenous Food Sovereignty***	58	103
Joyanna Sage, Gallatin College Mentor(s): Jennifer Woodcock-Medicine Horse ***Health Care and Medicine within Native American Culture***	59	104

Wyatt Chvojka, Gallatin College Mentor(s): Jennifer Woodcock-Medicine Horse ***Native American Healthcare and Horses***	60	101
Anna Ripley, College of Letters & Science Mentor(s): Michael Neeley ***Bone Fragmentation Levels for the Beaucoup Site and What They May Reveal***	61	104
Grace Hansen, Gallatin College Mentor(s): Jennifer Woodcock-Medicine ***The Importance of Drums in Native American culture***	62	103
Taylor Gill, Gallatin College Mentor(s): Jennifer Woodcock-Medicine Horse ***Research Poster Abstract***	63	102
Isabella Roff, Gallatin College Mentor(s): Jennifer Woodcock-Medicine Horse ***The Impact of Athletics at Carlisle Indian Industrial School***	64	104
Gabby Bunko, College of Letters & Science Mentor(s): Doug Downs ***(Dis)Integration and Reframing in Writing and Literary Studies***	65	101
Logan Graham, College of Letters & Science Mentor(s): Bree Cummins ***Social and sexual contact network modeling for HIV clinic recruitment***	66	109
Bryce Morrow, College of Letters & Science Mentor(s): Ryan Grady ***Invariants for Higher Tori via Topological Quantum Field Theory***	67	109
Courtney Scott, College of Agriculture Mentor(s): Zoe Pratte ***Mycoplasmopsis dominates the cloacal microbiome of spotted eagle rays***	68	115
Eric Welch, College of Agriculture Mentor(s): Michael Franklin ***BiFC image analysis of protein interactions in Pseudomonas aeruginosa biofilms***	70	117
Jacob Kasubick, College of Agriculture Mentor(s): Christa Merzdorf ***Determining the Relationship Between Aquaporin 3 and Calcium Waves***	71	113
Zoe Seaford, College of Agriculture Mentor(s): Ed Schmidt ***Optimizing the Reaction Conditions for S34-Cysteine Biosynthesis using CysK Enzyme***	72	116
Ryan Williamson, College of Engineering Mentor(s): Eric Boyd ***Reductive Biomining of Pyritic Ore by Methanogens***	73	117
Jacob Smith, College of Agriculture Mentor(s): Anja Kunze ***Modulating Neuronal Cell Migration Under Curved Confinements***	74	122
Eli Barton, College of Letters & Science Mentor(s): Neil Cornish ***Rapid Power Spectral Density Estimates for Binary Mergers***	75	129

MSU STUDENT RESEARCH CELEBRATION | SPRING 2023

STUDENT POSTER ABSTRACTS

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

AGRICULTURAL SCIENCES

Morning | 1 | ***Analyzing Sustainable Nitrogen Levels for an Efficient Camelina Production***
Anapaula Astorga Bedoya | College of Agriculture
Mentor(s): Jennifer Lachowiec and Racheal Upton | College of Agriculture

Camelina Sativa, an oilseed rich in fatty acids, proteins and antioxidants is currently used for multiple beneficial purposes, such as production of biofuel and cosmetics. Nitrogen is one of the most common and efficient fertilizers for the agricultural industry. Over 100 million tons are annually applied on crops for a better efficacy production of plant base products. Excessive use of nitrogen generates waste that damage the environment, such as contamination of rivers, soils, and air. Objectives on this project are focused on determining the phenotypic response and biomass production of multiple camelina accessions in different nitrogen fertilization concentrations (0ul, 1.5ul, 2.0ul, 2.5ul, 3.0ul, 3.5ul, 4.0ul). Hydroponic systems were used to evaluate the different camelina accessions grown in modified Hoagland solutions. To determine the impact of nitrogen availability on camelina development an end point growth pattern was assessed. In different nitrogen conditions such as 0ul and 1.5ul leaf number and overall biomass is expected to decrease. For medium levels of nitrogen (2.0ul, 2.5ul, 3.0ul) leaf and overall biomass are expected to be greater compared to optimal nitrogen conditions. For the high nitrogen levels (3.5ul and 4.0ul) leaf and biomass is expected to decrease.Understanding the nitrogen utilization efficacy is critical to improve crop yield and address the issues caused by over fertilization. This study contributes to decision making for management practices needed to promote camelina productivity. Determining the optimal nitrogen conditions for camelina will contribute to further the industrialization of this developing crop while minimizing the harmful damage to the environment.

Acknowledgements: USP - Undergraduate Scholars Program

Afternoon | 2 | ***Investigating the Relationship Between Virus Abundance and Honey Bee Health***
Bridget Doyle | College of Letters & Science | **Co-Author(s)**: Naomi Kaku and Michelle Flenniken
Mentor(s): Michelle Flenniken | College of Agriculture

Honey bees (Apis Mellifera) pollinate plants in agricultural and natural ecosystems. In North America, honey bee pollination services are valued between $17-18 billion dollars. Therefore, high annual losses reported in some parts of the world are concerning. There are many abiotic and biotic factors associated with colony losses, including viruses. The majority of honey bee infecting viruses are positive single stranded viruses such as deformed wing virus (DWV) and sacbrood virus (SBV). To investigate the impact of virus infection on honey bee health, laboratory-based infections studies are performed measuring mortality, flight capability, virus abundance, and gene expression at specific time points post-infection. Since flight capability may be impacted by honey bee weight and/or wingspan, these variables were measured, but there was no association between the thorax weight and wingspan length. Accurate quantification of virus abundance is a critical aspect of these studies, therefore to determine if virus quantification using honey bee abdomen samples was representative of the entire bee, virus abundance in head, thorax, and abdomen segments of individual bees was determined via qPCR and compared. This study determined that virus abundance data from head and thorax samples incorrectly underestimated DWV and SBV abundance, and the values obtained from abdomen samples most accurately reflected total virus abundance. Together these data help to provide us with a clearer understanding of sublethal virus infections in honey bees.

Acknowledgements: USP - Undergraduate Scholars Program

Afternoon | 4 | *Molecular Mechanisms in the Liver Impacting Meat Quality and Carcass Characteristic*
Alexandria Fox | College of Agriculture
Mentor(s): Jennifer Thomson | College of Agriculture

Meat quality is important to producers and consumers. Producers focus on harvesting livestock at a certain endpoint for the best marbling and tenderness possible. The USDA quality grade of meat depends on the maturity and the amount of intramuscular fat or marbling. Quality grades create a structure for producers and consumers to determine the palatability of a product, but often have variation and overlap between the different grades. This study aims to expand the knowledge of how genes expression in the liver and hepatic metabolic regulation contributes to USDA quality grades on different species of livestock. Fifteen wethers and fifteen steers from Red Bluff Research Center were fed to different points of Standard, Select, and Choice quality grades. RNA extracted from the liver tissue was sent to NovoGene for RNAseq analysis. The results found that the most abundant differences in bovine were between the standard and select groups. Select, compared to the standard group, had 1,114 up-regulated genes and 886 down-regulated genes. The most abundant differences for ovine was comparing the heavy and medium groups. The heavy and medium groups had 1,012 up-regulated and 1,150 down-regulated genes. For steer and wether analysis, expressed genes contributed to liver metabolism, synthesis, and cellular signaling. This study highlights the need for an expansion of evaluating hepatic gene expressions and its connection to intramuscular fat deposition.

Morning | 4 | *Montana's Newly Discovered Problem: Soil Acidity*
McKenna Hanford | College of Agriculture
Mentor(s): Manbir Rakkar | College of Agriculture

Farmers in Montana have been noticing that their soils are becoming acidic. Acidic soils could decrease the availability of nutrients to plants, reduce the functions of rhizobium, change herbicide effectiveness, and release aluminum into the soil, which is toxic to the plant. All the consequences of acidic soils make it very difficult for a crop to grow and provide optimal yield. Liming is one of the potential solutions in mitigating soil acidity, but the correct lime rate and its longevity is still unknown in MT. Therefore, I monitored the impact of lime on plants and soil after a period of 4 years since lime application. I collected plant dry biomass and plant height data three times, and soil pH data once during the 2022 growing season from three different locations across the Golden Triangle in Montana to figure out how liming affected different plant and soil characteristics that contribute to yield. I compared 0 tons/acre (control) strips to strips that had a lime rate of 4 tons/acre. The data concluded that the 4 tons/acre had a higher pH, that was not too far off from neutral. The results showed that when pH increases due to liming, the average plant height and biomass also increases, but several strips are not showing a positive effect and that could be a result of several things, such as drought, management practices, and/or other unknowns. If liming is necessary on your farm, make sure to apply the correct rate and to monitor the results.

Acknowledgements: USP - Undergraduate Scholars Program

Afternoon | 3 | *PPO Analysis of Winter Wheat*
Taylor Jarrett | College of Agriculture
Mentor(s): Suchismita Mondal | College of Agriculture

Polyphenol Oxidase (PPO) is an enzyme found in wheat that has significant control over discoloration and darkening in wheat products. Products such as Asian noodles look for wheat lines with low PPO activity which results in the lighter coloring of the noodles sold within this market. Specifically, Montana wheat is targeted around the Asian noodle market and developing wheat lines with low PPO for their products. This project has been centered around developing quicker analysis methods to allow for larger yields to be tested efficiently and allow earlier generation screening by taking previously used PPO analysis protocol and adapting the protocol to allow for effective testing of larger sample sizes. The testing assay involves mixing Levodopa (L-DOPA) and 3-(N-morpholino) propane sulfonic acid (MOPS) solutions to a pH of 6.5. The solution is then put into a 96-well plate containing 42 winter wheat samples, two blanks, and two checks of a known high and low PPO line from previous harvests. After shaking plates for thirty minutes, the solution is extracted and read through a mass spectrophotometer at 475nm to determine the presence of PPO in each sample. These results and modified testing assay allow winter wheat breeders to screen early generations and use this knowledge to create new low PPO lines specifically targeting Asian noodle markets.

Afternoon | 5 | *Fine Mapping a Wheat QTL for Productive Tiller Number*
Jared Lile |College of Agriculture - Graduate Student
Mentor(s): Jason Cook and Jennifer Lachowiec | College of Agriculture

Stability in yields can arise through plasticity in specific plant traits. One trait in hexaploid bread wheat that can be targeted for plasticity is productive tiller number (PTN). Productive tiller number describes the number of stems on a plant that produce their own mature heads of grain. It has been shown that wheat can fine tune PTN to fit its environment by senescing off early tillers that cannot be sustained. This is useful as a “yield buffer” allowing plants to produce fewer but healthier heads in drought or nutrient deficient conditions or produce many heads in resource-rich conditions. The genetics of PTN are not well understood; however, Naruoka et al. 2011 did identify a QTL (QTn.mst-6B) associated with PTN which was further characterized by Jones et al. 2020. My project is to fine map the QTn.mst-6B region and identify the causal variants therein. I will follow two approaches; the first using RNA sequencing to compare gene expression between near-isogenic lines varying at the QTL alleles, and the second to identify and phenotype a scaffold of recombinant lines to further narrow the QTL region. The preliminary results have shown four differentially expressed genes within the QTL region. This combined with the narrowing of that region, will provide strong evidence for the causal gene, and thereby lead to a greater understanding of the genetic components behind productive tiller number as well as provide insight into the mechanisms by which plants demonstrate stability of important agronomic traits.

Acknowledgements: Federal funding through your research mentor (NSF, NIH, NASA, DOE, etc.)

Morning | 2 | *The Performance of 10 Unique Crops Under Different Supplemental Greenhouse Lighting Solutions*
Jaemarc Lumba |College of Agriculture
Mentor(s): David Baumbauer | College of Agriculture

In this study, the effects of supplemental light-emitting diode (LED) lights were compared to Metal Halide lights currently in the Plant Growth Center on the growth of 10 different species of crops. Wild Oats, Durum, Barley, Field Peas, Camelina, Chickpeas, Spring Wheat Dagmar and Vida, Potatoes, and Lentils. Each species had five plants under each light with 16-hour photoperiod (5 am – 9 pm) and temperatures of 70°F Day/65°F Night. The supplemental LED lights used were from 2 companies, Arize with the Element L1000 Next-Gen LED light and Bios with the Icarus Ti3 LED light. The Arize LED lights had wavelength peaks at 650nm, a smaller peak at 450nm, and tiny peaks between 475nm-600nm. The Bios LED lights had wavelength peaks at 650nm, a small but more prominent peak than Arize at 450nm, and an overall broad peak between 475nm-600nm. The Metal Halide lights had wavelength peaks scattered between 400nm-700nm with one prominent peak at 575nm. Crop tiller and seedhead growth under the LED lights exceeded the Metal Halide lights, with the Bios LED light surpassing the Arize LED light in 80% of crops. The crop's dry weight (g) resulted in both LED lights exceeding the Metal Halide lights and the Bios LED surpassing the Arize LED light in 70% of crops. These results indicate that the LED lights were more effective in promoting plant growth than the Metal Halide lights, and the Bios Icarus Ti3 LED light performed better than the Arize Element L1000 Next-Gen LED light.

Afternoon | 1 | *Indoor Agriculture at the Winifred School*
Samuel McMaster |College of Agriculture | **Co-Author(s)**: Brandon Tillett, Sammy Jones, Peter Reis, and Clifton Yarborough
Mentor(s): David Baumbauer | College of Agriculture

How can small towns get locally grown fruits and vegetables that are fresh and healthy. The solution is growing them hydroponically indoors. That is what Winifred MT is doing in a town of 200 people. This project accomplished setting up two different hydroponic systems which included a vertical tower and a ducth bucket system. This was all done in a green house built at the Winifred School. With the vertical tower, different varieties of lettuce were grown to see what varieties would grow the biggest. This was done by taking the dry and wet weight of each variety and comparing them to each other to see what grew the biggest. This data let Winifred School know what verities of lettuce would work best for their vertical towers. Taking this concept of growing fruits and vegetables hydroponically can change food deserts across the country into a food oasis and Winifred MT is an example of that change.

Morning | 3 | ***Validation of a quantitative trait locus for grain number per spike in spring wheat***
Mei Ling Wong |College of Agriculture - Graduate Student | **Co-Author(s)**: Hwa-Young Heo and Nancy Blake
Mentor(s): Jason Cook | College of Agriculture

Wheat production in the Northern Great Plains of America has important contributions globally. Hard red winter wheat is perceived to have higher yield than hard red spring wheat. Previous research investigated causative alleles for high yield in winter wheat (Triticum aestivum L.) to improve spring wheat yield. To evaluate alleles for increasing grain yield that derived from spring and winter wheat parents, a winter wheat cultivar, 'Yellowstone', was converted to a spring growth habit line, 'S-Yellowstone' by introducing the Vrn-A1 spring habit allele from the spring wheat cultivar 'Choteau'. The previous study identified a quantitative trait locus (QTL), QSnh.mst-4A, with a large effect on grain number per spike (GNS) in a spring wheat Choteau/S-Yellowstone genetic mapping population. To validate QSnh.mst-4A effects on GNS and other agronomic traits, QSnh.mst-4A was backcrossed from 'S-Yellowstone' into 'Vida', creating near-isogenic lines (NILs). Phenotypic data were collected from rainfed field trials during 2020-2022 in Bozeman, Montana. The results showed that spike length, spikelet number per spike (SNS), and GNS were significantly greater in the NILs with the S-Yellowstone allele compared to the Vida allele. However, the increase in GNS from the S-Yellowstone allele did not show a significant increase in grain yield from 2022. This study suggests that better understanding the interactions between yield component traits in different environments could be critical to achieve future gain yield and benefit spring wheat breeding efforts.

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

ARTS & MUSIC

Afternoon | 6 | *Nanibah "Nani" Chacon*
Erin Archard | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

MMIW stands for Missing and Murdered Indigenous Women. It is a term used to raise awareness about the disproportionately high rates of abduction, rape, and murder of Indigenous women and girls across North America. Despite ongoing efforts to bring attention to this issue, Indigenous women and girls continue to be victims of violent crimes at alarming rates. One way to bring awareness to this issue is through art. I plan to highlight Navajo and Chicana artist Nanibah "Nani" Chacon who has been using her art to support the MMIW movement.
Nani created a traveling art exhibition titled Sing Our Rivers Red to bring awareness to the MMIW movement. This exhibition featured 3,406 earrings to represent the number of Indigenous women reported missing or murdered every year. The earrings were donated by over 400 people, organizations and groups across the United States and Canada.
Along with the earrings, the Sing Our Rivers Red exhibition also featured an oil painting by Nani herself titled Missing. The piece features an indigenous woman, almost transparent, surrounded by monarch butterflies against a landscape of an open field with mountains in the distance. Chacon compares indigenous women to the butterflies which are found around North America and have recently been classified as endangered. She is also making a connection between the woman and the land behind her. Both are being horribly mistreated and Nani believes that once we learn to respect either nature or women, that respect for the other will follow.

Morning | 18 | *Charlene Teters*
Libby Brockie | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Institute of American Indian Arts (IAIA) is a public tribal college in Santa Fe, New Mexico, excelling at thought provoking conditions and creating an exceptional education environment. IAIA has made it its mission to nurture Native and Non-Native people in their pursuit of a creative path. IAIA has a long list of alumni in the 61 years it has been running, with one of the many graduates being that of Charlene Teters. Teters is a Spokane born native and part of the Spokane tribe. Teters earned her Associates in Fine Art from IAIA going along her journey to get an honorary Doctorate in Fine Arts from Mitchell College in New London Connecticut. One thing that Teters is known for is her paintings and art installations, which has been shown all over the country in solo exhibitions and group exhibitions from Anchorage Alaska to New York City. Not only is art apart of her life but so is lectures talking about stereotypes especially in the native community, going on to being an activist agains the misuse of Native American imagery in sports and media and later being part of the board of the National Coalition of Racism in Sports and in the Media. Having achieved so many things in her time, Teters is not slowing down and will continue to use her platform to talk about Native American injustice. Other funding or support College of Arts & Architecture

Morning | 14 | ***Harrison Begay - Studio Style Artist***
Carol Chang | College of Letters & Science - Graduate Student
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

When researching any Native American artist or artwork, you will often find that the first search results include art owned by independent galleries and third-party sales sites like online auctions and Etsy. Native American art as commodity is pursued and valued in ways dependent on western economic markets. While the Arts and Crafts movement in the 1920's and 30's brought some sense of economic independence to Native American artists in the Southwest, Native art remained chained to the wants, needs, and perceptions of western society. At the Santa Fe Indian School, Dorothy Dunn taught Diné artist Harrison Begay (or Haashké yah Niyá) "Studio Style" painting, described as "flat, decorative painting that is devoid of perspective or shading." Today, Begay is one of the most prolific Native American artists from this era. Whether his works' popularity comes from the prolific nature of his work, artistic merit, or the strong connection between "authentic" Indian art and Indigenous identity at the time, Begay has thousands of influential works spread across the United States to this day.

Afternoon | 12 | ***Jolene Yazzie, A Development of Personal Style***
Kagan Clark | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

The focus of this project is to explore different Native American artists as they develop their personal style through an education at the Institute of American Indian Arts. The IAIA excels at thought provoking and creating an exceptional educational environment. They play a large role in the pursuit of Native American artistic career paths. The focal artist of this project is Jolene Yazzie, a Navajo artist. It will follow her early career and how her style has evolved and traces back to her tribal heritage. It then explores her time at IAIA and her exploration there. In her work as a comic artist she draws inspiration from stories that were passed down to her to develop her character's backstories. After graduating it will be shown how her personal style has varied from her early work and even from her formal education at the Institute of American Indian Arts and has become what makes her work original. This work will be presented alongside other Alumni of IAIA that work in other mediums as a way to follow the path of multiple tribes through the skill building techniques acquired at IAIA and what becomes of the educational foundations laid there.

Afternoon | 18 | ***Native Americans instruments***
Bailey Collins | Gallatin College - Graduate Student | **Co-Author(s)**: Max Zapata, Grace Hansen, Sophie Larsen, and Raef
Mentor(s): Jennifer Woodcock-Medicine Horse | Gallatin College

My emphasis will be on flutes while the other authors in my group focus on other instruments including vocals. I will be looking at how the flute is used in Native ceremonies and how it is sacred to Natives. The other authors and I will come together and show how all the instruments are connected and how important they are. We will also look at how they are made and what kind of process that entails.

Afternoon | 8 | ***Native American Horse Regalia***
Collin Enders | College of Arts & Architecture | **Co-Author(s):** Rachel Ingle, Emma Strobel, Declan Merrion, and Elizabeth Workman
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Horse regalia is an incredible way Indigenous North Americans showed appreciation for their new friends. When horses arrived, First Nations bestowed horse regalia on the horses they made into companions. This unique art form and the love for equines permeated throughout some Indigenous cultures, some entirely revolving around their faithful animals, and love for horses spread all over the continent. Ceramics has been a part of Native American culture for thousands of years and throughout history, motifs and designs developed to tell stories or represent meaning on the pot. To seek more on how ceramic designs were changed by horses, and how horse regalia was represented in pottery of today, this presentation will investigate the representations of horses and horse regalia in contemporary Native American ceramics.

Morning | 5 | ***An Examination of Contemporary Native American Graphic Art: Invention and Adaptation in Comicbooks***
Adam Fuller | College of Arts & Architecture - Graduate Student
Mentor(s): Jennifer Woodcock Medecine-Horse | College of Arts & Architecture

Art historical scholarship examining the comicbook as a graphic art needs to be improved. Serious examinations of form, style, and content in comicbooks can lead to meaningful discussions of broad cultural and sociopolitical topics. The visual narratives in American comics produced by major companies like Marvel and DC reach national and international audiences, especially through cinematic adaptations of narrative arcs and characters. Digital access to large comic libraries such as Marvel Unlimited and DC Universe Infinite has generated a newer and younger audience. These companies increasingly respond to and incorporate their diverse, multicultural audiences into familiar narratives or characters and newly developed ones. In an essential exhibition from 2018 at the Smithsonian's National Museum of the American Indian in New York titled "Jeffrey Veregge: Of Gods and Heroes," Salish artist Veregge incorporated a traditionally indigenous Northwest Coast art style called formline with the familiar forms of the Marvel Universe. By closely examining Veregge's formline work and other Native graphic artists' inventions and adaptations of comicbook characters, I will try to develop a discussion of the Native American and Indigenous graphic artists' impact on companies like Marvel and DC. I will also try to produce a discussion of formalism and content while remaining sensitive to my status and privilege as a white male student.

Acknowledgements: USP - Undergraduate Scholars Program

Morning | 12 | ***Native American Horse Regalia History and Symbolism***
Rachel Ingle | College of Arts & Architecture - Graduate Student | **Co-Author(s):** Collin Enders, Declan Merrion, Emma Strobel, and Elizabeth Workman
Mentor(s): Jennifer Woodcock Medicine Horse | College of Arts & Architecture

Horse regalia is an interesting subject of Native American art, both historically and in contemporary depictions. The decoration of animals is a form of art that has unique presentation in Indigenous North America, and has distinct styles within the First Nations here. To seek further insight into horse regalia, how it came to be, what it means, and what is it's significance in contemporary Native American art today, this presentation will explore several topics surrounding horse regalia. We will present how traditional horse regalia developed at the time of contact, tracing the trade of horses and the creation of art and regalia that followed this trade. Comparing different nations horse regalia in both form and content will provide further insight into its function and meaning. Examining the inclusion of horse imagery and regalia in contemporary ledger art and ceramics will broaden understanding of the significance of this form of art. By incorporating this variety of topics and sources we will present a more comprehensive picture of Native American horse regalia today.

Morning | 15 | ***Traditional Native Art Forms in Contemporary Settings***
Janice Kai | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Jaque Fragua calls himself a "professional Vandal" from the pueblo of Jemez in New Mexico. He studied at the Institute of American Indian Arts. He has featured his work at the Smithsonian National Museum of the American Indian, Institute of American Indian Arts and Museum of American Indian Arts & Culture. One of his famous works can be seen down the Indian Alley of Los Angeles, a mural called "Decolonize and chill/ We are Still Here". Just like most of his work it is in your face and he does not regret that. His Media depicts Emotional introspection, social injustice, civil unrest, and personal healing. Jaque repurposes Native Iconography that can be translated to the misconception of misappropriate Native American identity that the Mass Media has continuously depicted. His art educates about the reality of Native American history and current day issues that are under-covered. He believes that Graffiti did not start on the street corner of New York but was created through petroglyphs that can be seen in his hometown on the reservation. There is an increasing emphasis of traditional Native American Art forms in Contemporary settings, that separates the misconception of Indigenous peoples being prehistoric history from the Modern adaptation that Native Americans are struggling with. Native Artists are adapting to the turmoil of being a "Modern Native Artist" and the oppression that comes with it.

Afternoon | 14 | ***Instruments Used in Native American Music***
Sophie Larsen | Other/None
Mentor(s): Kathrine Woodcock | University College

A quick glance into north, Native American, musical instruments, you most likely don't think of when connecting these two topics. Diving into an overview of specifically the "shaker". A core sound and apparatus that grounded cultures with musical instruments. As well as connecting all the tribes through this one thing that they all could share in common, which was a shaker. Discussing and discovering the unique ways they all represented this instrument. Finding hidden historical facts that impacted them in such an encouraging and empowering mannerism that is not talked about enough.

Morning | 13 | ***Contemporary Aleut Jewelry Utilizing Traditional Methods: Denise Wallace***
Bri Mango | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Metalwork has always existed within the various native cultures that call the United States home, from the copper works found at the Cahokia mounds, the rich silvers mithing traditions of the peoples of the South-West and the intricate blades mithing traditions of the Tlingit. In the contemporary context, many native people carry on the tradition of their cultures metalworking traditions. Denise Wallace, an woman of Aleut descent, carries on a tradition of ivory carving and scrimshaw and incorporates traditional folklore and storytelling into her jewelry works, for which she attended the Institute of American Indian Arts in Santa Fe. Her work is a unique combination of undeniably Aleut subject matters and materials and a South-Western inspired inlay technique that creates contemporary pieces of storytelling and cultural preservation. Denise Wallace is based out of Hawaii and collaborates with her son who is also a metal smith and stone/ivory carver.

Morning | 8 | ***Views of Contemporary Native North American Art***
Kendall McKissock | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Contemporary Native art breaks into a dialogue with contemporary western art by adopting modern styles and standards while still being grounded in traditional native modes and imagery. Some artists see this as a possible parallel to the struggle with native identity that Indigenous Americans suffered through during the forced assimilation of colonization. The pieces and artist reviewed here will offer readers the contemporary world of Native American art and its entanglement with Modernism through the study of Wendy Red Star and her work within the Native art community. She is a visual artist who rethinks what American art can be and opens new doors between Native communities and educational institutions that for hundreds of years have ignored the voices of the indigenous. Her work is both engaged with her cultural heritage and with many forms and mediums of creative expression influenced by a plethora of historical events with styles of the contemporary. This essay will present a scholarly approach to the captivating background story and work by Wendy Red Star and her recontextualization of indigenous representation and specifically that of the Apsáalooke Nation.

Afternoon | 9 | ***Native American Regalia Through Letterwork and Beadwork***
Declan Merrion | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Native American regalia is a unique and intricate form of art that encompasses a wide range of techniques and materials, including letter work and beadwork. Letter work involves the use of applique or embroidery to create designs using letters and words, while beadwork involves the use of beads to create intricate patterns and designs. Together, these techniques are used to create stunning and highly personalized regalia that reflect the individuality and cultural identity of the wearer. Two artists who are known for their exceptional use of letter work and beadwork in their regalia designs are Jamie Okuma and Marcus Amerman. Okuma is a Luiseño and Shoshone-Bannock artist who creates highly detailed beadwork and applique designs that blend traditional Native American styles with contemporary fashion. Her work often incorporates letters and words to convey personal and cultural messages. Amerman, a Choctaw artist, is known for his intricate beadwork designs, which often feature bold patterns and colors that reflect his cultural heritage. He also incorporates letter work into his designs, creating personalized pieces that tell stories and convey important cultural messages. Overall, Native American regalia is a vibrant and important art form that continues to evolve and thrive today, thanks to the creativity and skill of artists like Okuma and Amerman.

Morning | 16 | *Steven Paul Judd: Reimagining Native Art as a Vehicle for Social Change*
Norah Mish-Flanagan | College of Letters & Science
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Steven Paul Judd is an Oklahoma City-based, native artist who specializes in contemporary native pop art. Member of the Choctaw and Kiowa nations, Judd was born in Lawton, OK, and grew up in OKC as the son of methodist ministers. He began his journey with contemporary art when he began looking for native pop art and after not finding any, decided to start making it himself. Judd's work features a wide variety of pop iconography, often drawing inspiration from TV shows and movie characters, popular media items, and toys. Similar, to contemporary artist, Andy Warhol, Judd's work challenges the boundaries of mediums, blending photography, painting, printmaking, photoshop, and traditional native art styles such as ledger art together. His use of color blocking and bright tones are indicative of the modernity that native art can have. He challenges the current depictions of indigenous culture, which are pre-historic and not representative of the 21st century, by placing native subjects in modern settings. By doing this he attempts to initiate a conversation and bring about social change through his art. In most of his works, he highlights the obstacles Native Americans have faced in the U.S. and offers a chance for indigenous communities to feel liberated. The popularity of Judd's work has proven that Native Americans want to see accurate representations of themselves in pop culture and are ready to take back their own expressive meanings of indigenous iconography.

Afternoon | 15 | *Nanibah Chacon*
Erica O'Borsky | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Chacon's bold use of color and expression of femininity and culture through illustration makes her art entrancing and impossible to ignore. My research focuses on what inspires her art and how it has grown into what it is today. Navajo and Chicana artist Nanibah Chacon was introduced to graffiti at the age of 16. From there she made a career as a painter and muralist. She received her bachelor's in education from the University of New Mexico, and along with her career as an artist she has seven years of experience in teaching. On top of those accomplishments, Chacon has had work installed in the Navajo Nation Museum, the ISEA International Arts and Technology Symposium, Old Town Lansing, in an exhibition at the National Hispanic Cultural Center, and the IAIA Museum of Contemporary Native Arts. The IAIA, Institute of American Indian Arts, is a public tribal college in Santa Fe, New Mexico, with a thought provoking, and exceptional educational environment. Chacon being featured in the museum is an honor, because they only feature the most progressive work of contemporary Native artists. The hope is that my research will inspire students, especially Native American students on campus, by seeing where her upbringing and hard work led her. It will also feature a diverse range of her work, and highlight the cultural influences that make Chacon's art so hard to ignore.

Afternoon | 11 | *Allan Houser*
Sean O'Neill | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Having been raised in rural America I am culturally unfamiliar with many American Indian stories and religious/spiritual ideology. Despite this, Allan Houser presents artwork in such a manner that I also feel like a part of his story. Houser is one of the most accomplished American Indian sculptors of the 21st Century. Integrating modernist techniques to express abstract and representational forms this artist's appeal to the academically linear art practices effectively builds cultural bridges. Houser communicates the knowledge of American Indian identity with profound elegance. With many sculptures presented in harmony with the natural landscape of Sante Fe, Houser's work speaks to people of all cultural backgrounds through visual form and space. Using art history scholarship and sculptural critique, I will discuss how modernism has developed in the United States and how I feel Allan Houser has achieved artistic excellence. I believe that by creating an opportunity for the viewer to feel a deeper sense of humanity, Allan Houser has made an effort towards a more familiar future.

Acknowledgements: USP - Undergraduate Scholars Program

Morning | 7 | *Jewelry as a Tool of Empowerment and Protection*
Josephine Parry | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Morgan Asoyuf is a Tsym'syen an artist from British Columbia who works primarily in goldsmithing, jewelry, gem-setting, and engraving. One of her recent projects titled "Royal Portraits" involved the use of jewelry and adornment in order to offer protection and a sense of regality to the wearer. The purpose of these pieces was to protect and elevate the status of the native women and two-spirit people on the front lines of activism for land rights and MMIWG2S+. Police tend to be less likely to physically manipulate activists if they are wearing indigenous art, because of the the superstitions associated with harming these cultural art objects. Asoyuf's "Royal Portraits" project made me interested in further investigating the ways in which jewelry, body adornments, and wearable sculpture can physically, emotionally, or spiritually protect the wearer.

Afternoon | 16 | *Traditional Native American Art Forms in Contemporary Settings*
Ali Rysted | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse |College of Arts & Architecture

Jamie Okuma is a Shoshone Bannock and Luiseño artist whose career began at the Institute of American Indian Arts in Santa Fe, New Mexico. Okuma's work brings Native American designs, motifs, and mediums to the contemporary world of fashion, making space for Indigenous voices in traditionally westernized settings. Her one-of-a-kind works include her ready-to-wear collections that showcase modern silhouettes adorned with traditional Native American motifs and beadwork informed by her upbringing on the La Jolla Indian Reservation, and her unique specialty in overlaying beadwork on designer shoes. Her "indigenized" pieces blur the lines of old and new, combining both Native American and western cultures. In her work that interprets western ideas of couture embraced through Indigenous designs and mediums, she reverses the roles of appropriation in high fashion.In addition to her international success, her designs have been featured in Vogue Magazine, and many are housed in numerous prestigious collections including the Metropolitan Museum of Art and the Smithsonian. Okuma's work illustrates the vibrancy brought to both Native American and western cultures in the synergy created by the collision of both art forms. Her success in the world of couture further creates more space for the presence of Native American art in contemporary western settings, as well as space for diverse voices to tell their own stories to international audiences.

Morning | 10 | ***Native American Bells***
Raef Smalley | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine Horse | Gallatin College

Native Americans have used bells for various purposes throughout their history. Bells were first introduced to the indigenous people of North America by European explorers and colonizers, but they quickly adapted them to suit their own cultural practices. For example, the Pueblo people of the American Southwest use bells in their traditional dances and ceremonies, where the rhythmic sound is believed to have a spiritual significance. In some Native American communities, bells were also used as a form of currency or as a means of trade. Additionally, bells were sometimes used as warning signals in times of danger or to communicate across long distances. While the use of bells in Native American cultures has evolved over time, their significance as an instrument of sound and communication remains an important part of many indigenous traditions.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 19 | ***Nayana Lafond - Violence Against Indigeous Women***
Makayla Sterbick | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Nayana Lafond is a Native American artist who creates Murdered and Missing Indigenous Women (MMIW) portraits. She started painting MMIW portraits when COVID started in 2020. She was inspired to make black and white paintings from a Saskatchewan woman named Lauraina Bear who posted a selfie designed to support MMIW. Her selfie included a painted red hand over her mouth. The selfie inspired Nayana to ask Lauraina if she could paint her self-portrait from the posted photo. Nayana then posted the painting of Lauraina Bear's portrait on social media. Nayanna received several positive comments and requests from people who wanted their portraits done. People sent pictures of loved ones, important people, and themselves to be painted. She has produced over a hundred portraits since she started in 2020. All of the portraits have been painted in black and white with the signature red handprint on the person's mouth. Some of the portraits include family members and survivors of the murdered and missing women. The red handprint on the mouth of the portraits represents the women's voices being silenced. Nayana does not take money for the portraits or monetary donations. She gets permission from the individuals to sell the prints to recover costs for supplies. She does this to shed light on the situation of being a survivor herself.

Morning | 6 | ***Respect and Mourning: Indigenous Horse Effigy Dance Sticks***
Emma Strobel | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Letters & Science

The horse, from its introduction to North America in the mid 1500's onwards, immediately captured the hearts of the indigenous nations. By the mid to late 1800's the horse was a symbol of status, a widely relied upon tool, and a revered companion. Horse effigy dance sticks created during this period (arguably the peak of indigenous Horse Culture on the Great Plains) to honor warriors' mounts, capture the love and respect of this relationship like no other objects we have preserved or studied today. Through an examination of horse effigy dance sticks and the deeply personal stories connected to them, I will capture more deeply and accurately this relationship that is more often than not examined by historians clinically and economically. While I will not overlook the technological innovation, economic reverberations, or societal developments sparked by the horses introduction, I will rather focus on how these effects and others were interwoven in a complex web of cause and effect with the emotional connections and subsequent development of a new cultural identity in the nations of the Great Plains.

Afternoon | 10 | *T.C. Cannon: The Spaces Between*
Annamarie Thomas | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Institute of American Indian Arts is a public tribal college in Santa Fe, New Mexico, excelling at provoking thought and creating an exceptional education environment. IAIA has made it its mission to nurture Native's and Non-Natives in their pursuit of a creative path. T.C. Cannon was a Kiowa Native painter and alumni of IAIA. During the 1960s, students attending IAIA, including Cannon, began to push the boundaries of Native American art. Moving away from traditional Native Art and incorporating elements of modern Western painting, Cannon's work helped to redefine what can be considered Native art. T.C. Cannon's paintings address the juxtapositions between Native and non Native while also incorporating the space in between the two. This research analyzes Cannon's upbringing, influences, and the role of IAIA in the development of Cannon's personalized style. It will also take into consideration Cannon's influence as not only a Native artist, but his impact on the greater artistic world as a whole and the way he changed how Native Americans were portrayed in art.

Afternoon | 7 | *Addressing the issue of violence against Indigenous Women*
Emmett Thorsen | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Systemic discrimination and oppression are the root of the violence towards Indigenous Women today. Aside from the discrimination Indigenous women face daily, they are also subjected to higher rates of violence when compared to non-indigenous women. This issue can affect communities as a whole and the violence can take many different forms. This abstract will focus on the causes as well as the consequences of violence against indigenous women while also exploring the efforts that have been made to raise awareness towards this issue. This abstract will highlight the importance of these issues while exploring the work of Cannupa Hanska Luger a New Mexico based artist who uses his platform to address violence against Indigenous Women among other issues like environmental justice. This abstract will take the form of a poster with a focus on bringing awareness to this serious issue while also providing support and resources.

Afternoon | 13 | *Women in Metalsmithing: Native Innovation*
Lydia Truman | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

The Institute of American Indian Arts, also known as IAIA, has revolutionized Native artists across the country. Located in Santa Fe, New Mexico, The IAIA excels at developing thought-provoking artists with its exceptional and creative, educational environment. The Institute, faculty and students alike, have dedicated themselves to nurturing Native (as well as non-Native) peoples in their pursuit of creativity. Originally, intended to be a high school, the IAIA has turned the narrative of tribal art on its head, developing a prospering community where Native artists can thrive. The enriching education found at IAIA has led to the emergence of a thriving ensemble of metalsmiths with notable jewelers such as Keri Ataumbi and Tania Larrson. Kiowa artist, Ataumbi, renowned within her field, has been featured in exhibitions from the Minneapolis Institute of Art to the Smithsonian National Museum of the American Indian. Larrson, of the Gwich'in nation, apprenticed under Ataumbi at IAIA before becoming a founding member of the Dene Nahjo, an Indigenous innovation collective in Denendeh. The education and support the two women received at IAIA gave these artists the foundations to prosper throughout their careers.

Morning | 9 | ***Horses: The symbols used and treasured in Indigenous North American horse regalia***
Elizabeth Workman | College of Arts & Architecture
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Letters & Science

As a species, the horse has served a huge role in Indigenous North American history. In many cultures the horse itself is a sacred member of the tribe, one who is identified to be as important and deserving of wearing symbols and legends as any human. To this end, this presentation will be identifying and breaking down some of the symbols and imagery present within Native North American horse regalia and discussing how they are used in historical examples of traditional Native horse regalia as well as the contemporary examples including but not limited to artists such Angela Swedberg and Roger White Owl Lavadour.

Afternooon | 17 | ***Native American Instruments***
Max Zapata | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine Horse | Gallatin College

This research project will contain a written paper explaining the information being presented as well as a decorated poster in order to visually show our topic and information in an organized and artistic manner. Our project will explore Native American music through the instruments that were and are still used today to create music by the Native Americans. For the project each of our group members will focus on a certain instrument, how it is made, its impact on tribal music, and how it can be played in a solo or group setting. We will also include some history on tribal music in America and how it connects to Native culture and how it is played today and relates to Native Americans in contemporary society. Our poster board will include images of these instruments and how prevalent certain instruments are in certain tribes or regional areas of the country. Overall this project will help us learn about Native American music through the instruments used to create it.

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

BIOCHEMISTRY

Afternoon | 21 | ***Antiarenaviral activity of radical kinase RiPP natural products***
Tyler Delridge | College of Engineering
Mentor(s): William Walls | College of Letters & Science

Ribosomally synthesized and post-translationally modified peptides are a large and expanding family of natural products. Throughout RiPP biosynthesis, enzymes aid in intermediate mechanistic steps known as post-translational modifications (PTMs). These complex intermediate modifications and the wide functionality of the RiPP natural products continues to attract the attention of research scientists today. One RiPP biosynthesis enzyme family called radical S-adenosylmethionine (rSAM) installs various PTMs using radical-based chemistry and an Iron-Sulfur cluster. However, the details of the substituent mechanistic steps of these reaction pathways have not been determined. The epimerase OspD is hypothesized to utilize a 5'-deoxyadenosyl radical, a co-substrate product of all rSAM enzymes, to regiospecifically install D-amino acids into the core of the precursor substrate. These epimerization sites are responsible for the rare antiarenaviral activity of OspD; This rare activity paired with the substrate ambiguity and irreversibility of this enzyme, show exciting potential for re-engineering a new antiviral. Mutagenesis and spectroscopy tools have been used to isolate mechanistic intermediates of this enzyme pathway and hope to elucidate the origin of the hypothesized substrate quenching proton-coupled electron transfer (PCET), and cysteine quenching PCET, resolving OspD to its active confirmation. We have successfully used electron paramagnetic resonance (EPR) to capture the intermediate radical substrate for the first time. We are now moving forward with deuterated amino acid substrates and further mutagenesis products to solidify this evidence as a mechanistic intermediate and uncover more about the origin of the two proton-coupled electron transfers.

Afternoon | 20 | ***Integration of Indian Education for All into Highschool Science Classrooms***
Emily Fuchs | College of Letters & Science
Mentor(s): Paul Gannon | College of Engineering

Indian Education for All (IEFA) is a program in Montana schools that stemmed from Article X of the Montana State Constitution which outlines that the state of Montana is committed to preserving the cultural integrity of American Indians within its education of youth. IEFA encourages all Montana teachers to implement at least one of the seven essential understandings of Montana Natives outlined by the Montana Office of Public Instruction into their curriculum no matter the age or subject that they are teaching. STEM fields in general have very few resources offered by the Montana Office of Public Instruction on how to include IEFA into high school level classrooms, and looking at Chemistry specifically the Office of Public Instruction has no resources offered at all. This research project looked at ways to combine IEFA instruction with the Next Generation Science Standards (NGSS) that are taught in high school chemistry classrooms, and produce an adaptable lesson plan that Montana teachers could use to enhance their instruction on the seven essential understandings of IEFA in a science classroom. The main process that was explored during this research project was nixtamalization and how the chemical processes involved in this Native American way of preparing food could be taught and explored through lab activities at a high school level. To finish off the project, this adaptable lesson plan was submitted to the Montana Office of Public Instruction for review and possible integration into their resources for teachers for IEFA in high school classrooms.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 20 | ***Investigation of Small Molecule Inhibition of Dual-Specificity Tyrosine Phosphorylation Regulated Kinase 1-A in treatment of Alzheimer's Disease***
Julia Gentry | College of Letters & Science | **Co-Author(s):** Kenai Wilson and Alex Charbonneau
Mentor(s): Martin Lawrence | College of Letters & Science

Human Dual Specificity Tyrosine Phosphorylation-Regulate Kinase 1A (DYRK1A) has been identified as a key factor in the development of neurodegenerative disorders such as Alzheimer's disease. Neuronal death due to the accumulation of insoluble amyloid plaques and neurofibrillary tangles is connected to the overexpression of DYRK1A. We first adapted a high-yielding purification protocol for the DYRK1A construct of amino acids 127-485 from the pNIC28-DYRK1A vector (Addgene) which included Ni-NTA affinity purification and size exclusion chromatography. Next, we used in silico docking models to characterize binding affinities and conformations of 18 novel inhibitors through Autodock Vina. These models predicted binding affinities within 1 μM of experimental values. Using both sitting drop and hanging drop vapor diffusion, we attempted to crystallize DYRK1A with these novel inhibitors to structurally characterize the interactions using X-Ray crystallography. Using an ADP-Glo™ Kinase Assay (Promega), we analyzed the inhibitory effects of these compounds on DYRK1A. Finally, we attempt to determine the active site conformation of apo DYRK1A, for which there is no known structure, through X-Ray crystallography. The goal of this work is to add to the body of knowledge on inhibitor scaffolds for DYRK1A and to increase understanding of the active site of the kinase.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 21 | ***Understanding the effect Reactive Balance Training has on joints through biomarker analysis of IL-6, Osteopontin, CTX-I and CTX-II*.**
Matthew Waldum | College of Education, Health, & Human Development
Mentor(s): David Graham | College of Education, Health, & Human Development

Reactive Balance Training (RBT) is a form of balance recovery training. RBT utilizes the unpredictable nature of a slip, or trip to train individuals to recover in a single-step response. Literature notes that dynamic RBT is an effective training regimen for balance training and fall prevention. However, RBT participants may experience large joint loads, which affect is not known on joint health. The purpose of this study was to analyze biomarkers that signify cartilage and bone degradation pre and post RBT session. This was achieved by having 7 healthy individuals ages 40-65 undergo a session of RBT. Each participant was considered fit and withheld the amount of strenuous activity to prevent biomarker increase not related to RBT. Quasi experimentation was done by having individuals alternate between 10 induced falls, and 30 induced falls. Urine was collected and analyzed for c-terminal telopeptide II (CTX-II), and collage type-II cleavage product (C2C) immediately before RBT, and one week post RBT. CTX-II was analyzed to assess cartilage degradation, and C2C was measured to observe the amount of type-II collagen breakdown. It was seen that there was an increase in both biomarkers for the participants, when compared to baseline. The biomarker levels were within normal limits post RBT session. Overall, it was deemed that RBT is safe for individuals to participate in.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 19 | ***Inhibition of DYRK1a with Novel Compounds***
Kenai Wilson | College of Letters & Science | **Co-Author(s):** Julia Gentry and Alex Charbonneau
Mentor(s): Martin Lawerence | College of Letters & Science

Dual Specificity Tyrosine-Phosphorylation-Regulated Kinase (DYRK1A) is a kinase found to phosphorylate tau proteins and plays a role in etiology of Alzheimer's disease. Inhibition can slow down the development of Alzheimer's disease or possibly halt development all together. Our research is focused on a family of novel compounds aimed to inhibit DYRK1A. The measured inhibition of these compounds will further the development for pharmacological treatment of Alzheimer's disease. Computational data was calculated to generate an indication of binding affinities of these novel compounds. Crystals were generated of the protein with now inhibitor to generate an apo structure of the protein. Crystals of DRYK1A were generated with JB-01-075 to generate a holo structure. Kinase activity was measured using an activity assay. This assay was used to generate an IC50 value. The IC50 value of JB-01-075 was measured and inhibition was observed. With refined techniques of activity assay and x-ray crystallography data, the computational data can be used to compare theoretical IC50's and generate a better understanding of DYRK1A's structure.

Acknowledgement: USP - Undergraduate Scholars Program

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

BIOMEDICAL SCIENCE

Morning | 23 | ***Influence of Shoe Cushioning on Skeletal and Muscular Contributions to Leg Stiffness Pre and Post Long Hilly Run***

Ashlyn Baird | College of Education, Health, & Human Development - Graduate Student
Co-Author(s): Lachlan Paige
Mentor(s): James Becker | College of Education, Health, & Human Development

While a few studies have evaluated how using maximal cushioning shoes (MAX) affect leg stiffness (kleg), these have all used short run durations. However, MAX shoes were originally designed for trail running environments featuring longer runs with elevation changes. Thus, this study examined how kleg and skeletal (kskel) and muscular (kmus) contributions to kleg change following a long hilly run (LHR) in either traditional (TRAD) or MAX shoe conditions. Sixteen runners completed a 10-mile LHR in a TRAD or MAX shoe. The LHR was performed on an instrumented treadmill and matched the elevation profile of a local trail run. Peak resultant ground reaction force (pGRF), three-dimensional leg compression (Δleg), kleg, and kskel and kmus contributions to kleg were calculated during level running pre and post LHR. Two-way mixed ANOVAs were used to evaluate differences across time and conditions. There were no shoe-by-time interactions, nor main effects of shoe or time for pGRF, Δleg, or kleg. Both kskel ($p < .001$) and kmus ($p = .006$) displayed main effects of time, with kskel increasing by 26% ($d = 0.72$) and kmus decreasing by 12% ($d = 0.52$) following the LHR. These findings agree with previous studies showing that MAX shoes do not affect overall kleg differently than TRAD shoes. Regardless of shoe condition, skeletal contributions to kleg increase following a LHR while muscular contributions decrease. These changes likely result from accumulated fatigue during the LHR. The influence of these altered contributions to kleg on performance or injury risk requires further investigation.

Afternoon | 23 | ***Creating An Algorithm to Study Osteocyte Lacunar Canalicular Bone Remodeling as We Age***

John Boone | College of Engineering
Mentor(s): Chelsea Heveran | College of Engineering

Loss of fracture resistance in aging bones is a major unsolved medical issue. Bone quality is determined by bone remodeling, which is the continuous process of forming and reabsorbing bone, accomplished by bone cells, and is directly related to fracture resistance. Emerging evidence shows that osteocytes, the body's most abundant bone cell, can directly remodel surrounding bone tissue. Osteocytes live in an expansive network in our skeleton, called the lacunar canalicular system (LCS). There are several methods to study the shape change of LCS, but these methods alone give no information on the extent of osteocyte remodeling activity. Using images created by a confocal laser scanning microscope (CLSM), I created a program that identifies marked osteocyte cells, which are marking whether LCS remodeling has or has not happened. Then, for each of the marked cells, my program identified the shortest distance to the endocortical (inner bone) wall. To calculate the shortest distance to the endocortical wall, I created a greyscale map of the image, identified the marked endocortical bone, and for each of the pixels on the endocortical bone calculated its distance to the cell. Finally, my program was then used to analyze the percent of bone-forming osteocytes in different strain regions within the bone and in different intracortical strain regions (distances) from the endocortical wall. This program helped me and my lab demonstrate that the percent of osteocytes forming bone in older mice is 40% lower than in young mice and is not dependent on strain.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 25 | ***Anthropometric Predictors Of The Postprandial Triglyceride Response In A Metabolically At-risk Cohort***

Morgan Chamberlin | College of Education, Health, & Human Development - Graduate Student
Co-Author(s): Emily Peterson, Lindsay Lee, and Stephanie Wilson
Mentor(s): Mary Miles | College of Education, Health, & Human Development

Elevated postprandial triglycerides (ppTG) are an indicator of impaired metabolic health and are influenced by visceral adipose tissue (VAT) levels. Skeletal muscle impacts TG clearance and, as a result, fat free mass (FFM) may be an important mediator of ppTG to consider in individuals with central obesity. PURPOSE: To investigate the contribution of VAT, FFM, and fat mass (FM) to ppTG iAUC in response to a high-fat meal in adults with central obesity. METHODS: Adults (n=78) aged 18-70 with elevated waist circumference (99.7 ± 13.4 cm women, 104.2 ± 9.3 cm men (mean ± SD)) completed a high-fat meal challenge (50g FAT, 54g CHO, 12g PRO) with blood collected at fasting and hourly timepoints for 4 hours postprandially. Serum TG were summarized as iAUC (TGiAUC). Bioelectrical impedance analysis was used to measure VAT, FM % , and FFM%. Linear modeling determined which measures contributed to ppTG and predict HIGH (top 1/3) versus LOW (bottom 1/3) TGiAUC responses. RESULTS: VAT was the strongest predictor of TGiAUC (=9.2, p=0.02) with an increase in ppTG observed with increasing VAT. FM% and FFM% did not predict TGAUC (p= 0.28 and 0.12, respectively). Average TGiAUC of HIGH vs LOW responders was 9.12 ± 2.55 and 1.51 ± 0.95 mmol/L x 4 hours, respectively. VAT was the only significant predictor of HIGH versus LOW TGiAUC group (p <0.01). CONCLUSION: TG response to a high-fat meal is best predicted by VAT. These findings stress the importance of strategies to decrease VAT in at-risk adults.

Afternoon | 22 | ***Rapamycin Does not Alter Bone Microarchitecture or Flexural Properties in Young Adult and Early Old Age C57BL/6 Mice***

Connor Devine | College of Engineering | **Co-Author(s):** Kat Paton
Mentor(s): Stephen Martin and Chelsea Heveran | College of Letters & Science

Rapamycin is an FDA approved macrolide compound that was recently found to extend the lifespan of multiple species by 7-14%, generating excitement for rapamycin use as an anti-aging therapeutic. This potential has been evaluated in various tissues including bone, where previous investigations found an age dimorphic effect of daily rapamycin treatment; aged vs. young mammals had improved vs. impaired bone accrual, respectively. This study determined the impact of low-dose, interval, intraperitoneal rapamycin treatment in skeletally mature young adult and early old age female C57Bl/6 mice using three-dimensional X-ray tomography (microCT) and three-point bending flexural testing to assess bone quality, and glucose tolerance testing as an index of metabolic health. As expected, age significantly decreased measures of trabecular microarchitecture and cortical geometry ($p < 0.05$ for all). Rapamycin did not affect these measures. Similarly, modulus, yield stress, and ultimate stress were all reduced by age ($p < 0.05$ for each), but not rapamycin treatment. Rapamycin treated mice exhibited higher fasting BG compared to vehicle mice (+14.26% $p = 0.018$). With a rapamycin effect on glucose metabolism, we found similar skeletal effects of rapamycin on the young adult and early old age mouse skeleton despite the conflict between previous studies on age and rapamycin effects on bone mass. To further evaluate long-term rapamycin as an anti-aging strategy, future work will employ longer duration rapamycin interventions across a greater variety of ages.

Acknowledgement: USP - Undergraduate Scholars Program and INBRE - IDeA Network for Biomedical Research Excellence

Morning | 54 | ***Effects of Manual Mobalizations on Foot Kinematics and Muscle Activity***
Jackson Golden | College of Education, Health, & Human Development | **Co-Author(s):** Riley Hagger
Mentor(s): James Becker | College of Education, Health, & Human Development

The effects of mobilization through manual therapy on the tibiofibular, talocrural, subtalar, and midtarsal joints are well documented in clinical patients, it is unclear whether mobilization may provide benefits to foot and ankle function in an otherwise healthy individual. Therefore, the purpose of this case study was to identify the acute effects of manual therapy mobilizations on foot kinematics, muscle activation, and plantar pressures during walking in a healthy individual. It was hypothesized that mobilizations would increase joint ROM, increase activation at the adductor hallucis (AbH), and increase peak pressures under the forefoot. Foot kinematics were recorded using a 10-camera motion capture system, EMG from miniature sensors placed on the belly of the AbH muscle, and plantar pressures from a pressure mat located in the middle of the walkway. Data was recorded for five trials each of walking before (PRE) and after (POST) foot mobilizations. PRE and POST ROM measurements were not significantly different for talocrural ($p = .093$), subtalar ($p = .351$), transverse tarsal ($p = .471$), 1st MPJ ($p = .823$), and tarsometatarsal joints ($p = .142$). AbH EMG activation was greater for POST (.36 mV) than for the PRE trial (.16 mV, $p = .002$). PRE and POST plantar pressures were not significantly different for any section of the foot including the M1 ($p = .734$) and M2 areas ($p = .905$). An acute bout of mobilizations does not appear to influence foot kinematics or plantar pressures, but may increase muscle activation in the adductor hallucis.

Morning | 55 | ***Effects of Manual Mobilization on Foot Kinematics and Muscle Activity***
Riley Hagger | College of Education, Health, & Human Development | **Co-Author(s):** Jackson Golden
Mentor(s): James Becker | College of Education, Health, & Human Development

While the effects of mobilization through manual therapy on the tibiofibular, talocrural, subtalar, and midtarsal joints are well documented in clinical patients, it is unclear whether mobilization may provide benefits to foot and ankle function in an otherwise healthy individual. Therefore, the purpose of this case study was to identify the acute effects of manual therapy mobilizations on foot kinematics, muscle activation, and plantar pressures during walking in a healthy individual. It was hypothesised that mobilizations would increase joint ROM, increase activation at the adductor hallucis (AbH), and increase peak pressures under the forefoot. Foot kinematics were recorded using a 10-camera motion capture system, EMG from miniature sensors placed on the belly of the AbH muscle, and plantar pressures from a pressure mat located in the middle of the walkway. Data was recorded for five trials each of walking before (PRE) and after (POST) foot mobilizations. PRE and POST ROM measurements were not significantly different for talocrural ($p = .093$), subtalar ($p = .351$), transverse tarsal ($p = .471$), 1st MPJ ($p = .823$), and tarsometatarsal joints ($p = .142$). AbH EMG activation was greater for POST (.36 mV) than for the PRE trial (.16 mV, $p = .002$). PRE and POST plantar pressures were not significantly different for any section of the foot including the M1 ($p = .734$) and M2 areas ($p = .905$). An acute bout of mobilizations does not appear to influence foot kinematics or plantar pressures, but may increase muscle activation in the adductor hallucis.

Morning | 56 | ***Acute Effects Of A Weekly Long Run On Metatarsal Bone Loads***
Kaitlyn McKibben | College of Education, Health, & Human Development - Graduate Student
Co-Author(s): Megan Peach
Mentor(s): James Becker | College of Education, Health, & Human Development

Metatarsal stress fractures make up 9% of all running injuries and long-distance runners who experience greater volumes of bone loading may be at a higher risk for developing stress fracture injuries. While the influence of footwear and footstrike pattern on metatarsal loading have been previously reported, it remains unclear how run duration influences metatarsal loads. PURPOSE: To compare changes in metatarsal bone loading parameters at the beginning and end of a long-distance run. METHODS: Nineteen long-distance runners (12 female; 21.57±3.53 years; 70.01±10.79 kg) ran a distance equivalent to 25% of their weekly mileage on an instrumented treadmill at a self-selected pace. Whole body kinematics, ground reaction forces, and in-shoe plantar pressures were recorded pre and post long run. Plantar and dorsal stresses, and midshaft bending moments were calculated using a musculoskeletal model of the metatarsals. Paired t-tests were used to compare mean peak loads between pre and post long run. RESULTS: Post run, peak plantar stresses increased 8% in the second ($p < 0.001$, $d = 0.248$) and 7% in the third ($p < 0.001$, $d = 0.182$) metatarsals. Peak dorsal stresses increased 5% in the second ($p = 0.029$, $d = 0.160$) and third ($p = 0.012$, $d = 0.135$) metatarsals. Peak midshaft bending moments increased 8% in the second ($p < 0.001$, $d = 0.245$) and 7% in the third ($p < 0.001$, $d = 0.180$) metatarsals. CONCLUSION: A non-exhaustive weekly long run increases metatarsal bone loading parameters in the second and third metatarsals, potentially increasing injury risk.

Morning | 22 | ***Novel Mechanism of Methane Synthesis***
Jordan Pauley | College of Letters & Science | **Co-Author(s):** James Larson and Brooklyn Brekke
Mentor(s): Brian Bothner | College of Letters & Science

Aerobic methane synthesis is a novel issue under investigation, a process previously believed to be limited to anaerobic methanogens. Initially, the McDermott and Bothner labs isolated a bacterial strain of Acidovorax from Yellowstone Lake that has been shown to produce methane in aerobic conditions. Recently, a new publication demonstrated that interactions between reactive oxygen species (ROS) and free iron may result in the formation of methane in all living organisms. This methane production has been shown to be increased by cellular oxidative stress and requires metabolic components.
The mechanism of this methane production remains unconfirmed but is hypothesized to involve the Fenton reaction. Methane can be produced through this mechanism in a chemical model system and involves the oxidation of Fe(II) to Fe(III) through the reduction of hydrogen peroxide to a free radical. The products of this reaction drive the formation of methane through oxidative demethylation of sulfoxides to form methyl radicals which are eventually converted to methane. Because this reaction can occur under ambient conditions, it offers the potential for this to occur in living cells. Addition of dimethyl sulfur oxide (DMSO) and FeCl¬3 drastically increases the amount of methane produced. To elucidate the mechanism of this methane production, I screened several metals that are known to display Fenton-like chemistry. Vanadium was seen to behave similarly to iron, while copper knocked out methane production. Further experiments are being conducted to determine the interactions of these different metals with DMSO and how this results in the consequent formation of methane.

USP - Undergraduate Scholars Program

Afternoon | 24 | ***Effect of unanticipated constraint on lower extremity energy absorption during jump landings following ACL reconstruction***

Brendan Silvia | College of Engineering | **Co-Author(s):** Fatemeh Aflatounian, James Becker, and Keith Hutchison
Mentor(s): Scott Monfort | College of Engineering

The purpose of this study was to examine the differences in energy absorption across the joints of the lower body of participants with anterior cruciate ligament reconstruction (ACLR) during unanticipated jump landings. This study investigated how an unanticipated directional cue influenced the relative proportion of negative work performed at the ankle, knee, and hip joints during a jump landing. We hypothesized that, due to previously reported compensatory mechanisms following ACLR, added cognitive challenge during a jump landing task would cause a decrease in the negative work done at the injured knee during landing. The uninvolved knee and limb absorbed more energy compared to the involved knee and limb (both $p<0.001$). This tendency may highlight maladaptive landing techniques following ACLR. Our hypothesis was not supported as there was not a significant change in energy absorption at the involved or uninvolved knee due to changing conditions ($p=0.908$ and $p=0.392$, respectively). Expanding analysis to other joints, the hip (involved:$p=0.001$; uninvolved:$p=0.024$) and ankles (involved:$p=0.007$; uninvolved:$p<0.001$) experienced significant differences between conditions. For unanticipated trials, the ankles demonstrated an increase in relative energy absorption, while the hips demonstrated a decrease in relative energy absorption. Participants shifted the relative energy absorption from the hip to the ankles when faced with an unanticipated jump landing constraint. As the increase in relative energy absorption at the ankle has caused movement patterns resulting in greater peak anterior shear force on the ACL, these findings highlight how sport-relevant scenarios can elicit ACL-injury-relevant shifts in energy absorption during a jump landing.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 24 | ***Relationship Between Body Composition and Inflammation in Individuals at Risk for Metabolic Syndrome***

Meghan Spears | College of Education, Health, & Human Development - Graduate Student
Co-Author(s): Morgan, Chamberlin, Prabina Bhattarai, Katy Kropatsch, and Stephanie Wilson
Mentor(s): Mary Miles | College of Education, Health, & Human Development

Metabolic syndrome has been characterized by increased systemic inflammation, but the contribution of body composition components (fat free mass, fat mass, whole body muscle, torso muscle, visceral adipose tissue) on inflammation in overweight populations with elevated abdominal obesity remains unclear. To investigate the relationship between body composition measures and fasting inflammation markers in individuals at risk for metabolic syndrome. Participants aged 22-58 (n=42) with an average waist circumference (WC) of 97.54±11.06 (cm) were assessed for inflammation and body composition. Fasting blood samples were assessed for cytokines (TNF-alpha, IL-23, IL-17, IL-1B, IL-6) to gain an inflammation profile of subjects. Cytokine concentrations were converted to z-scores and subjects were placed in one of two inflammation groups. Group Low (n=24) contained subjects with 3-5 cytokine z-scores <0, and group High (n=18) contained subjects with 3-5 cytokine z-scores z>0. Statistical analysis was done between groups comparing body composition measurements using t-test and linear regression. Between groups, absolute fat mass (FM) (pounds) ($p=0.04$) but not % body fat or % fat free mass (FFM) differentiated Low and High inflammation groups, with greater FM the High group. Average absolute FM of the High group (79.64±19.3 pounds) was greater than the Low group (70.37±12.58 pounds). Visceral adipose tissue ($p=0.17$), whole body muscle ($p=0.38$), and torso muscle ($p=0.34$) were not different between groups. In a population, the anthropometric factor that differentiated higher versus lower inflammation levels was absolute FM. Variations in VAT did not exacerbate inflammation and having greater FFM did not attenuate inflammation.

Morning | 26 | ***Effects of Prior ACLR and Cognitive Challenge on Postural Control following a Medial Side Hop***

Kaylan Wait | College of Engineering | **Co-Author(s):** Fatemeh Aflatounian, Janet Simon, Dustin Grooms, and James Becker
Mentor(s): Scott Monfort | College of Engineering

Altered postural control following anterior cruciate ligament reconstruction (ACLR) is a risk factor for a second injury. However, results can vary by balance task, which motivates the need for further investigation to understand potential therapeutic targets to improve ACLR outcomes. PURPOSE: Determine how postural stability compares between ACLR and uninjured limbs after landing from a medial side hop (MSH) test with added cognitive task. METHODS: 32 ACLR adults cleared for unrestricted activity (8 m / 24 f ; 19.8 ± 1.8 years, 1.71 ± 0.10 m, 69.7 ± 12.8 kg, 1.5 ± 0.6 years since surgery, Tegner: 6.8 ± 1.9) performed the MSH task and maintained single-limb stance for 30 seconds upon landing. The MSH was performed under single task (ST; MSH only) and dual task (DT; MSH + cognitive task) conditions. Center of pressure characterized postural sway using 95% confidence ellipse area (EA). Whole trial estimate (EAwt) and time-varying analysis were dependent variables. ΔEA quantified how much participants reduced sway over time. RESULTS: Condition and Limb were significant for EAwt. EAwt had less sway for DT than ST and for ACLR limb compared with uninvolved limb. Condition remained significant with the inclusion of MSH distance. For ΔEA, MSH distance was a significant covariate along with a trending effect of Limb, with more relative early-stance sway for the ACLR limb. CONCLUSION: Postural control following a demanding frontal plane jump was influenced by the addition of a cognitive task and differed between ACLR and contralateral limbs.

Acknowledgement: USP - Undergraduate Scholars Program and INBRE - IDeA Network for Biomedical Research Excellence

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

COMPUTER & INFORMATIONAL SCIENCE

Afternoon | 26 | ***Improving rural emergency services via systematic assessment of historical response and participation data***.
Michael Buffington | College of Engineering
Mentor(s): Ann Marie Reinhold | College of Engineering

Hyalite Rural Fire District (HRFD) responds to all fires, medical and other emergencies across 25 square miles in the southern Gallatin valley. Successful emergency response depends on 40 volunteers and 4 paid administrative staff. These volunteers and staff are responsible for meeting the increasing needs of its 9500 residents. HRFD has experienced a 60% increase in dispatches from 911 over the last 10 years. To address this increase in demand for services, they have implemented a variety of staffing programs to improve the reliability of their volunteers' response. To date, the efficacy of these programs has not been investigated systematically. I analyzed ten years of response and volunteer participation data to assess the impact of these programs using statistical and clustering techniques. Changes to staffing programs resulted in differential response rates to 911 calls and impacted volunteer-career lengths. HRFD management can use these findings to improve the critical services it provides to the community and benefit the careers of their volunteers' careers.

Afternoon | 30 | ***Spanish Lab - An interactive Spanish education app for children and teachers***
Cole Milne | College of Engineering | **Co-Author(s):** Geri Viallon and Makayla Broyles
Mentor(s): Clemente Izurieta | College of Engineering

In language classrooms all over the world, students spend most of their time learning vocabulary lists and grammar rules. Despite knowing words and grammar, many remain ineffective communicators in their second language. There are many language apps available, some of them excellent. But most of these are gamified ways of learning vocabulary and grammar. Our interactive Spanish Lab does not aim to replace these ways of learning, but rather offers a complimentary tool where students must be active participants, creating their own learning experience.Our app, Spanish Lab, allows teachers to build an interactive lesson where students participate. It offers students a fun way to build a narrative. It encourages them to use what they already know, visually reinforces their ideas, and gives them opportunities to create and interact in Spanish. By offering structured choices, an entire class can use the app to vote on what happens in the story, making the choices that move the story forward. The AI image generator is another effective aspect of the experience. Since each image is generated for that particular story, memory is reinforced. There is a sense of accomplishment in creating something unique. We want to give teachers a platform that leverages interaction, immediate feedback, and personal creation. We are hoping that this technology will help humanize the language classroom.

Afternoon | 29 | ***Neurodynamik***
Connor Parrott | College of Engineering | **Co-Author(s):** Zachary Jewett and Henry Wright
Mentor(s): Clemente Izurieta | College of Engineering

NeuroFluidic Diagnostics (NFD) develops a “nanotechnology-based finger-printing” method to refine pre-clinical drug discovery efficacy reports. Working with NFD, we have developed a web-based interface to allow researchers to utilize their services more efficiently. The primary objectives of this work are twofold. First, allow the user to submit an order based on their desired therapeutic drugs, cell types of interest, and biomarkers, charging them according to their selections. A portal allows NFD employees to view the orders and update the client throughout the process. This portal is built into NFD’s website utilizing a secure user-account system for both employees and users. We utilized SQL and Javascript to store the biomarker data as well as allow for asynchronous loading of the website. The second objective is to provide the users raw data spreadsheets so they can generate data maps based on their neurodegenerative disease markers. Data maps and easily accessible data play a critical role in drug efficacy reports, thus creating appealing and useful data visuals is essential. By creating a user-friendly, efficient, and secure interface NFD is able to expedite the preclinical portion of Alzheimer’s diseases drug FDA approval. Doing so saves time, money, and lives.

Afternoon | 25 | ***Continued Work on Raspberry Pi Camera System***
Matthew Phillips | College of Engineering
Mentor(s): Randy Larimer | College of Letters & Science

In the fall of 2022, I proposed to the MSGC BOREALIS labs to do continued work on the Raspberry Pi Camera System (RPCS). This continued work was to update the system to the newer parts for use by the 2023-2024 National Eclipse Ballooning Project (NEBP). Initially, we worked on getting the Raspberry Pi to work with the new ArduCam Rev D1. This was a large part of what needed to be resolved with the Dual Camera Multiplexer Hat, as switching from the Rec C board to the Rev D1 broke the system. What ended up being the largest difficulty was that both companies (the Raspberry Pi Foundation and ArduCam) were in the transition phase of switching to a new system library that would be used to interact with cameras moving forward. Beyond the Multiplexer Hat, there was also some minor difficulty in setting up a new type of Ubiquiti radio (the Rocket AC) for the system. What was done in regards to the Ubiquiti radio was adjusting the settings for a better long distance connection. Beyond fixing the system, I learned how to create a system image, using the dd linux command. This allows others to easily image their Raspberry Pis with all the systems automatically working upon startup (so long as all the proper hardware is connected).

Acknowledgements: MSGC - Montana Space Grant Consortium

Afternoon | 27 | *The Farm Owl*
Mason Reyher | College of Engineering | **Co-Author(s):** Cole Orelup
Mentor(s): Clemente Izurieta | College of Engineering

Efficient farming is an iterative process filled with trial, error, and grit. Someone's farm is never more than a single disaster away from bankruptcy. The onset of remote and computerized agriculture has allowed incredible amounts of food to be produced by large, corporate farms. Furthermore, computerized agriculture has enabled small farms to plan for and recover from disasters. While there is much to be gained from technology assisted farming, there are still significant complications and drawbacks. Fertilizer overuse and pests are among major problems that plague farmers. Issues like these have led to the bankruptcy of many small-town businesses, as well as ecological disasters like the Gulf of Mexico dead zone, where indirect overuse of fertilizer in the Golden Triangle has led to cyanobacteria toxifying major waterways. Over time, farming has evolved to incorporate various emerging technologies. With every iteration comes an improved method for solving previous problems within the agricultural process. In today's world, overuse of fertilizer is one of the largest problems that needs to be solved. By utilizing a lightweight drone, Raspberry Pi, and onboard camera, a drone can be flown into the sky to survey the farmland from above. Once landed, the drone can compute spliced, high DPI images that can be further transformed and analyzed using machine learning techniques. Herein we describe a solution that uses remote flight and computer vision to reduce fertilizer use in commercial and personal farmland, as well as perform integrated pest management maneuvers for major crops like corn and wheat.

Afternoon | 28 | *MilTech Capacity Plan Database*
Erin Scheunemann | College of Engineering | **Co-Author(s):** Brendan Verbrugge and Man Ho Yuen
Mentor(s): Clemente Izurieta | College of Engineering

MilTech is a company that was formed as a partnership between Montana State University and the Office of the Secretary of Defense. It acts as an intermediary between the private sector and several government agencies in order to provide the government with the latest technology quickly and reliably. For the various contracted projects MilTech provides assistance with, MilTech must manage the government issues budgets and spend the full amount for each project by the given deadline. Previously, the MilTech finance team had to import and export data between three tools: CatBooks, Excel, and Banner. This process was slow, cumbersome, and prone to human error. To make the process more efficient, more accurate, and less prone to error a LAMP-stack based web-app that interfaces with a database was created. This web app allows the MilTech finance team to avoid the usage of Excel and Banner, instead allowing them to import finance data from CatBooks directly into the web-app. The web-app automatically sorts the imported data for the finance team, allowing them to view and edit payment information in a variety of ways. The automatic data sorting of the web-app, combined with its ability to display the data in a variety of dynamic, editable tables drastically reduces the amount of time the MilTech finance team has to devote to budget management. Upon full completion of the web-app, its effectiveness as a solution to MilTech's budgeting problem will be verified by the MilTech finance team.

Morning | 28 | *How cyber capabilities impact military offensive operations on the battlefield and what the United States is likely to see in future conflict.*
Macy Schowalter | College of Agriculture - Graduate Student | **Co-Author(s):** Tyler Moravec
Mentor(s): Andrew Fallin and Clemente Izurieta

Cyber warfare has gained attention since 2010 when the US Government cyber worm, Stuxnet, infiltrated and disrupted Iran's nuclear program, leading the way in the development of offensive cyber capabilities worldwide. The United States has been a leader in cyber offensive and defensive capabilities but has tended to remain in the shadows to their true capabilities in order to limit other nation's use of these weapons for their advantage. Geopolitically, cyber has played a large part in countries national security, espionage programs, and diplomatic relations. However, despite its potential to effectively disrupt enemy military capabilities, such as targeting communications systems, critical infrastructure, and physical weapons systems; recent military operations have had limited use of this cyber potential with reconnaissance and ground forces on the battlefield. In the most recent conflict between Russia and Ukraine, cyber capabilities have been primarily used for intelligence gathering and the spread of information/disinformation. This research project explores historical and current offensive cyber capabilities in warfare and looks into the potential role cyber could have for the United States Military in future conflicts. A graph database will be the underlying technology to explore information and perform a detailed analysis of heterogeneous records of cyber-relevant data.

Morning | 29 | *OnWater Fish Measuring*
Ethan Skelton | College of Engineering | **Co-Author(s):** Caitlynn Koback
Mentor(s): Clemente Izurieta | College of Engineering

OnWater is a fly fishing app that allows users to store and access information regarding local fishing spots, and it also allows users to document their catches through photos. Many fishermen enjoy knowing the size of their fish. They take pride in the size of their catch and can compete amongst each other. OnWater will provide a feature that allows users to measure the fish without the use of external tools. Prior work by OnWater attempted the use of Augmented Reality (AR). Measuring through AR relies on multiple variables, but two main requirements are a 2D plane and consistent features, which complicates measuring techniques in fluid environments, such as a river, and on a wriggling subject -i.e., the fish. Research shows that on average, a fish's eye grows much slower in comparison to its body. As such, there is less variation between eye sizes as opposed to the body. This implies that it is possible to use the relative eye:body ratio to calculate the total length of the fish. Herein, we describe the implementation of a feature that allows the user to place points on a picture of the fish in order to calculate the pixel lengths of the eye and body. Based on the points distribution, an algorithm will calculate the best estimate of the fish's length. This feature is beneficial to all users of the app, as it removes the guesswork of describing the size of a fish.

Morning | 31 | ***Brightvine Mortgage Valuation Proposal***
Kate Stallbaumer | College of Engineering | **Co-Author(s):** Jacob Brown and Lauren Helbling
Mentor(s): Clemente Izurieta | College of Engineering

What happens to mortgages once banks lend out all the money they possess? Third party investors, often government agencies, offer to purchase these mortgages so banks can continue lending, and investors can reap the benefits of the mortgage payments. These corporations then sell shares of their mortgage pools, known as mortgage-backed securities, to private investors. Throughout this process, there is a massive transfer of paperwork and manual labor. Recognizing this inefficiency, Brightvine is developing a platform to connect mortgage securitization issuers to investors through the decentralized power of blockchain. Within this startup is the “Mortgage Desk” platform where investors purchase and sell mortgages on the Brightvine Marketplace. With this background, our team was tasked with developing a mortgage valuation tool to be featured in the Mortgage Desk to assist in determining which assets would be valuable purchases. We evaluated many factors contributing to asset valuation, such as details of the home and the interest rate of the lender, in order to predict the ideal buy and sell price points of the mortgage. Hundreds of potential fields go into consideration when developing a solution, and intensive research was required to come to a decision. Upon selecting essential fields and a current mortgage dataset for our training data, we pre-processed the data and ultimately developed a machine-learning solution, along with an interactive Material UI frontend, which interfaces as a microservice within Brightvine. Long term, this technology could be commercialized and sold to financial institutions outside Brightvine.

Morning | 30 | ***Eight:18 Sponsor Application***
Cameron Wilcox | College of Engineering | **Co-Author(s):** Jared Weiss and Tanis Hadwin
Mentor(s): Clemente Izurieta | College of Engineering

Sponsorships are an important aspect of business. Many marketing opportunities for businesses lie in their ability to sponsor events, and thus purchase the right to advertise their own brand, and build connections with people at any number of otherwise unrelated events. One problem is that sponsorships can be incredibly difficult to manage. Today, there does not exist a software solution that can be used efficiently and easily to manage a large number of sponsors and their assets. Today, Eight:18 employs a tedious system for tracking sponsors by hand through several spreadsheets, however, a more intuitive and efficient process to perform this task is necessary. We have developed a new solution (i.e., a web application) to transition the task to digital storage, and improve efficiencies. The web application is designed to track sponsors, their assets, and provide a platform for Eight:18 to interface with those sponsors as they strive to outreach to consumers. The React web framework was utilized to develop a user-friendly interface for this solution, and a selection of tools was carefully vetted to meet the back end functional requirements. This software provides an important contribution to modernizing the landscape of sponsoring events, not only for companies like Eight:18 who track sponsorships, but also by lowering administrative costs and reducing the chances for error. We expect that companies who provide sponsorships will have a better experience using this solution.

Morning | 27 | *GraphQL in Enterprise Architecture*
Riley Williams | College of Engineering | **Co-Author(s):** Colin Schutte and Gregory Hill
Mentor(s): Clemente Izurieta | College of Engineering

Application Programming Interfaces (APIs) are a big part of enterprise architectures as they are the middlemen between clients and data. However, there has not been much evolution to this kind of architecture as RESTful APIs dominate this space and improvements can be made. We have been tasked to explore and implement GraphQL in an internal system at F5 as a new technology that has unique advantages over REST. The current architecture is a typical 3 tiered architecture with a User Interface, REST API and a SQL Database. The current SQL database is hiding JSON data in the form of long strings. This is making it difficult and expensive to parse and duplicate. Since JSON data is graphical in nature, we are implementing GraphQL to integrate a graph database which will hold the JSON data. The JSON data is migrated from the SQL database to a graph database, and the GraphQL API is integrated into the system to call the database. These changes improve the runtime due to the GraphQL API, increase efficiency due to GraphQL queries and mutations, and improve scalability due to version history tracking capabilities. This research will contribute to the possible evolutions GraphQL can take as it grows in popularity as an alternative to the RESTful architecture, and as an example of the improvements that can be made to the API architecture space.

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

EARTH & ENVIRONMENTAL SCIENCE

Morning | 34 | ***The Effect that Nitrogen-Fixing Cyanobacteria have on Nutrient Cycling in an Alpine Lake***
Russell Conti | College of Agriculture
Mentor(s): Adam Sigler | College of Agriculture

Over the last ten years harmful algae blooms have increase five-fold causing an increase in environmental and human health concern. Harmful algae blooms are associated with a type of blue green algae that is known as cyanobacteria, which can produce harmful cyanotoxins. Our study aims to understand how a nitrogen fixating Aphanizomenon cyanobacteria, interact with an alpine lake nutrient cycle, focusing on nitrogen and phosphorus. We evaluated the internal and external nutrient loads for the lake. External nutrient loads were evaluated by collecting grab samples from lake tributaries and outflow. The lakes internal nutrient flux was estimated by creating 18 mesocosms that contained either shallow or deep lake sediment with treatment groups that contained varying volumes of cyanobacteria organic matter. Mesocosms were incubated in the dark for 12 days. During that period, four water samples were collected for nutrient concentration analysis. The area of the mesocosms were then related to the area of the lake and internal nutrient flux from lake sediments was calculated. Through our study we observed much more ammonium leaving the lake than entering and we found that internal contributions of phosphorus was greater than that from external sources. With deep sediments having the largest load contribution, as deep sediments have the largest potential to collect cyanobacteria organic matter from the water column. From this study, we conclude that cyanobacteria in the alpine lake are phosphorus limited and that internal sourced phosphorus from deep sediments is the largest contributor of bioavailable phosphorus.

Acknowledgement: McNair Scholars Program

Afternoon | 31 | ***Ten-thousand years of fire and soil evolution in the Northern Rockies***
Daniel Engen | College of Agriculture
Mentor(s): Anthony Hartshorn | College of Agriculture

While a workable knowledge of the short-term effects of fire on soils exists, only one study to date has integrated these short-term effects into the long-term consequences of fire on the evolution of soils. This study will quantify how long-term differences in fire frequency affect soil development in Western Montana by comparing soils underlying dry-mesic mixed-conifer forests historically subject to Indian burns to those not subject to Indian burns. To quantify these differences, sites which were historically frequented ('heavy use'), and thus frequently burned at low-intensity by Salish and Kootenai Indian tribes in western Montana, will be identified. Two soil pits will be dug at each location: one in 'heavy-use' areas, and one underlying nearby 'natural' forest areas subject to the same climatic and topographic factors, but lacking significant anthropogenic influence, resulting in a mixed-severity fire regime. As fire has been proposed as an accelerant to clay eluviation and nutrient loss, soils underlying heavy-use areas are expected to show a greater depth to peak clay concentration, and depletion of base cations in the surface horizons, as compared with more 'natural' areas. Elevated erosion rates are also expected in heavy-use areas, owing to frequent exposure of mineral soil to post-fire high-intensity precipitation events. Given the proliferating use of prescribed fire for forest management objectives on both private and public land, as well as in law, quantitative data on the long-term effects of management actions on the soil resource are essential, and will be provided by this study.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 32 | ***Age Dating Dacites from the Greater Yellowstone Region***
Hailey Finch | College of Letters & Science | **Co-Author(s):** Natali Kragh
Mentor(s): Madison Myers and Devon Orme | College of Letters & Science

The purpose of my research is to increase the number and spatial distribution of dacites (extrusive igneous rocks with high silica content) age dated in the Greater Yellowstone Region (GYR) in order to create a more complete picture of Yellowstone's volcanic history. Six samples of dacite units from south-west Montana and north-west Yellowstone were processed for zircons. The separated zircons were then mounted in resin and dated with a laser-ablation mass spectrometer using Uranium-lead (U-Pb) isotope analysis. U-Pb was used for all of the samples to maintain consistency, the lack of which is a major shortcoming with the current data available. The goal of this research is to reliably compare different dacites across the GYR and begin making conclusions about its geologic history. Current data indicates the dacites are Tertiary or Cretaceous in age. Samples dated within the Tertiary may coincide with the Absorarka volcanics (53 to 43 Ma) (Smedes and Protska, 1972). This would support many of the available dates and would allow for further conclusions about the progression of igneous activity during this time. Samples dated within the Cretaceous period, however, are much more complicated. Currently, there is only one volcanic deposit in the GYR that is dated as Cretaceous, and it was done so using K-Ar on hornblende (Tysdal et al, 1986). New data supporting this singular outcrop would indicate a much wider spread of early volcanism in the area than previously thought and would require a new interpretation of the geologic history of the region.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 32 | ***Mapping Crystal Ice Deformation with EBSD***
Lucas Jepsen | College of Letters & Science
Mentor(s): Colin Shaw | College of Letters & Science

Glacial motion is complex, studied across all scales and not fully understood. In order to understand macroscale glacial processes, an in depth understanding of microscale processes is essential. The emphasis of this research and methodology focuses on microscale processes within laboratory made ice, as well as natural glacier formations. This research covers four primary methods of study; (1) the creation of laboratory made polycrystalline ice, (2) compressive deformation of polycrystalline ice samples, (3) preparation of ice samples for cryogenic Electron Backscatter Diffraction (EBSD) analysis, and (4) applying methods to natural glacial formations. Combining these novel methods yields a new approach for understanding the microscale relationship between grain axis orientation and deformation in varying conditions. The primary purpose of this research has been to develop methods to map crystal ice grain orientation using cryogenic EBSD. After developing a sample preparation method for cryo-EBSD, samples of laboratory made polycrystalline ice were successfully mapped. Following the development of this novel process, samples of polycrystalline ice are to be compressively deformed and mapped with EBSD before and after deformation. This process will be completed with pure ice, and with samples that have been doped with varying concentrations of silica sand particles to evaluate the effect of particle contaminates on grain boundary interaction and orientation.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 33 | ***Analysis of Behavior and Health Outcomes for Volunteer Well Water Testing***
Michelle Leonard | College of Agriculture
Mentor(s): Adam W. Sigler and Michelle Grocke | College of Agriculture

Private well water supplies have been found to contain a variety of biological and chemical contaminants. These susceptibilities can result in health risks and outbreaks of waterborne diseases. While many know the health risks of well water, testing well water may often seem daunting and confusing. The Well Educated Program and my research guide private well owners to test and understand their well water. It is a crucial goal to educate well owners about their water quality and its direct connection to human health and quality of life. The Well Educated Program provides interpretations of the results, advice on how to treat home well water, well maintenance guides, and data summaries. The work conducted through MSU extension aims to collect data from around the state of Montana and its specific counties to compile information to transform it so the public can understand and visualize it. When observations are made with existing trends, the data collection can be used to survey participants to learn more about the success of the program and its ongoing projects. The Well Educated Program has collected data from around Montana to compile trend analysis data. This ongoing project looks to continue its work through data entry, the distribution of a program survey, and data collection. Survey deployment was completed through Qualtrics, with the potential for a companion hard copy survey mailed to participants who would prefer that option. Data collection and survey result analysis will be used to inform participants and improve the program.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 35 | ***Cumulative-risk assessment of exposure to well water contaminates, Boulder River Sub Basin, Jefferson County, Montana***
Elsa O'Neill | College of Agriculture | **Co-Author(s):** Margaret Eggers
Mentor(s): Mari Eggers | College of Agriculture

Introduction: An estimated more than 23 million US households rely on private well water. Private wells are not covered by the Safe Drinking Water Act. The Environmental Protection Agency (EPA) does not regulate private wells. Arsenic and Uranium levels in Montana's Boulder River sub-basin private well and stream water has not been assessed. Risk associated with water consumption water has not been assessed. Objectives: Assess cumulative health risk from lifetime consumption of private well water in Boulder River sub-basin, Jefferson County Montana. Improve knowledge of water quality, resources and education on effects of consumption of well water. Methods: Ground water information collected from Montana's Ground Water Information Center (GWIC) website. Health risks assessed using EPA cumulative risk methodology. Literature on water quality in sub-basin reviewed and utilized to achieve understanding of water quality. Sub-basin's water quality flyer prepared for local County Health Department. Results: Average cumulative risk for consumption of water in sub-basin is 4.632 and 9.029 for tested wells and streams. Values exceeding 1.0 are unsafe for lifetime consumption. Additionally, 55.25% of streams, 11.84% of wells tested exceed EPA's maximum contaminant level (MCL) arsenic. 97.27% of streams, 94.74% of wells tested in sub basin exceed EPA's maximum contaminant level goal (MCLG) for arsenic. Uranium levels exceed MCL: 50.77% of streams, 52.38% of wells tested exceed limit. 96.92% of streams, 98.41% of wells tested exceed uranium MCLG. Conclusions: Assessed risks and scope of contaminants in Montana's Boulder River sub-basin. Resource for relevant well owners created. This resource potentially applicable elsewhere.

Acknowledgement: USP - Undergraduate Scholars Program

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

ECOLOGY

Morning | 38 | ***Comparison of wood density, biomass allocation, and carbon isotope ratios between three high-elevation pines***
Tristan Burlingame | College of Agriculture | **Co-Author(s):** Sean Hoy-Skubik
Mentor(s): Danielle Ulrich | College of Letters & Science

High elevation 5-needle pines are crucial components of sub-alpine ecosystems across western North America threatened by climate change. This research is part of a study comparing effects of drought on whole-plant physiology of Pinus albicaulis, P. flexilis, and P. longaeva to improve restoration efforts. This project aims to answer this question: How do wood density, biomass allocation, and leaf carbon isotope ratios differ between species? To address this, we measured wood density, biomass allocation to above and belowground biomass (root:shoot ratio), and leaf carbon isotope ratios on greenhouse-grown 5-year-old seedlings of each species. Wood density was measured using the suspension technique. Biomass allocation was measured by weighing the dried roots, stems, and needles separately. Leaf carbon isotope ratios were obtained using an Isotope Ratio Mass Spectrometer at the Cornell Stable Isotope Laboratory. Mean wood density of P. flexilis was lower than that of P. albicaulis and P. longaeva ($p < 0.001$). Mean root:shoot ratio of P. longaeva was lower than other species ($p < 0.001$), and total biomass of P. longaeva was higher than the other species ($p < 0.001$). Mean leaf carbon isotope ratio was significantly higher in P. longaeva than of other species ($p = 0.001$). Results suggest that P. flexilis may be the least stress tolerant (wood density) and P. longaeva has lower water-use efficiency (leaf carbon-isotope ratio) and higher vulnerability to declining soil moisture (lower root:shoot). Taken together, the three species differ in physiological traits, possibly underlying their species-specific responses to drought under future climates.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 39 | ***Relationship Between NDVI and Soil Moisture in Yellowstone National Park***
Jackson Connors | College of Letters & Science | **Co-Author(s):** Carly Segal
Mentor(s): Andrea Litt | College of Letters & Science

The normalized difference vegetation index (NDVI) is a remote sensing calculation often used to measure vegetation productivity. However, the relationship between NDVI and physical characteristics, such as soil moisture, is largely unstudied. If NDVI could be used as a proxy for field-based measures, researchers could save time and effort. We sought to characterize the relationship between NDVI and soil moisture in Yellowstone National Park (YNP) and hypothesized that NDVI would increase linearly with soil moisture because soils with higher moisture holding capacity can support more plant growth. We also predicted that this relationship might change with grazing intensity; bison are the dominant grazers in this area and grazing may influence the soil and plant communities. During summer 2022, we recorded soil moisture from 9 sites and computed NDVI from Sentinel 2-A satellite imagery with 10-m pixel resolution. We found that the relationship between soil moisture and NDVI depended on grazing intensity. For every 1% increase in soil moisture, NDVI increased by 0.0019 (SE = 0.0007) in areas with low-intensity grazing, changed little (0.0004, SE = 0.0036) with moderate grazing, and decreased by 0.0082 (SE = 0.0013) with high-intensity grazing. We also found substantial unexplained variation in the model, which could result from variation in topography, climatic variables, and plant communities. Additionally, soil moisture could change more rapidly after precipitation events than NDVI, requiring us to consider time lags in the data. Exploring these factors is essential before NDVI can be considered as a reliable proxy for soil moisture in YNP.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 37 | ***Fungal Associacions in Montana's Native Orchids***
Ansel Fiddaman | University College
Mentor(s): William Dyer and Barbara Keith | College of Agriculture

Montana is home to approximately 31 native orchid (Orchidaceae) species, many of which are rare or threatened in the state. Most orchids rely on mycorrhizal relationships for part or all of their life cycle in the wild, particularly during seed germination and the protocorm stage. These relationships are often species-specific, with many orchids relying on only a few species of fungi. Understanding the relationships of orchids and fungi is crucial for orchid conservation, particularly for species that have not been successfully propagated using asymbiotic methods. In this study, I isolated fungi from the roots of several wild orchid species including Goodyera oblongifolia and Platanthera unalascensis, cultured the fungi on agar plates, and identified them through DNA barcoding of the nuclear ribosomal internal transcribed spacer (ITS) region. Preliminary results show associations with several fungi in Basidiomycota and Ascomycota. The results of this research may be of particular importance in orchid conservation, especially in propagation and reintroduction projects. Information on orchid mycorrhiza may also see application in agricultural fields, as some orchid mycorrhizal fungi can be found as pathogens on common crops like rice and potatoes.

Acknownledgement: USP - Undergraduate Scholars Program

Morning | 37 | ***Stomatal trait differences between geographically distinct foxtail pine populations***
Timothy Jones | College of Letters & Science
Mentor(s): Danielle Ulrich | College of Letters & Science

High-elevation five-needle pines (high-five pines) are both a keystone and a foundation species. They provide protection in harsh alpine conditions for other species to establish and decrease the melting rate of high elevation snowpack, which allows a constant source of water for streams and rivers throughout the year. As a changing climate and increased stress from drought threatens these species, such as the Whitepark pine (Pinus albicaulis), there is a pressing need to study early successional stages, which have higher mortality rates. Foxtail pine are endemic only in California and are split into two populations – one in the North, which experiences greater precipitation, and one in the South, which has a drier climate. The goal of this study is to determine if any differences in stomatal traits and stomatal conductance exist between juvenile trees - originating from northern and southern foxtail pine populations – when grown in a common garden experiment and exposed to the same drought conditions. Stomatal images were taken prior to a 25-week drought experiment, and stomatal conductance was measured throughout the drought. Due to the drier climate of the southern population, we hypothesize that juveniles originating from the southern population will have fewer and smaller stomata as well as lower stomatal conductance than juveniles originating from the northern population where the climate is cooler and wetter. This information would inform conservation strategies for struggling high-five pines, and aid future conservation strategies for foxtail pines, should it ever become endangered or threatened.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 36 | ***Response to Drought in Whitebark Pine***
Grace Miller | College of Agriculture
Mentor(s): Danielle Ulrich | College of Letters & Science

The whitebark pine is a keystone and foundation species in both alpine and subalpine ecosystems. It is one of the only species that can establish in such harsh environments and creates suitable habitat for other plants and animals. With recent global increases in temperature, the whitebark pine has experienced an alarming rate of decline. This decline can be attributed to biotic and abiotic stressors on the tree, including pathogens and increased drought. In our research, we investigated how these stressors may impact the tree's morphological traits. Specifically, we looked at stomatal density and stomatal size as reductions in stomatal size and density may reduce water loss. To obtain these data, we created stomatal imprints from whitebark pine juveniles that originated from different climates. Using ImageJ software, we analyzed the images to calculate stomatal density and area. From the data gathered, we hypothesize that juveniles grown in a common environment originating from locations with lower mean winter precipitation have smaller stomatal size and lower stomatal density than those originating from locations with higher mean winter precipitation, making them more drought resistant.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 35 | ***Plant Seed Set Response to Stigma Pollen Load***
Sabrina Morgan | College of Letters & Science | **Co-Author(s):** Lauren Gedlinskey
Mentor(s): Laura Burkle | College of Letters & Science

Plant-pollinator interactions provide an essential ecosystem service across species and community levels. Anthropogenic activity causing pollinator population decline facilitates an increased understanding of how pollinator activity influences response to change. This research will contribute to the knowledge of relationships between pollinator generalists and plant reproductive success, which is debated in pollinator community ecology due to the trade-off between pollinator visitation and the negative impacts of high heterospecific pollen loads. After quantifying seed sets of three species with varying peak bloom, averages of seed weight and quantity were compared to the ratio of heterospecific to conspecific pollen found on stigmas of select individuals. No significant correlation between peak bloom and conspecific pollen was found despite the prediction that species blooming early acquire low amounts of conspecific pollen. The results of this research can assist conservation efforts by determining if plant populations benefit from diverse pollinator visitation or if the quantity of heterospecific pollen is more influential for reproductive success.

Acknowledgement USP - Undergraduate Scholars Program

Afternoon | 33 | ***Species Distribution Modeling for Aquatic Invasive Species***
Joshua Naudet | College of Engineering | **Co-Author(s):** Leif Howard
Mentor(s): Meredith Hecker | Montana Space Grant Consortium

Invasive alien species (IAS) are the greatest threats to biodiversity. Species distribution modeling is a key resource for proactively managing their impacts and spread. Modeling habitat suitability into useful products for conservation practice are lacking and under-explored. This study demonstrates how the United States Geological Survey (USGS) Nonindigenous Aquatic Species (NAS) database can be combined with remotely-sensed environmental data to generate maps of relative IAS spread at relevant spatial scales. For this research project, the model targeted 5 high-priority AIS in North America (Rainbow Trout, Eastern Brook Trout, Eurasian Milfoil, Zebra Mussels, and Bighead Carp). These species were observed over 4 different spatial scales, otherwise known as pixel resolutions, in the model and statistically compared: 500m, 2500m, 5000m, and HUC Polygons. Crucial environmental variables (covariates) were also identified across the taxa to develop the model. This study highlights the use of presence data from NAS and NASA's remotely-sensed environmental data in invasive species modeling and proactive management and to help managers prioritize efficient use of limited conservation resources. It was concluded that the 500m pixel resolution produces the lowest error in all 50 states at 9%. It's recommended to maximize the model efficiency by using a pixel resolution of 500m for future research. Increased efficiency could also be made by inputting more covariate data to aid the prediction model. The model will be posted on the USGS website in 2023 so this tool is accessible for land managers to utilize across the US to minimize the negative impacts of AIS.

Acknowledgement: MSGC - Montana Space Grant Consortium

Afternoon | 34 | ***Analyzing Body Shape of West-slope Cutthroat Trout to Predict Individual Fish Performance in a Hatchery***
Zoe Schoop | College of Letters & Science
Mentor(s): Christine Verhille | College of Letters & Science

Conservation hatcheries stock the offspring of wild brood stock to supplement wild populations, but some brood stock die in the hatchery, resulting in reduced gene pool within stocked offspring. Fish body shape is affected by life history type, e.g., habitat and prey, which may influence performance in captivity. The motivation of this research is to test if there are correlations between fish body shape variables and survival and reproduction in captivity. Linear measurements, which have been related to fish lifestyle types such as foraging, will be performed on brood stock fish to test for correlation with hatchery performance. Photographs of 128 individual west slope cutthroat trout collected from Emery Creek in Northern Montana, were taken over three years of rearing in Sekokini Springs Hatchery. Photographs included a ruler to standardize scale. For each linear measurement, a linear regression with standard length will be performed to calculate residuals for each fish. Residual values will be compared to measures of performance, including survival, and egg/sperm production. Resulting linear measurements that correlate to fish performance measurements will be presented. Sekokini Springs Hatchery has attempted to identify fish at risk of not thriving in the hatchery and applied remedial actions to modify rearing conditions to improve performance with some success. If a detectable correlation between brood stock linear measurements and hatchery performance is found, linear measurements could be used for earlier identification and remedial action for fish at risk resulting in improved maintenance of the original brood stock gene pool within stocked offspring.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 36 | *Effects of drought stress on xylem anatomy of juvenile foxtail pine*
Naomi Vliet | College of Education, Health, & Human Development
Mentor(s): Danielle Ulrich | College of Letters & Science

Foxtail pine (Pinus balfouriana) is a species of high-elevation five-needled (high-five) pine endemic to California. They can be found in two geographically disjunct regions, one in wetter northern California and one in drier southern California. These populations are often considered to be two distinct subspecies. High-five pines are important foundational and keystone species in alpine and sub-alpine ecosystems, providing food and shelter for many other organisms. However, these high-elevation pines are declining at unprecedented rates due to factors including drought stress, which can affect the structural development of the xylem, the tissue that transports water in plants. Xylem anatomy influences the success of individuals' survival during drought because certain xylem traits determine the efficiency and extent to which xylem is able to transport water during drought. Drought stress can also alter xylem anatomy as it is being formed. Our study compares the effects of drought stress on the xylem anatomy of juvenile foxtail pines from the wetter northern and drier southern populations after exposure to normal and drought conditions. We are specifically comparing cell wall thickness, lumen area, and theoretical hydraulic conductivity. We hypothesize that trees from the drier southern population will have smaller lumen areas, thicker cell walls, and lower theoretical hydraulic conductivity.

Acknowledgement: USP - Undergraduate Scholars Program and McNair Scholars Program

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

EDUCATION

Afternoon | 38 | ***The Benefits of a Home School Practicum***
Kendall Fowler | College of Education, Health, & Human Development | **Co-Author(s):** Matilda Dietz
Mentor(s): Karie Orendorff | College of Education, Health, & Human Development

It has been well established that preservice teacher's require ongoing experience in order to develop their beliefs about teaching (Arnett & Freeburg, 2008), connect theory to practice (Krustchinsky & Moore, 1981), and become acclimated to their teaching role
(Dueck, Altmann, Haslett, & Latimer, 1984). Though exposure to teaching experiences is a crucial part of developing high-quality teachers, traditional models of practice include the bulk of these experiences toward the end of preservice teachers' college career or during student teaching. Students are understandably over-whelmed with their first true experience working with students in a school setting. This is their first time facing common classroom challenges such as behavior issues, time management, or dealing with students with special needs. One way we help prepare our preservice teachers at MSU is by providing them more controlled teaching opportunities (Cruickshank & Armaline, 1986) earlier in their program of study, such as out Home School Practicum. This is their first practicum, and it sets the tone by helping our students develop their instructional skills, apply theory and content to their teaching, and strengthen their belief that teaching is the right career path for them. Our poster will detail our experiences in Home School Practicum, talking about what we learned and how it benefits us in our future profession.

Afternoon | 39 | ***Lesson Learned Organizing a Community Event***
Landon Kiker | College of Education, Health, & Human Development | **Co-Author(s):** Winslow Perry and Wyatt Courchaine
Mentor(s): Karie Orendorff | College of Education, Health, & Human Development

Comprehensive School Physical Activity Program (CSPAP) is a framework for planning and organizing activities (CDC, 2013). A CSPAP is a multi-component approach by which school districts and schools use all opportunities for students to be physically active, meet the nationally recommended 60 minutes of physical activity each day, and develop the knowledge, skills, and confidence to be physically active for a lifetime (CDC, 2013). At Montana State University, we host a community event for elementary school aged children, called Little Bobcat Track. For this event we partner with our university track team. All students in kindergarten through 5th are welcomed and encouraged to participate in this event. Little Bobcat Track allows K-5 students to learn and experience the different events in track and field, such as learning how to high jump, throw a javelin, long jump and participate in many other fitness activities. It also creates a connection between MSU and the community. We are learning how to create, direct and implement a community engagement, which meets one of the criteria for community engagement in a CSPAP. Our presentation will reflect our experiences with running this even from start to finish.

Morning | 41 | *Adventures in Rural Teaching*
Danielle Linehan | College of Education, Health, & Human Development | **Co-Author(s):** Hayden Slade and Mary Sanchez
Mentor(s): Karie Orendorff | College of Education, Health, & Human Development

In the state of Montana, 96% of districts are considered rural, and most experience recruitment issues (Montana University System [MUS] Rural Educator Task Force [RERRTF], 2017). In 2017, 83% of all teaching positions were located in small rural schools, yet 90% of preservice teachers had no clinical teaching experiences in rural school settings during their preparation programs (MUS RERRTF, 2017). By providing opportunities for preservice teachers to experience teaching within rural contexts we are building awareness to the possibilities (Roberts,2005). Past research has found that during an immersive experience in a rural context, preservice teachers experienced "very significant attitudinal changes" in their "willingness to teach in rural areas, which also dispelled misconceptions about rural living and teaching" (Hudson and Hudson, 2008, p. 74). This past semester we were able to participate in a rural practicum. We taught at a K-8 school with 53 students. We will be presenting on our experiences from teaching class sizes of eight to what to do when a moose walks down the street while you are teaching.

Afternoon | 40 | *Archery – Not Just for Robin Hood*
Wyatt Theard | College of Education, Health, & Human Development | **Co-Author(s):** Gannon Warren
Mentor(s): Karie Orendorff | College of Education, Health, & Human Development

After being certified by the National Archery in the Schools Program (NASP), we taught archery to our students in Home School Practicum. Archery is an activity that doesn't discriminate based on popularity, athletic skill, gender, size, or academic ability. The National Archery in the Schools Program is an in-school program aimed at improving educational performance among students in grades 4th – 12th. And through it, students are learning focus, self-control, discipline, patience, and the life lessons required to be successful in the classroom and in life (NASP, 2023). We taught the NASP curriculum to students in grades 4-10. We are presenting on our experiences from the certification process to teaching archery to our students, and also on experiences of our practicum students.

Morning | 40 | *Introducing Morality to Children thorough Literature in French and Senegalese Cultures*
Josephine Willard | College of Letters & Science
Mentor(s): Ada Giusti | College of Letters & Science

Through analysis of peer-reviewed articles by French psychologists and original French and Senegalese short stories and fables, it is evident that societies and cultures use children's literature to teach the next generation the accepted morals and spiritual beliefs held by that group. To compliment a child's developing brain and communication ability, authors utilize stories, adventures, and illustrations to start the process of comprehending complex ideals and social structures. What this looks like varies depending on the culture and country. For example, the messages to children in France have traces of Catholicism and revolutionary pride. Whereas the children in Senegal are being taught about Islam, traditionalism, and spirituality. Researchers have also found the best practices for introducing morality to children between the ages of 6-8 years and how their brains process, and in turn, display this information. This research is culminated in an illustrated children's book, in French, explaining the concepts of liberty, equality, and fraternity (the French motto).

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

ENGINEERING & TECHNOLOGY

Morning | 50 | ***Upgrading Lignocellulosic Biomass into Platform Chemicals for the Synthesis of Green Plastics***
Emily Augustine | College of Engineering
Mentor(s): Stephanie Wettstein | College of Engineering

The consumption of plastics derived from non-renewable resources such as fossil fuels continues to increase around the world, raising concerns on its impact to the environment. This has proliferated the research into using innovative strategies to refine renewable alternatives like lignocellulosic biomasses, such as grasses, into bio-based chemicals. These biomasses contain cellulose, which contains glucose, and hemicellulose, which contains xylose. These sugars can be dehydrated into intermediates, such as 5-hydroxymethylfurfural (HMF) and furfural. Both HMF and furfural are considered platform chemicals that can be used to create different types of chemicals such as plastics and fuels. In this work, Montana-grown intermediate wheatgrass was processed in organic solvent mixtures to increase the yields of the platform chemicals. Reaction variables such as time, temperature, solvent properties, and pH were varied to determine what impacted the HMF and furfural yield the most. The reactions were carried out in 50/50 organic-water mixtures using -butyrolactone (GBL), sulfolane, and tetrahydrofuran (THF) as solvents, and were catalyzed with sulfuric acid. A maximum furfural yield of 68% was reached with GBL solvent, and the maximum HMF yield of 37% was reached with sulfolane, while water had the lowest yield for both furfural and HMF. The choice of solvent was shown to impact the yield but using an acid catalyst dampens the solvent's impact. This study shows that high furfural yields can be accomplished from biomass, but still requires further research for the process to be proven a viable option for the reduction of fossil fuel dependence.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 51 | ***A NEW MSU TOWER-DORM DESIGN PROPOSAL***
Christopher Brizzolara | College of Arts & Architecture - Graduate Student
Mentor(s): Andrew Vernooy and Jordan Zignego | College of Arts & Architecture

Gallatin County announced they will be constructing a new residential subdivision focused on providing affordable housing units to employees and traveling nurses. This spring the county was seeking competitive proposals from "vendors" to provide design services and to come up with a competitive proposal. Here is Brizzolara's response and his master studio project with Dr. Jordan Zignego and FAIA Andy Vernooy.

This proposal is saying this new development must:

• be LEED Silver+, • incorporate passive solar design, • be built of Mass Timber & CLT construction in order to be Net Carbon Positive, • utilize thick insulation, passive ventilation strategies, as well as using solar energy to create an entire net positive subdivision, and most importantly,
• any condo must be unfinished and empty on the interior, aka, built in the "half-a-home" style, in order to minimize cost and allow the ownera to finish their condos themselves.

Morning | 47 | *VORTEX RING GENERATION VIA BIO-INSPIRED FLEXIBLE ORIFICES*
Matthew Bryant | College of Engineering
Mentor(s): Sarah Morris | College of Engineering

Vortex rings are seen in many biological flows, such as in the propulsion of jellyfish and as a method of reducing damage within the left ventricle of the heart. While vortex rings produced by rigid orifices have been extensively studied, in nature these orifices are typically pliable. To better understand the vortex ring dynamics of biological systems, research into the effect of orifice stiffness is necessary. In this work, a custom-built vortex ring generator is used. A nozzle suspended in a water tank is connected to a syringe pump that can adjust the amount of fluid ejected. Fluorescent dye applied to the nozzle is used to observe a cross-section of the vortex ring, illuminated by a 532nm light sheet. A DSLR camera captures this process at 24fps, allowing for vortex ring characteristics such as the descent speed and center location to be analyzed in MATLAB. Data is collected using both a 3D printed rigid orifice and a flexible silicone orifice. As the descent speed is directly proportional to the strength of the vortex (circulation), this allows us to relate the strength of the vortex to orifice stiffness. It is anticipated that vortex rings generated via flexible orifices will be stronger than those from rigid orifices, as elastic potential stored in the flexible material can impart more energy to the developing vortex ring. The results from this study should contribute to the future design of high-efficiency bio-inspired propulsors. Further testing with different materials and stiffness matrices is recommended in the future.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 52 | *Contrast Enhancement of Underwater Objects with Polarization*
Kyndra Buglione | College of Engineering | **Co-Author(s):** Erica Venkatesulu, and Nathaniel Field
Mentor(s): Joseph Shaw | College of Engineering

It is known that vertical polarizers make it easier to see the contrast of objects through the reflections on the surface water. However, the amount of contrast enhancement from the polarizers has not yet been recorded. In this study, we placed a black and white tile next to each other in shallow water and measured the contrast between a white and black tile as a function of viewing angle relative to the surface normal. We took indoor measurements by placing the tiles in a small tub of water and controlling the background color reflecting off the water surface. To measure the polarization-enabled contrast enhancement, we used monochrome and RGB polarization cameras that simultaneously recorded the degree of linear polarization oriented 0°, 90°, 45°, and 135° from horizontal. We characterized the spectral response of the camera, created a pixel angle map, and performed radiometric and polarimetric calibrations. For all measurements, the contrast enhancement from the use of a polarization imager improved as a function of angle. When using a white reflection, the three colors of the RGB data had similar contrast enhancement values for all angles. However, when using a blue reflection, the blue band of RGB data had much greater contrast enhancement from the polarizer than the green and red bands. We also performed outdoor measurements that looked similar to the indoor measurements from the blue sheet. In this poster, we describe the experiments performed, the camera calibrations, and graphs of contrast enhancements as a function of incidence angle.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 53 | ***MECHANICALLY ATTENUATING CHEMOTACTIC NEURITE OUTGROWTH***
Madeline Conrad | College of Agriculture | **Co-Author(s):** Mackenna Landis
Mentor(s): Anja Kunze | College of Engineering

For the brain to communicate effectively and consistently, the neurons within it must form structures, called neurites, to carry signals from cell to cell. By a process called chemotaxis, neurites are guided by chemicals outside of the cell. Disorders like schizophrenia can cause a decrease in neurites and their branching. Antipsychotic drugs, such as aripiprazole, use chemotaxis to reverse that loss. However, chemotaxis alone is not enough to create the specific directions of neurite growth necessary to return neurotypical brain communication. Nanomagnetic forces (NMF), which generate a mechanical force by applying an external magnetic field on nanometer-scale magnetic particles taken up by the cell, have been demonstrated to orient neurite outgrowth. Our study investigated the combined effects of mechanical force actuation and growth stimulation within a neurotherapeutic context. PC12 cells were seeded on coated Petri dishes and allowed to reach 10% confluence. Then we incubated 10 µg/ml starch-NH2 magnetic nanoparticles (d:iron oxide = 100 nm) for 24 h. Culture media containing 1 µM aripiprazole and 20 ng/ml NGF was added every other day. Cells were placed in three different external magnetic fields and imaged (Leica DMi8 brightfield) at days 0, 3, 5, and 7 of incubation. This synergistic approach caused neurites to grow in a predetermined direction based on the applied magnetic field and increase in length as the force increased. These results indicate that the combined use of NMFs and antipsychotic drugs may have the ability to orient neurite outgrowth for future targeted cell therapeutics and neural tissue engineering.

Acknowledgement: USP - Undergraduate Scholars Program and INBRE - IDeA Network for Biomedical Research Excellence

Afternoon | 47 | ***The Early Subchondral Bone Response to ACL Injury Depends on Age in C57Bl/6 Mice***
Lexia Dauenhauer | College of Engineering| **Co-Author(s):** Brady Hislop and Connor Devine
Mentor(s): Chelsea Heveran and Ron June | College of Engineering

Half of 200,000 people who tear their ACL each year will develop post traumatic osteoarthritis (PTOA) within 10-20 years. This suggests that early biological and mechanical changes in the joint may affect the progression of injury to PTOA. Mice were randomly assigned to either ACL injury or sham-injured groups. Femurs were analyzed for osteoclast number density using histology. Tibiae were analyzed using microCT and nanoindentation to study bone microarchitecture and material properties. In the 5 month old mice bone volume and trabecular thickness decreased with injury ($p=0.028$, $p=0.002$, respectively) and loading ($p=0.017$, $p=0.023$, respectively). The subchondral bone plate thickness had an interactive effect with injury and loading ($p=0.001$) on only the lateral side. We found a increase in osteoclast number density ($p=0.021$). There was a trend towards an increase with injury on subchondral bone modulus ($p=0.052$). In the 22 month old mice there were no significant effects found. The effect of ACL injury on aging joints is important for understanding the development of PTOA in older patients. Our study finds that early subchondral bone responses are evident one week after ACL injury in young adult mice but no changes are found in early old age mice. This data advances our understanding that young and old joints do not respond the same to ACL injury. The unmet need for improved diagnostics and therapeutics for older individuals experiencing ACL tears motivates additional work to understand the effects of joint injury on the cells and tissue structures of the aging knee.

Acknowledgement: USP - Undergraduate Scholars Program and INBRE - IDeA Network for Biomedical Research Excellence

Morning | 48 | ***Analysis of Chromium Condensation Dependency on Water Vapor Concentration***
Ryan Dowdy | College of Engineering | **Co-Author(s):** Travis Van Leeuwen
Mentor(s): Paul Gannon | College of Engineering

At high temperatures (greater than 500 C), stainless steel forms a surface chromium (III) oxide layer (Cr2O3), which may undergo evaporation reactions to form hexavalent chromium vapor species (e.g., Cr2(OH)2 and/or CrO3). The condensation of these hexavalent chromium vapor species is of concern because they deposit on insulation materials in industrial processes such as power plants, chemical plants, leather tanning, electroplating, anodizing, textile manufacturing, and catalytic converters. Industrial workers may be exposed to hexavalent chromium which is a known carcinogen and has many negative health effects. The current research project involves analyzing how water vapor concentration effects the condensation of chromium onto fiber insulation at high temperatures. The experiment includes a tube furnace to heat up a certain amount of chromium (III) oxide with a steady flow rate of air over the chromium (III) oxide. Hexavalent vapor species are formed and condense on a fiber insulation material at the end of the tube furnace. A diphenyl carbazide EPA standardized test is used to approximate the amount of hexavalent chromium that deposited. Different trials in the experiment have varying water vapor concentrations which allows one to observe the difference that water vapor concentration makes on the condensation of hexavalent chromium. This research leads to a better understanding of the behavior of hexavalent chromium condensation which may assist companies in mitigating the condensation and exposure of this compound to their workers.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 46 | Q***uantification of ISS Isolate Fungal and Bacterial Biomass***
Micah Hickethier | College of Engineering
Mentor(s): Elizabeth Sandvik and Phil Stewart | College of Engineering

Since 2011, the International Space Station (ISS) has recycled wastewater to potable water, but has experienced intermittent clogging events in their wastewater treatment system due to accumulation of biofilm. L. mutabilis is a filamentous fungi isolated from fouled components in the ISS wastewater processing assembly (WPA). A distinguishing characteristic of this organism is production of hyphal structures that form as flocs when grown in liquid culture. This detached biofilm is suspended in solution and, in this case, cannot be centrifuged down due to the floating characteristic of hyphae adding another step to previously developed biomass quantification protocols- vacuum filtration. While microbial growth is frequently quantified using colony forming units per milliliter (CFU/mL), it doesn't account for the extent of biomass, particularly for this fungus. This project focused on utilizing biomass quantification methods of total carbohydrate, total protein, CFU/mL, optical density, and a flow cytometer to compare biomass of ISS Isolates L. mutabilis, R. Insidiosa, and a non-ISS isolated fungal strain A. Pullulans grown in a Microbial Ersatz and MTN (medias developed to represent the influent stream to the WPA). Data from these biomass quantification methods suggest that fungal strains L. mutabilis and A. Pullulans produce more biomass when grown in MTN than bacterial strain R. Insidiosa. Data also suggest that organisms grown in MTN- newly synthesized media with trace nutrients added- promoted growth more than Microbial Ersatz- the initial media used to model the influent stream-.

Acknowledgement: USP - Undergraduate Scholars Program and MSGC - Montana Space Grant Consortium

Morning | 44 | ***Spatially Resolved 3D Desaturation Model of a Gas Diffusion Layer with Comparison to Synchrotron Computed Tomography Data***
Emma Hollis | College of Engineering | **Co-Author(s):** Taitan Workman
Mentor(s): Ryan Anderson | College of Engineering

Proton exchange membrane (PEM) Fuel Cells are of pertinent interest in research for renewable energy due to their small size and environmentally friendly energy production as the only byproducts are water and excess heat. PEM fuel cells create water as a byproduct due to the oxidation reaction of oxygen, this then builds up in the gas diffusion layer (GDL) and is moved by the gas or is transported across the membrane. Water management is crucial in PEM Fuel cells, however, since they are not transparent results have only been obtained at inlets and outlets. Synchrotron computed tomography data has been collected in previous studies to show the spatially resolved desaturation of a GDL when a gas channel is adjacent to it. This project created a 3D model in COMSOL using geometry and inlet conditions obtained from experimental studies. The COMSOL models are able to spatially show the movement of water in a variably saturated GDL with a serpentine gas channel over the period required to dry the GDL. Liquid water saturation, desaturation rates, and evaporation rates were collected over volume averages in each simulation trial. The data was compared to literature results and was in good agreement. These results can be coupled into further fuel cell physics with a water source term to model the water removal within an active fuel cell and are vital to showing effective water management.

Acknowledge: USP - Undergraduate Scholars Program

Afternoon | 46 | ***Analysis of the Effects of Microorganism Nutrient Broth on Hempcrete Strength***
Alixandra Huhta | College of Engineering
Mentor(s): Kirsten Matteson and Chelsea Heveran | College of Engineering

Past research at Montana State University has established a mix design of hempcrete, a mixture of water, hemp plant materials, and a binder, to optimize compressive strength. Further research is being performed to optimize the consistency, density, and compressive strength. It has been proposed to incorporate the use of microorganisms that cause the precipitation of CaCO3 to increase the compressive strength of hempcrete, as the porosity and density of hempcrete are likely more favorable the viability of microbes than traditional concrete. Before incorporating microorganisms, this study requires the effect of the required nutrient broth on hempcrete compressive strength to be understood. Mixes with varying cement to lime binder ratios have been investigated. Previous research showed that an increase in cement increased compressive strength, while it is expected that higher lime content will increase microbial viability. A control mix (only water) was compared to a nutrient broth mix at cement to lime binder ratios of 20:80, 50:50, and 80:20. All mixes were tested for compressive strength at 7 and 28 days. Nutrient broth was found to have little effect on the 20:80 binder ratio mix, as both mixes had almost equal strengths. With the 80:20 mix, nutrient broth was found to delay compressive strength. At 7-day testing, the nutrient broth was found to be 99.7% weaker than the control. However, at 28-day testing, the nutrient broth was found to be 33.8% stronger than the control. Mixing of the 50:50 mix is scheduled, and results will be available for the research celebration.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 50 | ***Impedance Spectroscopy Sensors to Detect Biofilm in Maple Sap***
Ruby Jackson | College of Engineering
Mentor(s): Stephan Warnat | College of Engineering

Biofilm, an assemblage of surface-associated microbial cells enclosed in an extracellular polymeric matrix (EPS), are known to have pervasive effects in the food processing industry. Specifically, unwanted biofilm growth occurring in maple sap lines reduces the economic syrup value. One technique to monitor biofilm growth in real time is with the use of microfabricated electrochemical impedance spectroscopy (EIS) sensors. EIS is a method which involves applying sinusoidal perturbations over a range of frequencies across an interface and the responses are recorded. We integrated these sensors into sap lines to continuously measure biofilm growth, temperature, and microbial-specific concentrations, allowing producers to accurately track sap quality in real-time and make decisions on sanitation practices to improve maple syrup quality and economic value. Experiments were performed both abiotically and biotically over a 72-hour time frame in a laboratory-controlled environment, where elemental conditions were closely regulated. In order to observe the effect of humidity and temperature on the sensors, similar experiments were performed outdoors, in an uncontrolled environment. For biotic experiments, EIS data followed trends that suggest microbial growth and confocal microscopy confirmed a biofilm monolayer on the surface of the sensor. Our study suggests that microfabricated EIS sensors can establish a reliable in situ quality control system and effectively aid in the mitigation of biofilm growth in sap lines. USP - Undergraduate Scholars Program College of Engineering Engineering & Technology

Morning | 45 | ***An Experimental Study of Liquid Droplet Deformation and Removal in a Microchannel***
Garrett Kennedy | College of Engineering
Mentor(s): Yaofa Li | College of Engineering

This intention of this research aims to better understand the dynamics of liquid droplets adhering to solid substrates in confined spaces, which has relevance to various applications in environmental and energy sectors such as oil and gas recovery, water management in fuel cells, and detergency. The inefficiency of the current oil recovery process using water flooding is attributed to the lack of understanding of the microscale physics governing the macroscopic process. Microfluidic models offer an optimal alternative to traditional research techniques, providing detailed flow characterization with micrometer resolution at low cost. In this project, 3D-printed microchannels will be designed and fabricated to mimic pore structures in real reservoirs, and a microscopy-based method will be developed for microscale flow characterization. The dynamics of water traveling over an oil droplet in confined space will be studied using an inverted microscope and high-speed camera, and the data will be analyzed using particle image velocimetry (PIV) to gain insight into the fundamental mechanisms governing droplet deformation, detachment, and motion. The results will help support theoretical model development, validate existing numerical models, and provide guidance to practical operations.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 45 | ***Process Development for Ergonomic Assessment of Laparoscopic Surgery Training Tasks***
Rhyan Klostermeyer | College of Engineering
Mentor(s): Bernadette McCrory | College of Engineering

Conventional Laparoscopic Surgery (CLS) is a Minimally Invasive Surgery (MIS) with proven patient benefits, including lower post-operative complication rates, reduced post-operative pain, and improved surgical cosmesis. While patient benefits of laparoscopic surgeries are well supported, increasing amounts of research aim to investigate the demands of laparoscopy on surgeons and trainees. Training for laparoscopic procedures involves mastering fine-motor skill activities on a laparoscopic surgery simulator, such as the official Fundamentals of Laparoscopic Surgery (FLS) simulator. The goal of this project was to develop a process for performing an ergonomic assessment of laparoscopic surgery training tasks for trainees on the FLS simulator. A secondary goal of this research is to compare the demands of conventional laparoscopic training for human subjects with laparoscopic training for veterinary applications. Electroencephalography (EEG), galvanic skin response (GSR), and eye-tracking techniques were used to develop a process for ergonomic assessment. FLS training tasks selected include a standard breadboard peg transfer task and a VALS (Veterinary Assessment of Laparoscopic Skills) breadboard peg transfer task. Pilot testing data and interpretation of each metric will be presented. The development of this process will allow for a future large-scale ergonomic assessment of laparoscopic training techniques with medical and veterinary students.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 41 | ***MAVERICK***
Christopher Long | College of Engineering | **Co-Author(s):** Tristan Sampley
Mentor(s): Michael Walach | College of Agriculture

MAVERICK (Micro air vehicle enabling the return of information and collected knowledge) is an automated drone designed to return scientific ballooning payloads from the high atmosphere. This project was submitted to NASA for the FLOATing DRAGON Competition to compete for a spot on HASP to fly a payload from 120-thousand feet and land in a designated landing zone. The research conducted with this project included researching different fixed wing aircraft characteristics, performing dynamic flight tests, performing destructive landing tests, validating the data collected from testing, and the exploration of the prospect of using composites for the construction of the UAV. The research outcomes for this project entailed the discovery of the fragility of off-the-shelf automation parts the viability for the drone to navigate using off the shelf parts, an increased understanding of flight dynamics for the drone, and the education of composites manufacturing fundamentals.

Acknowledgment: MSGC - Montana Space Grant Consortium

Morning | 42 | *Controlled Venting of Helium for High Altitude Balloons*
Maximus Marceau | College of Engineering | **Co-Author(s):** Kris Allick and Jackson Murphy
Mentor(s): Randal Larimer and Michael Walach | College of Engineering

The goal of this research project was to create a venting system that would attach to a high-altitude balloon to gain a high level of control over the vertical velocity that the balloon travels with. The idea for the project began with the need to get a balloon to float at a desired altitude so stable video footage and potential readings of gravity waves could be obtained. This project has larger implications as the venting system that was created will be used in the NEBP (National Eclipse Ballooning Project). There are forty teams across the country that will be launching balloons during the two upcoming eclipses, one in October 2023 and the other in April 2024. This was a multidisciplinary project involving mechanical, electrical, and computer engineers that began summer of 2022 and is up until the present. Each component of this system is discussed including the mechanical, PCB circuit board, and software design that make up the venting system. The evolution of the project is detailed along with the field tests that occurred throughout the project. Overall, the venting system was determined to be a viable option for all the teams to use during the upcoming eclipse due to a specific successful field test that the University of Maine helped perform and is discussed in detail. Improvements and the future of the venting system will be discussed such as ideas on how to get more efficient confirmation back to the ground that the balloon is venting helium effectively.

Acknowledgement: MSGC - Montana Space Grant Consortium

Afternoon | 49 | *An Effective Implementation of Molecular Tagging Velocimetry in Microfluidic Systems*
Matthew Netley | College of Engineering
Mentor(s): Yaofa Li | College of Engineering

Microscale flows are ubiquitous across many different applications including medical purposes, micro-processor cooling, and oil and gas extraction. Improving the understanding of multiphase flow in porous microchannels is one of the main goals of microfluidics research. Velocity is a key parameter in fluid dynamics, as many other parameters are dependent upon it. A typical method of measuring velocity is Particle Image Velocimetry (PIV), which is performed by adding fluorescent tracer particles to a fluid flow, illuminating it with a laser, and imaging the tracer particles' displacement. Then, based on the time interval between images, velocity can be measured in two dimensions. This method is considered non-invasive in macroscale flows. However, when applied to microscales, this is no longer true as the solid particles are much larger with respect to channel size. This results in particle behavior that does not represent the characteristics of the flow, as the solid particles have non-negligible inertia.
A nonintrusive alternative to PIV is Molecular Tagging Velocimetry (MTV), which is based on tagging of molecules, instead of physical tracer particles, thus considered to be much more non-intrusive. In this study, we will combine MTV and fluorescent microscopy to characterize the flow in 3D printed microchannels. This will contribute to a new and accurate method of measuring flow within microchannels as well as porous micromodels, which contain obstructions to the flow within the channel. In addition to velocity measurements, diffusion of the fluid can be measured based on the intensity of the light emitted from the dye.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 42 | ***Frictional properties at tool-ply interface during forming of continuous vs stretch broken carbon fiber prepreg***
Tasnia Javin Nur | College of Letters & Science - Graduate Student
Mentor(s): Roberta Amendola and Douglas Cairns | College of Engineering

Forming processes of carbon fiber composite materials are characterized by relative movement between composite laminate and the forming tool and also between the subsequent prepreg plies within the laminate. It is critical to characterize frictional properties both at tool/ply and ply/ply interface during composite forming in order to achieve process optimization and high-quality products. A dedicated experimental fixture has been designed and developed at Montana State University in order to conduct research for the characterization of inter-ply and tool-ply frictional behavior of carbon fiber composite prepregs. Preliminary tool-ply friction experiments performed with uncured continuous carbon fiber reinforced with Hexcel HexPly® 8552 epoxy resin system demonstrated the viability of the test fixture and further experiments were performed based on the observations from preliminary results to understand better and analyze the friction behaviors of stretch-broken carbon fiber (SBCF) reinforced prepreg materials in particular. The effect of key processing parameters representative of autoclave forming such as forming rate, normal pressure, viscosity of uncured resin (controlled by temperature) on the frictional properties were investigated, both for continuous prepregs and MSU-made stretch broken carbon fiber (SBCF) composite prepregs. Recent results will be presented and compared to provide a better understanding of optimizing the manufacturing process with SBCF materials.

Morning | 51 | ***Furthering Engineering Education through CFD Analysis of a Tipi***
Elliot Papendorf | College of Engineering
Mentor(s): Sweeney Windchief and Ryan Anderson | College of Education, Health, & Human Development

This research project focuses on the development of a curriculum module for ECHM 321 Chemical Engineering Fluid Mechanics that incorporates both course content and indigenous education. The project involves the investigation of fluid flow characteristics in a tipi and the identification of variables that influence those airflow patterns. The project uses a combination of computational fluid dynamics simulation in COMSOL and lab-scale experimentation to explore the fluid flow behavior in the tipi structure under varying conditions, such as wind/fan speed and tipi configuration. The CFD simulations are validated by comparing air-speed measurements obtained at various characteristic points on the tipi model between the simulation and experiment trials. While we are still working to perform trials and simulations, the values already obtained are similar, indicating the validity of the COMSOL simulations. Many COMSOL simulations of a 1:1 scale full-detail tipi have already been performed for different wind speeds/directions and configurations, showing relationships between those variables and the airflow patterns observed in the structure. The validated COMSOL simulations and experimental results will be used to develop a curriculum module that teaches fluid mechanics concepts such as Reynold's number, turbulent/laminar flow, and the relationship between conservation of mass and fluid velocity. On April 20th, we are scheduled to attend ECHM 321 to implement this module, where we will have students help construct a full-scale tipi, calculate Reynold's number at various domains, and hypothesize about airflow patterns. This module provides a novel approach to fusing indigenous and engineering education in a university setting.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 49 | ***Small-Scale Zero Pressure Balloon: A Method to Increase Testing and Data Collection***
Abigail Ross | College of Engineering | **Co-Author(s):** Mike Walach and Chad Dunbar
Mentor(s): Randy Larimer | College of Engineering

The Montana Space Grant Consortium (MSGC) Balloon Outreach, Research, Exploration, and Landscape Imaging (BOREALS) Program is focused on the design, manufacturing, and testing of high altitude balloons, including both zero pressure balloons as well as vented latex balloons. In addition, current research is focused on floating a balloon at 90,000 feet with attached payloads in preparation for the National Eclipse Ballooning Project (NEBP). The launch of zero pressure balloons in a university research setting is limited by the size of the balloon and resources needed to test and launch the balloon. Considering standard university research projects span approximately ten weeks, and it can take approximately 72 hours of labor to manufacture a full-size zero pressure balloon, a program will likely only be able to launch between two and four zero pressure balloons for the duration of the project. This does not allow for ample time to redesign and collect data in order to make the necessary modifications to improve the functionality of the zero pressure balloon. This current research seeks to resolve this problem through the design, manufacturing, and implementation of a small-scale zero pressure balloon, which, when manufactured, provides an avenue for more frequent testing and data analysis in order to advance the re-engineering process. This project features a zero pressure balloon scaled to one-third of its original size. The scaled-down balloon presented challenges with existing seam-sealing methods and mechanisms, which catalyzed the design and testing of an adjustable seam-sealer track.

Acknowledgement: MSGC - Montana Space Grant Consortium

Afternoon | 44 | ***Experimental Investigation of Modular Building Materials: Producing the New Generation of Greener and Reusable Building Materials***
Kylee Rux | College of Engineering | **Co-Author(s):** Elif Ugur
Mentor(s): Adrienne Phillips and Chelsea Heveran | College of Engineering

The production of concrete is responsible for nearly 5-8% of global anthropogenic greenhouse gas emissions, creating adverse effects for both humans and the environment. Researchers have developed eco-friendly concrete that replaces a portion of its contents with waste materials or by-products. However, several challenges remain. Although recycling waste concrete as aggregate is common in the U.S., the use of recycled aggregate for new concrete production is limited. Furthermore, concrete does not reach full strength for 28 days after pouring, inhibiting its use for temporary or relief shelters where quick construction and recyclable materials is ideal. Recently, building-blocks made of sand and cemented together using bio-inspired techniques have been studied as an alternative to ordinary concrete. One technique is known as microbially induced calcium carbonate precipitation (MICP) which relies on the ureolytic bacterium S. pasteurii and calcium media to produce calcium carbonate mineral. To enhance this process, bio-trapping of S. pasteurii near the sand surfaces via electrostatic interactions was tested. Treating sand particles with 3-aminopropylmethydiethoxysilane (APMDES) creates positively charged surfaces that attract the negatively charged S. pasteurii cells. The results from compressive strength testing demonstrated that the APMDES-treated specimens were greater in strength, relative to the untreated specimens. Whether the left-over rubble from the strength tests can be crushed and recycled into new building materials is currently being investigated. Overall, these bio-bricks could represent one out of many sustainable strategies to reduce the impacts of the concrete industry while offering the ability to be recycled and used to construct temporary shelters.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 43 | ***Disposing Toxic Waste in Brain Tissue with Noninvasive Intervention***
Sarah Shenk | College of Engineering
Mentor(s): Lori Ray | College of Engineering

The glymphatic system is a system of vessels wrapped around the brain that carries fluid that rids the organ of discarded proteins and waste that clumps together and turns toxic. It is believed that the system functions best during the deepest stage of sleep. We are responsible for developing mathematical models based on fundamentals of transport phenomena in physiological systems to aid a team of researchers developing a noninvasive intervention that stimulates and extends the deep stage of sleep to improve the glymphatic function. Based on previous research, it is hypothesized that neural protein waste disposal delays neurodegenerative diseases such as Alzheimer's and Parkinson's diseases. We gather data from various researchers to define parameters numerically in the mathematical modeling of transport phenomena. The data that is derived from reading MRIs displays the transport of cerebral spinal fluid from the choroid plexus through and around the brain and then out by watching the concentration of a tracer administered into the blood stream. As the concentration decreases in the blood, it increases in the ventricles and basal cistern at approximately the same rate. The dispersion of the tracer also shows that the subarachnoid space and the periarterial space have similar concentration trends with the subarachnoid space slightly behind. Through our findings in the mathematical models, we aim to contribute to the development of a noninvasive intervention to help delay the onset of neurodegenerative diseases.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 43 | ***Spatial Variance of Bone Quality Measures Influenced by Age and Diet in C57BL/6 Mice***
Steven Watson | College of Engineering | **Co-Author(s):** Kenna Brown
Mentor(s): Chelsea Heveran | College of Engineering

As the aging demographic increases, limitations lead to higher fat diets (HFD)1. Both age and HFD have been documented to decrease bone fracture resistance and quality2,3. Both alter metabolic pathways implicated in bone quality, particularly on the inner surface. We hypothesized that bone quality is altered with age and diet with proximity to the bone marrow cavity, that would correlate to loss of bone fracture resistance (Kc). Femurs were collected from male and female C57BL/6 mice euthanized at 5 and 22 months old (n = 7-11/group), fed either a HFD (45%) or low-fat diet (LFD 11%) for two months. Right femurs were used in notched three-point bending to measure Kc. Left femurs were embedded in epoxy for Raman mapping (30 points over 63 μm x 21 μm) on rehydrated cross-sections (785nm laser, 60X). For all bone quality measures, the rate of change (ROC) on the inner-most bone (0-10%), and area under the curve (AUC, 0-40% thickness) were calculated. The strongest Spearman correlations between bone quality measures and Kc values are total carbonate (-.48), mineral:matrix ratio (-.30), crystallinity (-.29), and matrix disorder ROC (.27). These correlations indicate that the more mature mineral present in the first 0-40% and the ROC of matrix disorder of the first 10% of bone are important in diminishing fracture resistance. This novel mapping method demonstrates that mineral and matrix maturity contribute differently to bone toughness spatially. This method can improve our understanding of fracture toughness mechanisms within bone to better prevent bone fragility in vulnerable groups.

Acknowledgement: USP - Undergraduate Scholars Program

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

HEALTH

Afternoon | 55 | *Farm and Ranch Workers Stress Survey*
Andee Baker | College of Agriculture
Mentor(s): Michelle Grocke-Dewey | College of Education, Health, & Human Development

The work completed on this research project targeted some critical stressors for an underserved population in rural communities: farm and ranch workers. I assisted on the USDA-funded 3-year Western Regional Agricultural Stress Assistance Program (WRASAP) under the CO-PI at Montana State University (Dr. Michelle Grocke). Most of the time on the project has been used on outreach to collect survey responses by tabling in Lewistown, Billings, Miles City, Forsyth, and Missoula. The end of data collection is March 31st, and analysis will begin upon the closure of data collection. The team predicts that the key stressors found in farm and ranch workers will likely be similar to those of farm and ranch workers. At the time of the presentation, we will submit the finalized numbers of Montana stressors for this niche population.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 53 | *ACCURACY OF A WRIST-WORN CLINICAL ACTIVITY MONITOR FOR PREDICTING WALKING ACTIVITY ENERGY EXPENDITURE*
Jocelynn Coley | College of Education, Health, & Human Development | **Co-Author(s):** Bailey Perin and Alex Bruns
Mentor(s): Daniel Heil | College of Education, Health, & Human Development

Wrist-worn electronic devices are common for everyday monitoring of many biophysical metrics. These devices always include an accelerometry-based physical activity monitor (AM) for indirectly sensing whole-body motion and EE metrics. PURPOSE: This study's purpose is to determine the accuracy of a clinical wrist-worn AM to predict EE during steady-state walking in lab (treadmill, TM) and free-living (overground, OG) settings. METHODS: Twenty college-aged men and women were recruited for a one-hour visit to the MSU Human Performance Lab. Direct measures of EE (portable indirect calorimetry) and predicted EE from a wrist-worn AM were collected simultaneously during 10-mins of quiet sitting, 5 mins each of slow, medium, and fast-paced TM then OG walking. Predicted measures of activity EE (PAEE, kcals/min) from the AM were compared with calculated measures of AEE (EE walking activity - EE RMR; kcals/min) using paired t-tests for all 6 walking conditions (=0.01 after Bonferroni adjustment). RESULTS: Predicted mean AEE for TM walking was higher than mean AEE for all TM speeds (Mean difference =+0.9 to +1.4 kcals/min; P=0.01-0.03), but this was only significant at the fast TM speed (P=0.01). The slope and y-intercept values for the regression of TM PAEE on AEE differed significantly from those of the line of identity (P<0.001) and PAEE was statistically similar to AEE at all OG walking speeds (Mean differences = +0.3 to -0.5 kcals/min; P=+0.34 to +0.53). CONCLUSION: Our findings indicate that this clinical wrist-worn AM was accurate for OG walking but tended to overpredict AEE for TM walking.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 57 | ***Life Course Perspectives on Exercise: Examining Interpersonal Relationships Influences on Physical Activity***
Sophia Hojnacki | College of Education, Health, & Human Development
Mentor(s): J. Mitchell Vaterlaus and Tasha M. Schaffer | College of Education, Health, & Human Development

The United States has a growing aging population. By 2034, it is predicted that there will be more older adults than children. The current study aimed to understand how older adults perceived interpersonal relationships influenced their physical activity (PA) in early life (under age 18), young adulthood (ages 18-34), middle adulthood (ages 35-59), and older adulthood (ages 60+). Participants included 19 older adults (n = 8 men, n = 11 women) between the ages 60 and 83 (mage = 68.9) who were recruited in one community in the western United States. Participants completed online surveys and in-depth interviews. Five themes were constructed through qualitative case study analysis: (1) Exercise trajectory across the lifespan (e.g., types of physical activity at different life stages, perceived personal health), (2) Family and community (e.g., largely focused on how early interpersonal relationships influenced perceptions and experiences with physical activity), (3) Relationships of choice (e.g., romantic partner and friend influences on physical activity), (4) Children and grandchildren (e.g., difficulty exercising when children were young, children and grandchildren as a motivator for exercise), and (5) employment (e.g., formal education and work settings increased exercise for most, retirement increased a focus on exercise). Results will be discussed in relation to existing literature and theory, and future research directions will be provided.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 54 | ***An Investigation of the Availability and Suitability of Patient-Centered Material for Patients with Müllerian Anomalies in Rural Communities***
Nicole Holt | College of Education, Health, & Human Development
Mentor(s): Miranda Margetts | College of Agriculture

A preliminary study conducted by our research team revealed that the internet is the primary source of information for patients diagnosed with Müllerian Anomalies (MAs, or congenital uterine anomalies). There is limited online educational information for this population, and the content that is available varies in consistency and patient-centeredness. The National Library of Medicine created the Health Education Materials Assessment Tool (HEMAT), which consists of a yes/no checklist related to the suitability of the content, to determine the readability of patient-focused educational materials. By administering the HEMAT assessment, we determined the suitability of written online information about MAs, thereby identifying challenges to be addressed in creating content for this population. The online material assessed was obtained from sources located in the Network of the National Library of Medicine Region 4. The Flesh-Kincaid calculator - which uses syllable count, word count, and sentence length in its scoring - was also used to further assess the material and determine the level of education required to comprehend the content. Many of the online sources did not pass the HEMAT, meaning that they are unsuitable for patients. Out of the 31 sources provided by clinics in Region 4, only 9 passed the HEMAT. The reasons for failure varied but were commonly the lack of definition of medical terms or the use of visual aids that did not enhance comprehension and engagement.These results highlight that access to suitable online education materials is an additional burden faced by members of this health disparity population.

Acknowledgement: USP - Undergraduate Scholars Program and McNair Scholars Program

Afternoon | 56 | ***Anthropometric Determinants Of HOMA-IR In A Metabolically At-risk Population***
Katy Kropatsch | College of Education, Health, & Human Development - Graduate Student
Mentor(s): Mary Miles | College of Education, Health, & Human Development

Postprandial lipemia and impaired glucose metabolism are contributors to impaired metabolic health in metabolic syndrome. Elevated BMI and increased visceral adiposity (VAT) are linked to increased insulin resistance (IR) whereas increased fat-free mass (FFM) may confer a protective effect. However, the contribution of postprandial lipemia and anthropometric measures on IR in at-risk individuals is unclear. To investigate the contribution of FFM, VAT, BMI, and postprandial lipemia on IR in adults with central obesity. METHODS: Adults (n=54) aged 18-70 with elevated waist circumference (96.5 ± 12.2 cm women, 102.6 ± 8.4 cm men (mean ± SD) completed a high-fat meal challenge (50g FAT, 54g CHO, 12g PRO) with blood collected at fasting and hourly for 4 hours postprandially. Triglycerides (TG) were measured as a marker of postprandial lipemia and summarized as iAUC (TGiAUC). Bioelectrical impedance analysis was used to measure BMI, VAT, and FFM%. HOMA-IR was calculated using fasting insulin and blood glucose levels. Linear modeling was utilized to determine physiological measures contribution to IR as measured by HOMA-IR. BMI and VAT were independent predictors of HOMA-IR (p=0.04 and p=0.01, respectively) while no association was found for FFM. When adjusted for TGiAUC as a covariate (p=0.02), BMI was the only anthropometric predictor of HOMA-IR (p=0.03) with a 6% increase in HOMA-IR for each unit increase in BMI. In metabolically at-risk individuals as measured by elevated waist circumference, HOMA-IR is best predicted by BMI. This finding is consistent when taking into account TGiAUC; a common co-determinant of metabolic risk and IR.

Afternoon | 52 | ***Native Americans Mental Health***
Mason Naomi | Gallatin College
Mentor(s): Jennifer Woodcock | Gallatin College

Mental health is a pressing issue in the world, but it especially effects Native Americans. On average Native people experience 2.5 times more psychological distress than the general population. There are many reasons for the higher mental illness rate, one of which is the lack of resources surrounding reservations. There is also a shortage of programs that are sensitive to native culture. This a huge problem that needs attention, and steps need to be taken to help resolve Native Americans mental heath.

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

HUMANITIES

Afternoon | 65 | ***(Dis)Integration and Reframing in Writing and Literary Studies***
Gabby Bunko | College of Letters & Science
Mentor(s): Doug Downs | College of Letters & Science "

This project interrogates the changing relationship between Writing and Literary studies and how utilizing overlapping values can provide the basis for rethinking and reframing the relationship between the two fields for student benefit. Since the inception of literary studies, English Departments in American colleges and universities over a century ago, literature and composition have been pursued as largely separate fields of study. This study won't argue for consolidation and reintegration, but, as both a writing and literature major, the researcher has noticed places where students could benefit from further integration. This study explores means of integration which can eventually be translated in the university setting and beyond to high schools for greater student accessibility. One way of understanding how the two fields think differently about writing (noun and verb) and reading is to look at conceptual metaphors (Lakoff and Johnson 1980) in corpora of literary and writing studies scholarship and in writing and literature classes. Conceptual metaphors allow direct comparison of these data sources for convergence and divergences in interests and values. Interviews with faculty teaching those courses provide insight into teaching philosophies, and student surveys provide feedback about effects on student learning outcomes. Furthermore, interviews the English Department chair and completed discourse analyses of English Department websites show how the departments present themselves. The hope in sharing this research is to reframe the way we think about the relationship between the two for the benefit of both fields and students.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 59 | ***The Legand of Mato Tipila***
Caroline Chea | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

The great legend of Mato Tipila (Bear's Lodge, formerly and inappropriately known as Devil's Tower) across Native American plains cultures presents various stories, yet most of the stories have similarities to each other. For instance, in Kiowa culture the myth states that the seven girls were playing along a stream and suddenly they were chased by a bear. They climbed a low rock and asked for protection from the Great Spirit. Their cry for help was heard, and the rock grew higher and higher, ascending the girls into the sky. Eventually, they became the Pleiades, and the rock became known as Mato Tipila with its vertical bear claw marks on the rock. Lakota culture has a similar legend to the Kiowa with the girls being chased by a bear, running back to the village, and crying out for help: "Rock, take pity on us; Rock, save us". Then the rock began to rise up, so high that they were safely out of the bear's reach, and taken up to the sky. We will explore the similarity across Native American legends about the Mato Tipila and the spiritual aspect of Mato Tipila.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 60| ***Native American Healthcare and Horses***
Wyatt Chvojka | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine Horse | College of Arts & Architecture

Horses have proven through history to sacred to Native American cultures both spiritually and physically. Since it's into the United States in the 1400's the horse became synonymous with cultures. Horses were and continue to be decorated in fine garments signify their importance to Native American culture and medicine.

Afternoon | 57 | ***Government Policies During the Native Boarding School Era***
Jack Connolly | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine | College of Arts & Architecture

An overview of policies put in place during the boarding school era in order to forcefully abduct children and place them in boarding schools. Emphasis placed on federal funding for boarding schools in order to forcefully isolate and assimilate native children. An overview of boarding school locations and strategies for forcing children into these schools. Insight into the continuation of the native assimilation period through government policies aimed at putting native children into white families. White adoptive families and further efforts to assimilate native children to the western world. Destruction of the native family structure due to boarding school and assimilation policies. Focus placed on the end of the boarding school era in the nineteen-seventies and what government policies finally ended this era. The post-boarding school era and its impacts still felt today within native communities. Current legislation and its impact on native youth and culture. The future outlook for boarding schools still open today, along with the continuation of native culture.

Afternoon | 63 | ***Research Poster Abstract***
Taylor Gill | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine Horse | Gallatin College

For our research poster, my group chose to use boarding schools and their impact on Native American communities throughout the late 1800s to the modern day United States. For my section's theme I would like to find contemporary social issues that relate in some way to the institutions Native American children were forced into. Some instances of this could be the treatment of immigrants by ICE and the United States government as a whole, or even the methods used by the U.S. justice system to incarcerate certain populations more frequently than others. The disproportionately high number of crimes against Native American women and the lack of effective action to improve or even address the situation by law enforcement and the United States government is another topic I would like to address. In terms of immigration, the forced separation of children from their parents or caretakers in immigration detention centers could draw a good amount of parallels to the separation of Native children from their families as well as their isolation from the rest of the world. I also feel that the treatment of Native Americans by law enforcement offers a lot of comparisons to the way they've been treated historically, where crimes against Native communities are overlooked or even inflicted by law enforcement.

Afternoon | 62 | ***The Importance of Drums in Native American culture***
Grace Hansen | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine | Gallatin College

This study is aimed to give an insight into the importance of drums in Native American culture. Drums are important in Native American culture as both musical instruments and a symbols of spirituality. . Drums are a fundamental part of many religious ceremonies and rituals, and they are used in a wide range of cultural activities, including traditions, social gatherings, and communication. Drums are so important in Native American culture that they are honored like they would honor an ancestor. There are many kinds, shapes, and sizes of drums that serve different purposes. In early times, traditional drums were crafted from natural resources found in the environment, such as animal skins from animals like elk and horses to form the drumhead and wood to make the shell of the drum. Hand drums are the most well know drum but there are also water drums, powwow drums, and sweat drums. The beat of the drum is said to be the heartbeat of the animal that was used to make the drum, Indigenous Nations, and Mother Nature herself. In conclusion, the drum is an important element of indigenous culture that is valued for its spiritual, symbolic, cultural, and social significance. Drums are a symbol of indigenous people's connection to their surroundings and their traditions, representing the heartbeat of the resources used to make it, the rhythm of the earth, and the harmony of the culture. Drums serve as one of the most essential parts of Native American culture.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 58 | ***Indigenous Food Sovereignty***
Torsten Raichlen | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine | College of Arts & Architecture

Indigenous Food Sovereignty is an essential concept that is closely connected to cultural preservation, the promotion of healthy diets, and the protection of the environment. Indigenous peoples have deep connections to the land, and their traditional foods are an integral part of their cultural heritage. By promoting Indigenous Food Sovereignty, we can help to preserve cultural heritage, promote healthy diets, and protect the environment.

Acknowledgement: Empower Program

Morning | 58 | ***Sterilization of Native Women***
Tae'Sha Red Hat | Other/None
Mentor(s): Jennifer Woodcock - Medicine Horse | College of Arts & Architecture

Within my presentation I will present what I have learned through my research of Sterilization of Native Women. It has been estimated that 25 to 42 percent of Native American women have been sterilized in the 1960s and 1970s. The women have been sterilized as young as 15 years old. Most of the sterilization was unwanted and without consent. So how it was without consent is the women would be told that they would need an Appendectomy and then would get sterilized without knowing it or giving permission. The federal government conducted sterilization procedures on these women because they do not want any full blooded natives alive to receive full benefits of being an enrolled tribal member.

Afternoon | 61 | ***Bone Fragmentation Levels for the Beaucoup Site and What They May Reveal***
Anna Ripley | College of Letters & Science
Mentor(s): Michael Neeley and John Fisher | College of Letters & Science

Archaeological sites often contain fragments of bone from animals hunted or kept for consumption. Sites located in the Great Plains of North America often contain bison bone. Native Americans resourcefully used every portion of the bison and even extracted bone marrow and bone grease, sources of bone fat, for use in foods such as pemmican. Fat is an important macronutrient for hunter-gatherers, as it is denser in calories and easier to metabolize. In temperate climates, fat is less likely to go rancid and can be used in winter preparations. Bone fat can also be used in the construction of tools, the treatment of animal skins, or as a fuel. The degree of bone fragmentation within sites can indicate the extent of bone grease processing. Intense bone grease processing may be attributed to strained resources during that time and place. Bone from the Beaucoup site, located in northeastern Montana, is being evaluated for its fragmentation levels.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 64 | ***The Impact of Athletics at Carlisle Indian Industrial School***
Isabella Roff | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine Horse | Gallatin College

My research project is on how athletics, focusing on football, shaped the legacy and impact of Carlisle Indian Industrial School. In a point in history where Native Americans were being assimilated into white, American society, I will showcase how specific teams and athletes within Carlisle, really paved a way for other Native Americans to also be successful in athletics. Famous figures, such as Jim Thorpe will be on display. My research has led me to the conclusion that sports and other competitions were valued and promoted in assimilation boarding schools, because they were believed to make “Indians” more like white Americans; physically and culturally. Athletics proved to lead to massive success for many students that attended Carlisle Indian Industrial School. This time in history was a turning point for Native Americans and their abilities to perform and succeed in the realm of sports.

Acknowledgment: MSGC - Montana Space Grant Consortium, USP - Undergraduate Scholars Program, and INBRE - IDeA Network for Biomedical Research Excellence

Afternoon | 59 | ***Health Care and Medicine within Native American Culture***
Joyanna Sage| Gallatin College
Mentor(s): Jennifer Woodcock-Medicine Horse | Gallatin College

An overview of ceremonial and religious practices within the medical field of Native American Culture is provided, including how hospitals incorporate Native American’s religious practices, and how Native Americans incorporate natural and spiritual medicine within their culture.

Morning | 60 | ***The influence of Parent-Child Interaction Therapy on families and their children***
Abbigail Sparks | College of Education, Health, & Human Development | **Co-Author(s):** Sarah Mendoza
Mentor(s): Kalli Decker and J. Mitchell Vaterlaus | College of Education, Health, & Human Development

Parent-Child Interaction Therapy (PCIT) is an evidence-based, early intervention mental health model that supports families of young children experiencing challenges or delays in social emotional development. PCIT includes a licensed mental health therapist teaching parents therapeutic play skills by using positive attention to guide behaviors. PCIT uses live parent coaching via bug-in-ear technology, typically using a one-way mirror in a therapy setting. Since providing early intervention services in children's natural environments is shown to best support their development, there is a movement in the field of PCIT to adapt the traditional in-clinic model of services to serve children and families in their most natural environment - their homes. We ask: what are parent's experiences with receiving PCIT services? The authors partnered with PCIT therapists to invite families to participate in a survey and in depth interview. Preliminary analysis highlight the positive experiences of both parents and children who participated in PCIT services. Trends have emerged showing common themes within family's who participated in PCIT. These results include formation of positive relationships both within the family unit and with the therapist, learning specific skills that benefit parenting and life experiences, families preferring PCIT delivery in the home, and positive impacts on both parenting abilities and child's behavior.

SPRING 2023 | MSU STUDENT RESEARCH CELEBRATION

MATHEMATICS

Afternoon | 66 | ***Social and sexual contact network modeling for HIV clinic recruitment***
Logan Graham | College of Letters & Science
Mentor(s): Bree Cummins | College of Letters & Science

Clinics tasked with diagnosing HIV are faced with a problem in recruiting new individuals for testing. When an individual receives an HIV diagnosis, the clinic may attempt to recruit more individuals to get tested from the diagnosed individual. They may do this by inquiring about the individual's sexual contacts or social contacts in the at-risk community. A useful tool for these clinics would be simulations of recruitment strategies on social and sexual contact networks. However, since the true network structures are not available, these simulations need to be based on indirect data. In my work, the indirect data comes from a study called uConnect conducted in the Chicago area (Schneider, Cornwell, and Jonas et al., 2017). Degree sequences and overlap between social and sexual networks are extracted from the uConnect survey data. These degree sequences were found to have some exponential correlation. I will show the results of sampling networks from these degree sequences using a configuration model to predict an overlap between these social and sexual networks. Then by varying the correlation in some degree sequences and using the same process to model networks off them I show the relationship between correlation in degree sequences and overlap in networks. My hope is that these jointly sampled social and sexual networks will be used in simulations of recruitment efforts, and the results they yield will help HIV clinics in their recruiting efforts.

Afternoon | 67 | ***Invariants for Higher Tori via Topological Quantum Field Theory***
Bryce Morrow | College of Letters & Science
Mentor(s): Ryan Grady | College of Letters & Science

Given a physical system, one is often interested in taking measurements. If the value of an invariant is measured for a system at some time, then the value of said invariant must remain constant as the system evolves, which is particularly useful if the system becomes complex, and measurements become difficult to take. In this project, calculations of a power series invariant were made for quantum systems involving products of spheres. In particular, these power series arose as the traces of various differential operators, which were calculated using eigenbases found for these operators.

Acknowledgement: USP - Undergraduate Scholars Program

MICROBIOLOGY & CELL BIOLOGY

Morning | 63 | *Gut Microbiome Residency of Bacteroides Species*
Zea Cain | College of Agriculture | **Co-Author(s):** Brandon Fernandez, Paul Van Erp, and Nicholas Pinkham
Mentor(s): Seth Walk | College of Agriculture

The goal of this research is to evaluate the population dynamics of individual asexually reproducing clones of the genus Bacteroides in the human gut microbiome and discover how this population changes over time. This project uses the same samples as previous research done in the Walk Lab, research that discovered Escherichia coli is the most resident and abundant species of Enterobacteriaceae in the human gut. It will utilize primarily GTG5 rep-PCR and 16S Sanger sequencing to classify species that are present. This project is testing the hypothesis that Bacteroides species evolve differently in the human gut compared to E. coli, which are often residents, whereas Bacteroides may be more transient. The topic is especially important to public health as the majority of studies regarding Bacteroides pertain to antibiotic resistance, pathogenesis, nosocomial infection, and water quality assessment. Longitudinal and ecological studies related to naturally occurring, nonpathogenic Bacteroides are uncommon, so there is very little information overall about how members of this genus evolve. Initial results have indicated that Bacteroides have a wide range of how long they reside in the gut, varying greatly between species and individuals. It has also been implied that some Bacteroides clones may exist in the gut of different participants, which is unique in that bacterial clones have been found to be highly specific to their environment.

Acknowledgement: USP - Undergraduate Scholars Program and INBRE - IDeA Network for Biomedical Research Excellence

Afternoon | 71 | *Determining the Relationship Between Aquaporin 3 and Calcium Waves*
Jacob Kasubick | College of Agriculture
Mentor(s): Christa Merzdorf | College of Agriculture

Experiments are being done to test whether aqp3b influences neural tube closure by affecting Ca2+ events in the neural plate cells. GCaMP 6 mRNA is injected into Xenopus embryos at the four-cell stage. Once translated the GCaMP 6 protein will bind to Ca2+ and fluoresce in the injected part of the neurula. This allows calcium events that occur in the injected side of the neurula to be seen by fluorescence microscopy. Four-cell Xenopus embryos will be injected with aqp3b morpholino oligonucleotide (MO) which will inhibit the translation of the aquaporin aqp3b on the outer edges of the neural plate. Aquaporin aqp3b is being inhibited to investigate if it influences neural tube closure by affecting Ca2+ events that occur in the neural plate cells. Analysis of this process will proceed through time-lapse imaging of neurula stage embryos to capture calcium waves that occur during neural tube closure. First, a RStudio program will analyze the tracer images Ruby Dextran fluorescence surface area, to determine if the area affected by the injection, is similar to other injections. Then, images will then be run through a statistical program to determine whether the inhibition of aqp3b changes the duration, frequency, or intensity of the Ca2+ events.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 64 | ***Developing a Novel Tool to Image Organic Matter in Soil and Ice Samples***
Nicole Krysiak| College of Letters & Science
Mentor(s): Christine Foreman and Madelyne Willis | College of Engineering

Organic matter (OM) is a mixture of organic compounds found in freshwater and agricultural environments. OM can affect reactivity and microbial communities within an environment. Through the use of fluorescence spectroscopy, the dynamics and biogeochemical role of OM can be measured. To measure OM quality, Excitation Emission Matrix Spectroscopy (EEMS) can be used to scan a sample through a range of excitation/emission wavelengths, and measure fluorescence intensity. EEMS identifies different fluorophores and positions of excitation/emission maxima within the OM. To run a soil sample on the F4, a sample must be taken to a lab and an organic matter extraction performed; this process is time consuming and results in destruction of the sample. We have been developing an organic matter bioimager: Spatial Excitation-Emission Matrix Spectroscopy (SEEMS). SEEMS takes false color images of a soil sample to spatially resolve OM fluorescence on the surface of a sample. These images display the fluorescence of the OM present in the sample and requires no OM extraction. To validate SEEMS, the data collected from SEEMS was compared to the EEMS data collected using a Horiba F4 . Samples were also run on the UV-Vis spectroscopy instrument which measures the amount of UV or visible light being transmitted or absorbed in a sample. The UV-Vis was used to roughly determine OM concentration and to do a spectral correction of the F4 data.

USP - Undergraduate Scholars Program

Morning | 62 | ***Optimization of Adeno-Associated Virus 8 (AAV8) for Induction of Hepatocellular Carcinoma in Mouse Liver***
Reed Noyd | College of Agriculture
Mentor(s): Ed Schmidt and Justin Prigge | College of Agriculture

Hepatocellular carcinoma (HCC) is the fifth most common cancer worldwide and the third leading cause of cancer related mortality with a 10-year survival rate of merely 22–35%. The Schmidt Laboratory has great expertise in redox biology, molecular genetics, and thiol chemistry: all of which contribute to hepatocellular carcinoma. The laboratory has created mouse models with genetic deletions in liver specific genes that play a key role in keeping the cell in a reduced environment. It has been observed that increased antioxidant activity can lead to higher incidence of cancer. However, the lab does not currently have an efficient system of creating HCC in a timely fashion. Senior Scientist, Dr. Prigge, designed a plasmid which contains guides for p53 and PTEN genes and placed it into an adeno-associated virus 8 (AAV8). These tumor suppressor genes are two of the most mutated in liver cancer. The virus is injected into mice that express Cas 9 in hepatocytes. Quantification of genetic “cutting” via Cas 9 has been accomplished with a T7 endonuclease assay and PCR. Results have illustrated that the system creates mutant p53 and PTEN genes in mouse hepatocytes. Furthermore, mice have generated several isolated liver tumors within 4 weeks post injection. The AAV8 system is quite robust for developing liver cancer which is strongly supported from our genetic and visual evidence. This research could be instrumental in efficiently inducing hepatocellular carcinoma in mouse models to better understand liver cancer pathology.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 65 | ***Isolation and characterization of Pyrosphaera: a novel genus of thermophilic Crenarchaeota***
Paige Schlegel | College of Agriculture | **Co-Author(s):** Anthony Kohtz, Zackary Jay, and Roland Hatzenpichler
Mentor(s): Anthony Kohtz and Roland Hatzenpichler | College of Letters & Science

Hot springs in Yellowstone National Park (YNP) are an abundant source of interesting and novel lineages of uncultured extremophilic archaea, even within the well-studied phylum Crenarchaeota. This study discusses the process of isolating and characterizing one such organism, a novel genus of Crenarchaeota from sediments of a high-temperature spring in YNP (78°C, pH 6.1). The complete circular genome of the isolate was assembled using a combination of Nanopore and Illumina sequencing data. Phylogenetic analysis and comparative genomics indicate that this organism forms a novel genus in the Desulfurococcales, for which the name Pyrosphaera yellowstonensis is proposed. This pure culture and complete genome have been used to characterize the organism physiologically and genetically to understand its metabolic potential, environmental distribution, and role in ecosystem biogeochemistry cycling processes. Annotation of the genome has revealed potential metabolic pathways for energy generation involving carbon, sulfur, and hydrogen cycling. Notably, the P. yellowstonensis genome encodes several [Ni-Fe]-hydrogenases that broaden the diversity of hydrogenases found in archaea. Through analysis of sediment metagenomes obtained from other YNP hot spring locations, P. yellowstonensis is present at relative abundances ranging from 0.1-7.2% in several other spring locations. Pyrosphaera has the potential to play an important role in elemental cycling within its environment and serves to expand our knowledge of archaeal diversity.

Afternoon | 68 | ***Mycoplasmopsis dominates the cloacal microbiome of spotted eagle rays***
Courtney Scott | College of Agriculture
Mentor(s): Zoe Pratte and Frank Stewart | College of Agriculture

Investigating the microbiomes of elasmobranch fishes (sharks, rays, and skates) is relatively novel, and is important due to the ecological roles these animals play in marine food webs. Studying elasmobranch microbiomes is difficult because of the equipment and personnel needed to capture and care for these animals. Scientists at Mote Marine Laboratory (Sarasota, Florida) routinely capture spotted eagle rays (Aetobatus narinri) and temporarily hold them for research purposes. Through collaboration with Mote, we analyzed microbial communities present in the eagle ray cloacal microbiome, which is influenced by both fecal and gut microbiomes. Using analysis of the 16S rRNA gene, we discovered that the cloacal microbiome of these rays is dominated by the Mycoplasmoposis genus. This is unlike previous research, and also concerning because some Mycoplasmoposis species are known to be potentially pathogenic to marine animals. More research is needed to determine the pathogenicity of this microbe and how it is impacting the health of spotted eagle rays. Additionally, at Mote, the ray's barbs are removed during temporary holding, creating a wound that can be sampled to study the microbiome dynamics of wound healing, something hard to do in the wild. Thus far, we found that the wound microbiome hosts a large diversity of microorganisms, however it does not vary significantly from the normal skin microbiome. Since spotted eagle rays are rarely seen with infections or signs of illness, understanding the microbes of the wound and skin microbiome could provide insight to how these animals fight infections and recover from injuries.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 72 | ***Optimizing the Reaction Conditions for S34-Cysteine Biosynthesis using CysK Enzyme***
Zoe Seaford | College of Agriculture
Mentor(s): Ed Schmidt | College of Letters & Science

The Schmid Lab uses heavy isotope-labeled amino acids to analyze flux of 34S-containing metabolites in key redox cell pathways in the mouse liver using mass spectrometry. As 34S-labeled amino acids are extremely expensive, we have adopted methods for in-lab synthesis of heavy methionine and cystine. The newest synthetic method adopted by the Schmidt lab generates heavy cystine using bacterial-derived enzyme O-acetylserine sulfhydrylase, Na234S. My project for the semester has been optimizing the reaction conditions for this particular biosynthesis. The conditions being tested are temperature, enzyme concentration relative to reactants, time, and the use of reducing agent tris carboxyl ethyl phosphine (TCEP). We have found that incubating our CysK at 55 degrees has produced the highest amount of cystine. We have also found that this enzyme needs to be incubated at 55 degrees for longer than 24 hours. Beyond 24 hours, product yield was not significantly increased. As a recent publication reports rapid, albeit small scale synthesis using enzyme concentrations (relative to reactants) greater than 50x that in our previous protocols, we have chosen to test various enzyme concentrations across different time frames seeking comparably efficient catalysis that are more cost effective for bulk synthesis.

Acknowledgement: USP - Undergraduate Scholars Program and McNair Scholars Program

Morning | 61 | ***Asymmetric Protein Distribution in Zic3 MO-Injected Embryos***
Ann Warren | College of Agriculture
Mentor(s): Christa Merzdorf | College of Agriculture

This study investigates the role of asymmetrical protein distribution during convergent extension (CE) in Xenopus embryos. CE is a crucial cellular movement that occurs during embryonic development, specifically during gastrulation and neurulation. Faulty convergent extension is known to lead to a variety of developmental disorders, specifically neural tube defects such as spina bifida. Developmental gene Zic3 has been shown previously to play an unusual role in CE by inhibiting convergence but not extension when knocked down by a morpholino oligonucleotide (MO). It is thought that this asymmetrical effect arises from irregular distribution of membrane proteins typically used for coordinated cellular movements. Two membrane proteins of interest are Vangl2 and Rab11, which play important roles in convergence and extension. This study uses in situ immunofluorescence to visualize the distribution of Vangl2 and Rab11 in Xenopus embryos. Embryos are injected with a mixture of zic3 MO, GFP mRNA, and fluorescent rhodamine dextran. Embryos are fixed and cross-sectioned at stage 13 of development. Antibody staining is then performed to visualize the distribution of the proteins.
These results will provide new insights into how these membrane proteins are distributed in embryos under normal and inhibited conditions. This information will then give rise to how protein asymmetry may contribute to the cellular movements that occur during convergent extension. A deeper understanding of convergent extension is crucial to advance our comprehension of neural tube defect conditions.

Acknowledgement: USP - Undergraduate Scholars Program and INBRE - IDeA Network for Biomedical Research Excellence

Afternoon | 70 | *BiFC image analysis of protein interactions in Pseudomonas aeruginosa biofilms*
Eric Welch | College of Agriculture
Mentor(s): Michael Franklin and Heidi Smith | College of Agriculture

My research project for the Fall of 2022, “”BiFC Image analysis of protein interactions in Pseudomonas aeruginosa biofilms”” aimed to examine the mechanisms by which Pseudomonas aeruginosa bacteria preserve ribosomes from degradation throughout periods of dormancy. The project was conducted from June 2022 to November 2022, and involved the the growth of modified strains of Pseudomonas aeruginosa bacteria in colony biofilms, fluorescent treatment of the biofilms, and microscopic analysis of the biofilm with the BiFC (bimolecular fluorescence complementation) technique. It was found that the biofilms exhibited a greater intensity of fluorescence near the surface for both the DNA stain and fluorescent proteins attached to the target factors, possibly indicating that cells near the surface of the biofilm are more functionally active. The results of the experiment varied significantly between replicates and are not sufficient to draw conclusions from. Some of the methods established for the conduction of the project will be carried forward and implemented in future projects.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 73 | *Reductive Biomining of Pyritic Ore by Methanogens*
Ryan Williamson | College of Engineering | **Co-Author(s):** Devon Payne and Rachel Spietz
Mentor(s): Eric Boyd | College of Agriculture

Economically important metals, including copper (Cu), cobalt (Co), and nickel (Ni), are increasingly being sought to meet growing demands associated with the transition to renewable energy technologies. However, traditional mining practices used to extract these metals are not economically feasible when metals are present at low concentrations in ore deposits. Biomining may allow for a more sustainable and economically viable approach, in particular for low-grade ores. Methanogens are anaerobic archaea that produce methane (CH4) as a byproduct of their metabolism, which is dependent on metalloenzymes that require iron (Fe), sulfur (S), Co, and Ni. Recent studies have shown that methanogens can reductively dissolve pyrite (FeS2), the most abundant iron-sulfur mineral present within Earth’s crust, to access bioavailable forms of Fe and S. FeS2 ores commonly contain impurities of Cu, Co, and Ni, which raises the question as to whether methanogens can access these metals from pyritic ore. This study aimed to test whether the model methanogen strain, Methanococcus maripaludis, can grow on natural FeS2 ore containing Co and Ni impurities as the sole source of S, Fe, Co, and Ni. We found that in the absence of any added S, Fe, Co, or Ni source, cells did not grow. When natural FeS2 with Co and Ni impurities was provided to the cells, CH4 and cells were produced. These results demonstrate that methanogens can access S, Fe, Co, and Ni from FeS2 ores through reductive dissolution processes. Ongoing work involves quantification of Fe, Co, and Ni accumulation in M. maripaludis cells.

Acknowledgement: USP - Undergraduate Scholars Program

NEUROSCIENCE

Morning | 67 | *Beta Intrusion during N2 Sleep is Negatively Associated with Nocturnal Heart Rate Variability in Healthy Adults*

Gianna Migliaccio | College of Agriculture | **Co-Author(s):** Ian Greenlund, Jeremy Bigalke, Jennifer Nicevski, and Jason Carter
Mentor(s): Cara Palmer | College of Letters & Science

Increased cognitive hyperarousal is a proposed mechanism associated with clinical poor sleep. An objective marker of nocturnal hyperarousal is high-frequency electroencephalography, particularly within the beta frequency range. Acute and chronic poor sleep quality are associated with autonomic dysfunction, but little is known regarding the relationship between nocturnal autonomic function and beta frequency intrusion. This study explored the association between beta spectral power during stage two (N2) sleep and nocturnal heart rate variability (HRV) in healthy adults. We hypothesized heightened beta power during N2 sleep would be associated with reduced nocturnal HRV. Twenty-four participants (12 males, 12 females; age 25±1 years; BMI 27±1 kg/m2) underwent an 8-hour sleep opportunity with continuous polysomnography and 5-lead electrocardiogram. 5–10 minute periods from the first two N2 cycles absent of cortical arousals, respiratory events, and limb movement-associated arousals were analyzed. Central and frontal regions' beta power and nocturnal HRV data were analyzed across each hemisphere. Time-domain HRV was quantified as the root mean squared of successive differences (RMSSD) and proportion of R-R intervals (RRI) varying by greater than 50ms (pNN50). An inverse correlation was observed between central beta power and RRI (R=-0.473, p=0.019), pNN50 (R=-0.450, p=0.028), and RMSSD (R=-0.406, p=0.049). A similar relationship was observed between frontal beta and RRI (R=-0.487, p=0.016) and pNN50 (R=-0.423, p=0.039). Our results indicate a negative association between N2 beta power and nocturnal HRV, suggesting nocturnal hyperarousal may be associated with poor cardiac autonomic function.

Acknowledgement: Support is provided by the National Institutes of Health (AA-024892, U54GM115371; P20GM103474, 2TL1 TR002318).

Morning | 66 | *Dual Neurotransmitter Neurons in Drosophila*

Ann Morris | College of Agriculture
Mentor(s): Steve Stowers | College of Agriculture

The research I do focuses on dual-neurotransmitter neurons, which are neurons that release multiple neurotransmitters at once. Advantages of dual-neurotransmitter neurons over single neurotransmitter neurons have been proposed, such as the ability for two different precise signals to be sent to the same post synaptic neurons. Further studying these types of neurons could give more insight into neurological diseases, behavioral mechanisms, and treating diseases where these types of neurons are involved. I mainly study gabaergic and glutamatergic neurons in the fly brain and I am working on determining whether these neurons are in the same synaptic vesicles or different ones. This allows me to see if these neurons are dual-transmitter neurons and the effect this has on a fly's behavior. To target or remove either neuron of interest I generate genome-edited conditional alleles of the glutamate-specific gene vGlut and the GABA-specific gene Glutamatic Acid Decarboxylase (GAD). I do this through recombinant DNA analysis, which results in bacterial plasmids. A method I have recently been optimizing is called expansion microscopy, which has expanded the flies brains ten fold and has allowed for more clear images to be taken. CRISPR constructs are being used to target specific glutamatergic and gabaergic neurons in the ellipsoid body of the fly brain to identify the specific neurons in this area and their dual neurotransmitter usage. Using these genome edited flies and expansion microscopy techniques has produced promising data.

Afternoon | 74 | ***Modulating Neuronal Cell Migration Under Curved Confinements***
Jacob Smith | College of Agriculture | **Co-Author(s):** Mackenna Landis
Mentor(s): Anja Kunze | College of Engineering

During peripheral nervous system development, neuronal cells migrate outward from the neural crest to their final positions in the body. This migration of neuronals is influenced by mechanical and chemical cues, which have been extensively studied in the brain, but less so in the PNS. Incorrect neuronal migration can cause neurological disorders such as loss of sensation and movement, so understanding this movement is critical. Our research examines the physical and chemical cues acting upon peripheral neurons during this migration. First, PC12 cells (rat, P8) were cultured on 35-mm polystyrene Petri dishes coated with either poly-L-lysine (PLL) or 3% agarose curvatures and PLL, with media containing DMEM (97%), FBS (1%), HS (1%), and PenStrep (1%). Curvatures consisted of multiple concentric circles, with barriers between each circle, and were fabricated by stamping agarose with a 10:1 PDMS mold. These curvatures were designed to mimic curvature values found within the developing embryo. Cells were exposed to control media or media containing 50 ng/mL nerve growth factor (NGF). These cells were then imaged every 15 minutes for 24 hours using a Dino-Lite microscope, and tracked using ImageJ FIJI Manual Tracking software. This tracking showed that cells exposed to NGF moved an average of 8.566 times faster than control cells on a Petri dish, while cells seeded on agarose curvatures moved an average of 45.033 times faster than control cells. Our work may imply that physical changes may have a larger effect on neuronal migration than chemical cues.

Acknowledgement: USP - Undergraduate Scholars Program

PHYSICAL CHEMISTRY

Morning | 69 | *Tuning NMM Cathodes for Sodium-Ion Batteries*
Sara Cochella | College of Engineering |**Co-Author(s):** Joshua Greene
Mentor(s): Nicholas Stadie | College of Letters & Science

Most modern-day batteries rely on lithium as a principle component (the charge carrier), much more naturally scarce and therefore expensive than sodium. The development of sodium-ion batteries (NIBs) aims to reduce the cost of and scarcity of access to energy storage. While some concepts have been demonstrated, before NIBs can reach a level of performance that will allow mass use, they need to be optimized. We focus this work on exploration of the cathode, a limiting component to realizing working full-cell NIBs. A recently discovered cathode material (Na0.67Mn1-xMgx02, NMM) is our subject of focus, and we explore the range of x from 0.2to 0.9. After synthesis, X-ray diffraction was performed to analyze the crystalline structure of each composition. Overall, the samples produced in this study are less amorphous than those reported in previous work for x up to 0.2, a promising sign for effective use in electrochemical applications. As Mg content was increased, additional phases were shown to form, indicating that there is a limit to the incorporation of Mg within NMM.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 68 | *Effects of Ball-Milling and Calendering on the Electrochemistry of Lithium Iron Phosphate as a Lithium-Ion Cathode Material*
Sydney Romero | College of Engineering
Mentor(s): Nicholas Stadie and Connor Welty | College of Letters & Science

Lithium-ion batteries are the state-of-the-art in electrochemical energy storage due to their high energy density, modest power density, and long cycle life compared to other rechargeable battery chemistries. The cathode currently limits the energy density of the lithium-ion battery. Lithium-iron phosphate (LFP) is a promising cathode owing to its consistent, high potential associated with lithiation/delithiation and the high elemental abundance of iron. Higher performance is observed in LFP cathodes with particle sizes measuring in nanometers, owing to limited kinetics within the bulk. In this work, the effect of ball-milling methods, doctor blade height, and a calendering device on mass loading and homogeneity was explored on electrodes consisting of 80 wt.% LFP, 10 wt.% conductive additive (Super P), and 10wt.% binder was explored. Overall, higher ball-milling speed and longer ball-milling times, as well as the use of a calendering device was shown to markedly improve the performance of thick LFP cathodes (5-20 mg cm-2), lending reliable cathodes for full-cell lithium-ion batteries.

PHYSICS & SPACE SCIENCE

Morning | 71 | *Si-Stilbene fluorescence spectra and delay time properties*
Logan Aro | College of Letters & Science
Mentor(s): Aleks Rebane | College of Letters & Science

Si-Stilbene is a new trans stilbene isomer that has recently been developed. The fluorescence properties of this specific isomer have not yet been analyzed. The first analysis was determining Absorption-excitation-emission spectral profiles for this compound studied in two different solvents (ACN and THF). After that was determined, our second goal was to determine the delay characteristics of the fluorescence using a Fabry-Perot etalon, a pulsed laser, and a streak camera. The spectral profiles and delay characteristics determine how this new isomer will fluoresce when light is shown on it and how quickly it will respond to that light. The Absorption-excitation-emission spectra for this fluorophore were analyzed with a spectrum analyzer and we were able to successfully determine the spectral profiles in the two solvents but ran into significant hurdles concerning the delay calculation with the streak camera. These issues will be further detailed later on in the report.

Afternoon | 75 | *Rapid Power Spectral Density Estimates for Binary Mergers*
Eli Barton | College of Letters & Science
Mentor(s): Neil Cornish | College of Letters & Science

Detection of gravitational waves requires incredible sensitivity, an abundance of noise is present throughout all durations of signals, often times containing non-Gaussian transients. Currently implemented techniques of noise reduction and spectral estimation, such as BayesWave or Welch Averaging, aren't designed to work with signal duration expected in many Gravitational Wave detections, nor do they properly account for noise transients within data. As a result, these techniques are slow and as detector sensitivity improves, they won't be nearly as rapid as is necessary to keep up with the influx of signals. Here a modified PSD estimation technique is presented using wavelet de-noising, and an adapted method of parameter inference is shown. These analyses run much faster than currently implemented techniques, with comparable or even more effective estimates.

Morning | 74 | *Configurable Strain Lattices in WSe2*
Arthur Battaglin | College of Letters & Science
Mentor(s): Nicholas Borys | College of Letters & Science

Two-dimensional semiconductors are materials composed of an atomic layer of transition metal atoms (Mo or W) sandwiched between two atomic layers of chalcogen atoms (S or Se). These materials can be mechanically exfoliated into single layers to form atomically thin 2D semiconductor systems that exhibit optical properties such as absorbing and emitting light. Furthermore, these systems can withstand large amounts of strain, which allows them to be draped over nanostructures that locally stretch the material. It has been shown that by applying this sort of strain the structure of the system can be dynamically altered, allowing for the realization of new quantum emission effects. In previous studies involving the exploration of this regime the nanostructures have been spatially static. In efforts to learn more about these systems, we constructed a spatially dynamic nanostructure by depositing nanoparticles onto a silica substrate that are able to be moved around with an atomic force microscope. Our system consists of a 1L-WSe2 flake draped over a bed of silica nanoparticles. We then demonstrated that an AFM gave us the ability to physically manipulate the arrangement of beads, providing us with a configurable strain lattice embedded into the 1L-WSe2 flake. What we found is that the 1L-WSe2 draped over nanoparticles produces narrow emission that can be spatially moved due to the configurable nano system.

Morning | 72 | ***Exploring the Solar System with the NOIRLab Source Catalog***
Katie Fasbender | College of Letters & Science - Graduate Student
Mentor(s): David Nidever | College of Letters & Science

The solar system is dominated by the sun and eight main planets, but it is also full of much smaller orbiting bodies called Solar System Objects (SSOs). Over a million SSOs have been found to date, but many remain undiscovered and there is still much to learn about their properties and interactions. The ongoing study of SSO motion, formation, and physical characteristics improves our understanding of the Earth's neighborhood, the mechanisms of planet formation, and potential impacting objects. The NOIRLab Source Catalog (NSC) is an actively-updated inventory of objects captured in over 400,000 telescope images. It covers about 80 percent of the sky with 9 years of observations, and contains detections of very faint objects; Sirius, the brightest star in the sky, is about 2.5 billion times as bright as the median of objects in the NSC. Because of these reasons, the NSC is a fantastic tool for studying the solar system. With a computational method developed at Montana State University for the NSC's enormous scale, over 600,000 trails of SSO measurements were detected in the latest data release, and many more are expected to be identified in the next update of the catalog. The large number of SSO observations gives us the opportunity to explore the color, composition, and collisional history of asteroids in the Main Belt.

Acknowledgement: MSGC - Montana Space Grant Consortium

Afternoon | 76 | ***Characterizing Radiation Forces on Aspherical Microparticles With ADDA Software***
Carson Sander | College of Letters & Science
Mentor(s): Brian D'Urso | College of Letters & Science

In high-precision experiments involving the study of trapped microparticle motion, it can be burdensome or impossible to examine the shape of the particle of interest for consideration of how it may be unexpectedly moved by incident light. However, simulating this radiation force on microparticles of various plausible shapes provides insight into the importance of particle shape compared to other experimental factors. Using the ADDA software package -- a package that calculates scattering and absorption of light by particles of arbitrary shape using the discrete dipole approximation -- we approximate the forces on several shapes of microparticles due to an incident plane wave of light, and we use this to comment on the experimental importance of particle shape.

Morning | 70 | ***Double Sided Vibrating Target and Interferometer for Position Detection***
Lars Savage-Leuchs | College of Letters & Science
Mentor(s): Randy Babbit | College of Letters & Science

A PhD student's Lidar/Digital Holography system at Spectrum Lab requires an optical target vibrating on the order of microns, and a separate system to simultaneously determine the target's position with time while the Lidar/DH system operates. The target must be observable on two sides with antiparallel normals, in order for the two separate systems to make their respective measurements. Comparing the data sets in post processing independently verifies the target undergoes sufficient displacement to determine the Lidar/DH system's performance with known phase changes. We present a system involving a piezoelectric-chip driven target, an interferometer for target position determination, and a post processing algorithm to determine the position of the target in time. Here we show that the target vibrates on the order of microns and that our system is able to determine the target's position in time.

Morning | 73 | *Defining Electron Microbursts Through Analysis*
Tessa Skirsky | College of Letters & Science
Mentor(s): John Sample | College of Letters & Science

Electron microbursts are intense bursts from Earth's radiation belt into the atmosphere; however, the formal definition of microbursts varies widely across the field. FIREBIRD-II is a pair of CubSats that have been collecting data since January 2015. The mission of FIREBIRD-II has been to gather information on microbursts in low Earth orbit for analysis. Analysis of this data has been taking place using Python code that evaluates and finds electron microbursts in the taken data. Through changing coding parameters and time windows, we explore the definition of an electron microburst. A new definition for electron microburst would be valuable to the community to help bridge gaps between current definitions and provide uniformity.

PSYCHOLOGY

Morning | 79 | ***Urban vs. Tribal Residence: Discrimination and Mental Health in American Indians***
Mikayla Bullman | College of Letters & Science
Mentor(s): Neha John-Henderson| College of Letters & Science

While the effects of discrimination, oppression, and historical loss on mental health in American Indians (AIs) have been observed, less is known about how place of residence is related to AI mental health. Acknowledging that rates of suicidal ideation are higher for AIs residing on a reservation, there is a need for addressing risk/resilience factors related to place of residence. Our study examined mental health in a sample of 719 American Indian adults, where 15% identified as currently living on a tribal reservation. Compared to those living off a reservation, AI adults living on a reservation reported more experiences of everyday discrimination alongside higher reported experience of childhood and recent trauma. Those on a reservation also reported taking more medications for mental health, had higher levels of anxiety, and higher scores on the alcohol use disorder identification test. A positive correlation was found between problematic alcohol use and anxiety, and was stronger for those on living on a reservation ($r = .56$, $p<.001$) as compared to those not on a reservation ($r = .31$, $p<.001$). The relationship between alcohol use and depression was significant and positive for those who lived off a reservation ($r=.28$, $p<.001$), but was interestingly not significant for those living on a reservation. These findings highlight the need for exploring, considering, and understanding the complex nature residence plays in the affect of mental health. By understanding the unique factors associated with residence, more successful and integrative mental health interventions may be developed and implemented.

Acknowledgement: INBRE - IDeA Network for Biomedical Research Excellence

Afternoon | 78 | ***Youth Aware of Mental Health: Impacts of a Mental Health Literacy Course Implemented in Rural Schools***
Paisley Ferdina | College of Letters & Science
Mentor(s): Jayne Downey | College of Education, Health, & Human Development

Montana was the 3rd leading state in deaths by suicide in 2020, following Wyoming and Alaska (CDC). Youth Aware of Mental Health (YAM), a promising mental health promotion and suicide prevention program, has been evaluated in Europe and had minimal preliminary studies in the United States. A demonstration of help-seeking behaviors and mental health literacy, YAM was effective in reducing the number of suicide attempts and suicidal ideations in schools in Sweden. The presented study used an uncontrolled pretest/post-test design to analyze the potential for YAM to reduce rates of depression and anxiety and increase help-seeking behaviors. YAM was delivered to 3,069 students in 6 schools as part of regular school curricula. A subset ($N = 410$) completed surveys before and 3 months post. Significant increases were not found pre- to post-intervention in depression and anxiety scores. 1 of 10 help-seeking behaviors (asking a partner) found a significant increase. In the original SEYLE study, significant results were not found in the 3-month post-test survey as well (Wasserman et al. 2015). Several confounding variables may have led to bias or flaws in the study. A randomized controlled trial with a larger, more diverse sample size would be most advantageous for YAM research in the future.

Acknowledgement: McNair Scholars Program

Morning | 77 | ***Bidirectional associations between sleep and emotion regulation in rural youth and adolescents***
Julia Horst | College of Agriculture
Mentor(s): Cara Palmer | College of Letters & Science

Dysregulation of emotion has been linked to the development of affective disorders during adolescence and persisting into adulthood. However, there is a limited body of research exploring the relationship between sleep and emotion regulation specifically in children and adolescents. It remains unclear whether the complex, bidirectional relationship that exists between sleep and emotion is also present in emotion regulation techniques such as dampening and savoring. Understanding emotion regulation and sleep in the context of rural adolescents is essential to developing better treatment and prevention methods for rural areas associated with high rates of anxiety, depression, and suicide. This study aims to determine if a bidirectional relationship exists between adolescent sleep and emotion regulation through week-long at-home monitoring of 71 rural youth ages 8-17. Following semi-structured sleep and psychiatric initial interviews, participants underwent a week of normal sleep monitored by actigraphy along with twice-daily diary responses reporting on sleep habits, emotion, stress, mood, mental health, and social activities. Collection of this daily data provided an objective measure of sleep that was not influenced by subjective reporting biases, and the daily measures of emotion regulation prevent retrospective recall biases and allow for observation of changes across the week. Preliminary results using a series of hierarchical linear models indicated that youth who tended to dampen positive emotions are more likely to experience internalizing symptoms and difficulties falling asleep, whereas youth who savor positive emotions typically have better mental health. Final results will further explore the relationship between emotion regulation tendencies and sleep patterns.

Acknowledgment: USP - Undergraduate Scholars Program

Afternoon | 77 | ***Parental Divorce/Separation and Adolescent Cell Phone Acquisition***
Lori Reynolds | College of Education, Health, & Human Development | **Co-Author(s):** Paige Lagerquist
Mentor(s): J. Mitchell Vaterlaus | College of Education, Health, & Human Development

Concerns about the timing of adolescent smartphone acquisition have been discussed due to the potentially adverse effects of smartphone technology on adolescent's social, physical, psychological, and emotional development. It may be that the experiences and age of smartphone acquisition vary by diverse family experiences. The current study explored adolescents' acquisition of a cell phone/smartphone in relationship to parental separation or divorce and the parental reasoning behind the decision. Young adults (n=205) completed an online survey about their experiences with cell phone acquisition during adolescence. Participants who experienced parental divorce/separation acquired cell phones at significantly younger ages than those who did not experience parental divorce/separation (p = 036). Three themes were identified through phenomenological qualitative analysis: (1) safety and staying in touch, (2) cell phone concerns, monitoring and rules, and (3) changes in cell phone use following separation/divorce.

Acknowledgement: USP - Undergraduate Scholars Program and McNair Scholars Program

Morning | 76 | *Attentional Control and Reaction Time in Deception*
Jaime Rush | College of Letters & Science
Mentor(s): Keith Hutchison | College of Letters & Science

Deception is rampant in society and detecting it can be difficult and inconsistent. One measure that consistently exposes if someone is generating a lie, is reaction time. This experiment investigates whether reaction times can validly predict deception, as the effort in generating a lie should take time, especially if someone low in attentional control is trying to do multiple things at the same time. In order to obtain a measure of individual differences in attentional control, participants first complete three tasks: the RSPAN, the Antisaccade, and the Stroop task. After the attentional control tasks, participants respond truthfully and deceptively to autobiographical questions under a high or low cognitive load. Participants reaction time to answer the questions is recorded. It is expected that participants with lower attentional control abilities will take longer to produce deceptive answers when under a high cognitive load than those higher in attentional control. This predicted finding would suggest those lower in attentional control struggle to quickly produce convincing lies when under load, which can lead them to be more easily detected. These findings have implications for the potential development of new lie detection methods.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 75 | *Cooperation and Perceived Intelligence: An Exploration of Perception's Effects on Cooperation*
Josiah Shirley | College of Letters & Science
Mentor(s): Brandon Scott |College of Letters & Science

Cooperation is an essential part of the human condition as it helps to strengthen social connections and improve quality of life. Best, Reed, & Hooly, (2018) found that participant's behavior during a modified Prisoner's Dilemma game was influenced by their perception of their partner's personality. The purpose of our study was to understand whether one's perception of their partner's intelligence level, as compared to their own, will affect their cooperative behavior during a modified Prisoner's Dilemma game. Specifically, we hypothesized that if a person perceives their partner as having a lower intelligent quotient (IQ) than their own, they will choose to cooperate less than if their partner's IQ is perceived as being similar. We are still collecting data from MSU undergraduate students enrolled in the Introduction to Psychology course and have no findings at this point. Participants took a fake IQ test and were told that a study partner (no partner exists) had an IQ that was lower (lower IQ condition) or the same as their IQ (same IQ condition). Participants then engaged in the modified Prisoner's Dilemma in which their binary choice (A or B) and their partner's choice (A or B) would result in differing amounts of monetary gain (e.g., $8 versus $1) for being less or more cooperative. This study may add to the literature by providing evidence for a novel factor that influences cooperation. Our study may have practical implications for assigning group projects where intelligence may be considered.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 78 | ***Reward Sensitivity and Its Connection to Chronic Dieting***
Nievalinda Strong | College of Letters & Science
Mentor(s): Neha John-Henderson | College of Letters & Science

Early diagnosis and intervention for eating disorders is an important predictor of treatment success but can be difficult to accomplish due to the secretive nature of such disorders. Previous clinical research has found that a high or low sensitivity to punishment and reward is linked with specific eating disorder diagnoses. For example, individuals with anorexia nervosa have been shown to be highly sensitive to punishment and may also be less sensitive to reward. Little is known about whether these sensitivities may indicate a risk for developing an eating disorder within a nonclinical population. The current study sought to examine this latter point by analyzing whether high or low punishment and reward sensitivities correlate with different iterations of chronic dieting (e.g., consistent calorie restriction versus yo-yo dieting). This study may lead to a clearer understanding of the connection between chronic dieting and eating disorders and may improve early intervention efforts. College-aged participants (n=120 completed a series of surveys assessing eating behaviors, thoughts about dieting and body size, reward and punishment sensitivities, and childhood trauma. After sorting data based on dieting subtype and symptom severity, it is expected that correlations with reward and punishment sensitivity will align with results seen in clinical populations. These findings may allow for another means of assessing eating disorder risk and thus improve early diagnosis and intervention efforts.

Acknowledgement: USP - Undergraduate Scholars Program

Morning | 80 | ***Differences in Collaborative Process Variables Across Working Memory and Recall Performance***
Edison Woodward | College of Letters & Science|**Co-Author(s):** Ninoo De Silva
Mentor(s): Michelle Meade and Keith Hutchison | College of Letters & Science

The present study aims to examine the role of collaborative process variables (CPV), or how individuals communicate during recall tasks, and how those differences might be related to working memory capacity (WMC) and recall performance. To accomplish this, we analyzed conversations between participants who worked in pairs to recall words from categorized and uncategorized lists in order to determine the way individuals request and give feedback. We expect to find that partners who acknowledge and elaborate on each other's contributions will have better recall performance. Further, high-WMC individuals should be more likely to use effective CVP resulting in better recall performance for both categorized and uncategorized lists. Low-WMC individuals will be less likely to use effective CVP resulting in relatively worse recall for the uncategorized lists because they lack retrieval support. The results of this study will have important implications for understanding how language influences memory, and the role of WMC in this relationship.

Acknowledgement: USP - Undergraduate Scholars Program

SOCIAL SCIENCES

Afternoon | 80 | *Sacred Native American Lands of Montana*
Arianna Ahrens | Gallatin College
Mentor(s): Jennifer Woodcock-MedicineHorse | Gallatin College

Montana is home to many Native American sacred sites and land. Tribes that reside in These lands hold significance to the different Montana Native American tribes and their members. Montana tribes include Crow, Cheyenne, Sioux, Chippewa and Blackfeet, among many others. However, many of the sacred lands and sites have been stripped from the Native Americans. Today, many Native Americans reside on reservations allotted to the tribes by the United States government in the 1860s. In this paper, I will explain the significance and history of these lands and sites, the history of the Native American tribes in Montana, how the Native Americans' land was taken by the United States government through the Fort Laramie Treaty of 1851 and otherwise, and how the reservation system affects tribal members.

Morning | 81 | *Substance use and mental health among LBGTQ+ individuals and Racial/Ethnic minorities during the COVID-19 pandemic*
Isabelle Carnes | College of Letters & Science
Mentor(s): Kaylin Greene | College of Letters & Science

This research examines the impact of the COVID-19 pandemic on the substance use and stress of racial/ethnic minorities as well as sexual and gender minorities (SGM). A narrative review of 35 scientific articles published between 2020 and 2022 was conducted. The minority stress aided in the conceptualization and the framing of the review. The minority stress model states that mental health and substance use inequalities are driven by structural vulnerabilities; that is, hierarchal power structures created and continue to maintain health disparities. Key findings indicated that the COVID-19 pandemic exacerbated the long-standing inequalities found throughout not just racial/ethnic minority populations, but the LGBTQ+ (lesbian, gay, bisexual, transgender, queer and other identities) community. Substance use during the pandemic increased among minority populations. In particular, the number of drinking days increased among all racial/ethnic groups investigated, pointing towards substance use as a means to cope. Racial/ethnic minorities and LGBTQ+ populations faced increased discrimination during the pandemic, as well as increased negative affect and lower overall wellbeing. Furthermore, some LGBTQ+ individuals became more isolated because of the pandemic, likely due to social distancing measures. For others, the pandemic led to increased risk of harm from unsupportive families. Findings from the literature suggests that there is a need to change policies surrounding substance abuse, such as by increasing restrictions on the purchase of alcohol. Likewise, there is a need to tackle the vast inequalities and stressors facing minorities through increased funding towards support organizations that serve these populations.

Morning | 82 | *A social analysis of the incorporation of green building technologies in Gallatin County*
Atticus Cummings | College of Letters & Science
Mentor(s): Cody Warner and Sara Rasch | College of Letters & Science

The building industry is a significant contributor to global carbon emissions. To reduce emissions and mitigate climate change, more sustainable building technologies must be used. These technologies largely exist; however, the rate of adoption is too slow to meet global targets. Several barriers have been identified that hinder the adoption of sustainable building technologies, including up-front cost, client wishes, and concerns about the longevity of products. In this qualitative sociological study, architects and general contractors in Gallatin County were interviewed to determine the primary barriers they face when adopting sustainable building technology, and if they believe that simply reducing the price of sustainable building materials would be enough to induce a faster rate of adoption.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 79 | *Sacred Lands of the Southwest*
Edwin Harrison | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine | Gallatin College

The Sacred Lands of the Southwest have many beautiful characteristics and lovely views. Some tribes in this would include the Navajo, whose sacred land is Monument Valley always known as Tse Bii Ndzisgaii meaning valley of the rocks. Other tribes in the area include Pueblo, Apache, Hopi, and Zuni. Another sacred land I will be discussing is Mesa Verde where the Pueblo Indians ancestors used to live. It is a beautiful National Park where ancient pueblo built thriving communities in cliffs and on mesas in Mesa Verde.

Afternoon | 81 | *Snoqualmie Falls*
Jake Hopkins | Gallatin College
Mentor(s): Jennifer Woodcock-Medicine-Horse | Gallatin College

The Snoqualmie Falls are a staple of Washington State. Featuring a 268-foot waterfall not far from the city of Seattle the falls capture the eye of thousands of tourists every year. However appreciation of the falls became long before tourism in the area began. The people of the Snoqualmie tribe have inhabited the land surrounding the falls for 1000's of years. In this project we will explore the rich Native history surrounding the falls. From the traditions and rituals that commonly took place there over the many years to the transfer of ownership that now sees a native tribe owning the land the falls sit on. The falls have significance with the Snoqualmie people to such an intensity that they are tied to the very way they believe they were created. When a moon deity created the first man and women, that very same deity then went on to create the Snoqualmie falls the Native cherish so much.

Afternoon | 83 | ***Men's Longitudinal Experiences During the COVID-19 Pandemic: A Qualitative Case Study Approach***

Alexandra Nelson | College of Education, Health, & Human Development | **Co-Author(s):** Rebecca Vujovich
Mentor(s): J. Mitchell Vaterlaus | College of Education, Health, & Human Development

Few studies have focused on men's experiences during the COVID-19 pandemic. In the United States, employment and childcare often align with traditional gender roles, but the pandemic required shifts in daily living that may have altered this. The purpose of this study was to explore men's lived experiences and well-being during the COVID-19 pandemic in the United States. The study took a longitudinal approach collecting data (surveys with open-ended data; 2 participants completed in-depth interviews in 2021) from participants (n = 13) in March 2020 and April 2021. A qualitative case study approach was used to identify lived experiences over time. Constructed themes will be presented and results will be discussed in terms of implications for future pandemic planning.

Afternoon | 82 | ***Value in the eyes of farmers and researchers: A case study to explore value-added food entrepreneurship with Senegal smallholder women farmers***

Olivia Schwintek | College of Education, Health, & Human Development | **Co-Author(s):** Chidimma Ifeh and Hannah Kempf
Mentor(s): Wan-Yuan Kuo and Sun-Hwa Kim | College of Education, Health, & Human Development

Since 2018, we have worked with women farmers in Senegal using local ingredients to develop food products such as the Bonbon Bouye peanut bar. In fall 2021, our collaboration received a commitment from the African Development Bank to build the first food processing facility in the women's village of Ndangane, and construction is currently underway. Communication is imperative in cross-cultural collaboration, yet our communication with the farmers has been challenged by distance, the pandemic, and a lack of telecommunication infrastructure in our partners' village. Better understanding our Senegalese partners' perspective is essential for constructing a practical entrepreneurship model that addresses the goals of our team and their community. The objectives of this project are twofold: assess the benefit of value-added food entrepreneurship from the perspective of the women farmers; and identify effective tools to streamline communication with the women farmers. A December 2022 survey asked our collaborators about benefits of value-added food processing and our partnership, as well as ideas to improve our communication. During our January visit to Senegal, focus group discussions were held and farmers identified the following benefits of our collaboration in value-added food processing: the use of local ingredients, nutritional benefits, opportunity to establish a sustainable business to break out of the cycle of poverty, and knowledge exchange. Training materials were shared with the women farmers to support them in food product manufacturing in the new facility. A survey will be distributed in April to analyze the efficacy of these materials and our communication.

Acknowledgement: USP - Undergraduate Scholars Program

Afternoon | 48 | *Educational Heart Model*
Kristin Wurst Comeaux | College of Engineering | **Co-Author(s):** Carl Griffin, Jenna McNally, and Jack Larson
Mentor(s): Erick Johnson | College of Engineering

The project's goals include creating an apparatus able to match the velocities and pressures created by an average-sized human heart. These values will be measured at the inlets and outlets and pressure change in each heart chamber. The chambers designed will be accurate in volume, but not necessarily shaped to an anatomically correct heart. The system is not required to resemble a heart in appearance but will be focused on providing valid hydraulic values for a healthy cardiovascular system. At a minimum, the design will be validated with a two-chamber model. The primary purpose of the model is to be an educational tool. Most models of the heart are passive and do not properly represent the flows occurring through the cardiovascular system. Developed by four engineering students, there was a different approach taken than a typical heart model. By using bellows, linear actuators, and electromechanically controlled valves, the heart model will be constructed based on mechanical engineering and fluid dynamic principles. The heart model is still in the research phase, with development and construction beginning in the Fall 2023 semester. USP's grant has allowed the group to research materials and purchase more expensive, more accurate linear actuators. The leader of the project will present the research in the form of a poster board, screenshots of CAD, and what the group has written for the project thus far.

USP - Undergraduate Scholars Program

INDEX

List of presenters alphabetically by last name.

S

T

V

W

Z

List of presenters and abstracts by College.

—

College of Agriculture

College of Arts & Architecture

College of Education, Health & Human Development

College of Letters & Science

Gallatin College

Norm Asbjornson College of Engineering

Other