

MONTANA  
STATE  
UNIVERSITY  
**STUDENT  
RESEARCH  
CELEBRATION**  
**SPRING  
2022**

Celebrating  
research and  
creativity in  
all academic  
disciplines.



# MSU Student Research Celebration

## Spring 2022

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The Undergraduate Scholars Program and McNair Scholars Program Acknowledge the Following Sponsors and Partners for their Ongoing Support of Student Research

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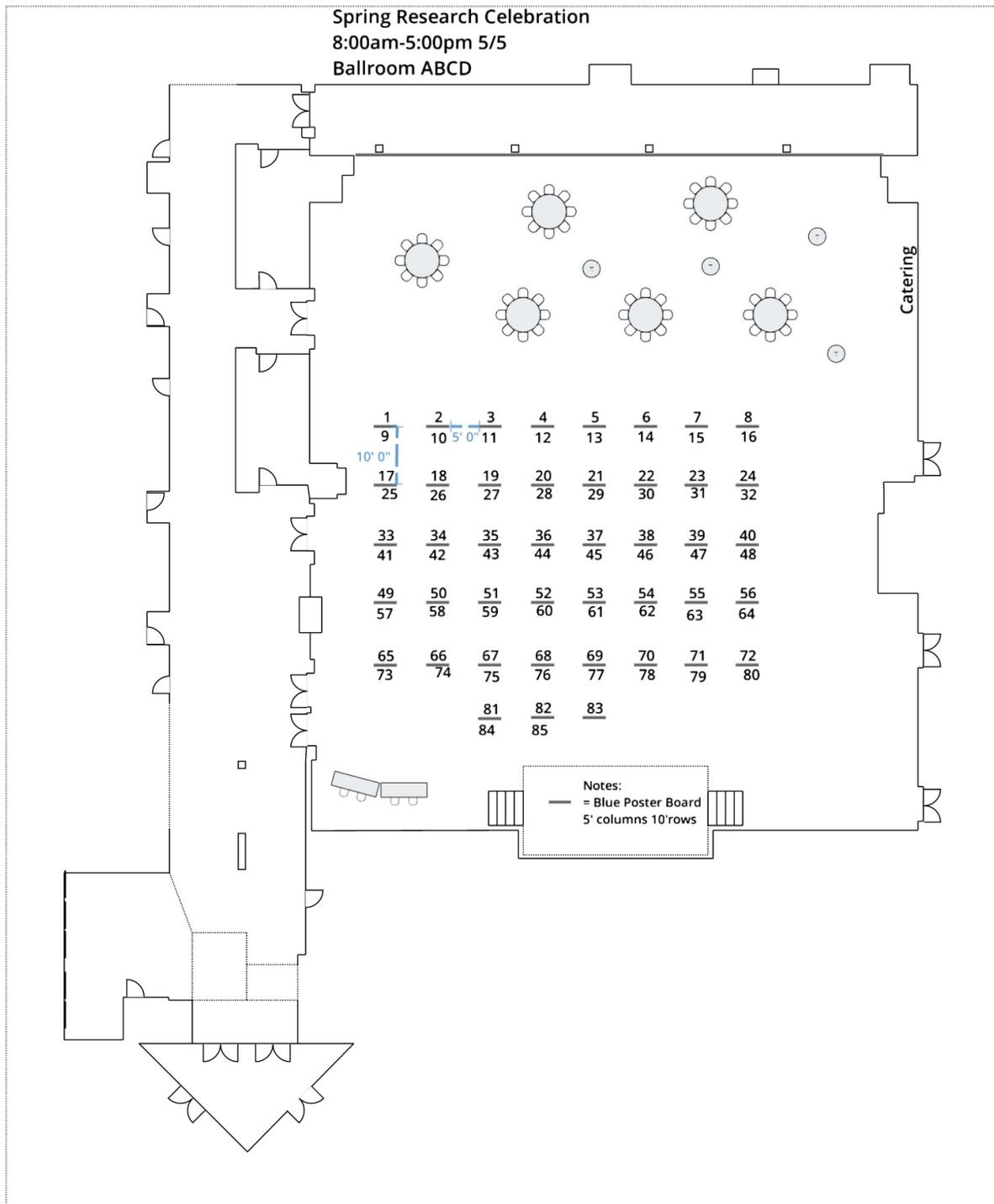
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# CONFERENCE MAP





## MORNING POSTER PRESENTATIONS

SUB Ballrooms

9:30AM – 12:30PM

Primary Author, Department; Coauthors Mentor(s) TITLE	SESSION (AM/PM)	Poster Number	Page
<b>Thomas Halvorson, Mechanical &amp; Industrial Engineering</b> Mentor(s): Stephen Sofie; David Driscoll <i>Thermal consolidation of metallic tin porous membranes with ammonium chloride</i>	AM	01	27
<b>Samantha Kelderman, Chemical &amp; Biological Engineering</b> Mentor(s): Dana Skorupa; Brent Peyton <i>Thermophilic bioconversion of degraded plastic wastes to Polyhydroxyalkanoates (PHAs) utilizing T. thermophilus</i>	AM	02	34
<b>Grace Beck, Chemical &amp; Biological Engineering</b> Mentor(s): Paul Gannon; Wan-Yuan Kuo <i>Comparing the Carbon and Water Footprints of Extruded Lentil Puffs and Wheat Puffs</i>	AM	03	5
<b>Matt Egloff, Mechanical &amp; Industrial Engineering</b> Mentor(s): Roberta Amendola; Doug Cairns <i>Formability of Stretch-Broken Carbon Fiber</i>	AM	04	20
<b>Riad Morshed Rezaul, Mechanical &amp; Industrial Engineering</b> Mentor(s): Cecily Ryan; Douglas Cairns <i>Effect of sizing deposition and fiber length on the uncured handleability and formability of stretch broken carbon fiber</i>	AM	05	56
<b>Cailin Casey, Mechanical &amp; Industrial Engineering; Claire Yager</b> Mentor(s): Chelsea Heveran; Mark Jankauski <i>The flying insect thoracic cuticle is heterogeneous in structure and in thickness-dependent modulus gradation</i>	AM	06	10
<b>Malakai Coblenz, Mechanical &amp; Industrial Engineering</b> Mentor(s): Mark Owkes; Phil Stewart <i>A Multispecies Biofilm Growth Model</i>	AM	07	13
<b>Ashton Chan, Mechanical &amp; Industrial Engineering</b> Mentor(s): Dilpreet Bajwa <i>Enhancing the Mechanical Properties of Wood via Cellulose Nanocrystal (CNC) Impregnation</i>	AM	08	11
<b>Saptarni Chanda, Mechanical &amp; Industrial Engineering</b> Mentor(s): Dilpreet S Bajwa <i>Nano Boron Oxide Incorporation to Cellulose Nanocrystals and Lignin containing Cellulose Nanocrystals to Improve the Thermal, Mechanical and Flammability Properties of high density polyethylene polymer</i>	AM	09	11
<b>Dalton Nold, Mechanical &amp; Industrial Engineering</b> Mentor(s): Dilpreet Bajwa <i>Tensile Properties of Stretch Broken Carbon Fiber Prepreg</i>	AM	10	51
<b>Andrew Durado, Mechanical &amp; Industrial Engineering</b> Mentor(s): Dilpreet Bajwa <i>Biodegradable Composite Hydromulches for Sustainable Organic Horticulture</i>	AM	11	19
<b>Courtney Scott, Microbiology &amp; Cell Biology</b> Mentor(s): Frank Stewart; Zoe Pratte <i>Characterizing microbiome diversity in tiger sharks with unusual diets</i>	AM	12	61
<b>Katrina Lyon, Microbiology &amp; Cell Biology; Barkan Sidar; Thomas Sebrell; James Wilking; Rama Bansil</b> Mentor(s): Diane Bimczok <i>Characterizing the luminal microenvironment of human organoids for studies of gastric pH regulation</i>	AM	13	40
<b>Kassidi Thompson, Microbiology &amp; Cell Biology; Alyssa Mandich</b> Mentor(s): Jason Carter <i>Decreased Total Sleep Time is Associated with Increased Heart Rate Reactivity in Women</i>	AM	14	67
<b>Brad Burns, Microbiology &amp; Cell Biology</b> Mentor(s): Bernadette McCrory <i>Risk of Injury and Biomechanics of Beginner and Advanced Rock Climbers</i>	AM	15	9

<b>Emily Cleveland, Microbiology &amp; Cell Biology;</b> Sarah Hagengruber Mentor(s): Jason Carter <i>Sex Differences in Heart Rate Variability after Evening Binge Alcohol Consumption</i>	AM	16	13
<b>Julia Roemer, Microbiology &amp; Cell Biology</b> Mentor(s): Kelly Shepardson; Agnieszka Rynda-Apple <i>Determining the cellular interaction required for fungal clearance by immune cells</i>	AM	17	57
<b>Emma Kerkering, Microbiology &amp; Cell Biology;</b> Gianna Migliaccio; Ian Greenlund; Jeremy Bigalke Mentor(s): Jason Carter <i>Reliability of Heart Rate Variability during Stable and Disrupted Polysomnographic Sleep</i>	AM	18	35
<b>Caden Messer, Microbiology &amp; Cell Biology</b> Mentor(s): Christa Merzdorf <i>Studying convergent extension in animal cap explants induced to become dorsal mesoderm and neural ectoderm</i>	AM	19	44
<b>Gwendolyn Mueller, Microbiology &amp; Cell Biology;</b> Heini Miettinen-Granger Mentor(s): Susy Kohout <i>Breaking Voltage-Sensing Phosphatase Dimers</i>	AM	20	49
<b>Madelyn Mettler, Center for Biofilm Engineering;</b> Hannah Goemann Mentor(s): Brent Peyton <i>A simplified laboratory model of a Martian saline seep</i>	AM	21	45
<b>Jordan Pauley, Chemistry &amp; Biochemistry;</b> James Larson; Grace Ludlow; Kristen Gregg; Brooklyn Brekke Mentor(s): Brian Bothner; Martin Lawrence <i>Aerobic Methane Synthesis by a Bacterial Aminotransferase</i>	AM	22	53
<b>Amelia Graves, Chemistry &amp; Biochemistry;</b> Brooklin Hunt, Caylee Falvo, Manuel Ruiz, Bat OneHealth Mentor(s): Raina Plowright <i>Cytochemical Characterization of Grey-Headed Flying Fox (<i>Pteropus poliocephalus</i>) blood cells</i>	AM	23	26
<b>Tasnia Javin Nur, Chemistry &amp; Biochemistry;</b> Zachary White Mentor(s): Roberta Amendola; Douglas Cairns <i>A novel Experimental unit to evaluate inter-ply and tool-ply friction in carbon fibre reinforced polymer composites prepregs</i>	AM	24	51
<b>Kayla Kozisek, Chemical &amp; Biological Engineering;</b> Molly Taylor; Charles Hocomb Mentor(s): Robin Gerlach; Huyen Bui <i>Isolation of new algal and bacterial strains from high pH/ high alkalinity habitats</i>	AM	25	37
<b>Alexi Panos, Chemical &amp; Biological Engineering</b> Mentor(s): Martin Lawrence <i>Solving the 3D Structure of the First Known Methanogenic Aminotransferase Enzymes</i>	AM	26	53
<b>Jaelynn Roesler, Chemical &amp; Biological Engineering;</b> Esther Stopps Mentor(s): Stephanie McCalla <i>Using SPR to Test Cooperative Binding Constraints of Nucleic Acids</i>	AM	27	58
<b>Anna Stewart, Chemical &amp; Biological Engineering</b> Mentor(s): Nicholas Stadie <i>Synthesis of a Triply Periodic Minimal Surface Graphene Foam Material</i>	AM	28	66
<b>Sarah Peterson, Chemical &amp; Biological Engineering</b> Mentor(s): Jennifer Brown <i>Rheological Study of VitroGel</i>	AM	29	55
<b>Yoni Shchemelinin, Mechanical &amp; Industrial Engineering;</b> Jared Nelson; Douglas Cairns; Dilpreet Bajwa; Cecily Ryan Mentor(s): Amendola Roberta <i>Hydraulic bulge testing to compare formability of continuous and stretch broken carbon fiber prepreg laminates</i>	AM	30	62
<b>Hayden Sofie, Mechanical &amp; Industrial Engineering</b> Mentor(s): David Driscoll <i>Novel Microstructures for Enhanced Performance Monopropellant Thrusters</i>	AM	31	64
<b>Jonmichael Weaver, Mechanical &amp; Industrial Engineering</b> Mentor(s): David Miller <i>Effects of Ultraviolet Environmental Aging on Ultrahigh-Molecular-Weight-Polyethylene Composites</i>	AM	32	70
<b>Kenedee Lam, Chemical &amp; Biological Engineering;</b> Matthew Magoon Mentor(s): Stephanie McCalla <i>Developing an Aptamer Against Acetaminophen to Detect Acetaminophen Toxicity at the Point-of-Care</i>	AM	33	38

<b>Noah Loomis, Mechanical &amp; Industrial Engineering</b> Mentor(s): Dilpreet Bajwa <i>Comparison of Stretch Broken Carbon Fiber and Continuous Carbon Laminates Longitudinal Mechanical Properties</i>	AM	34	40
<b>Abigail Murray, Civil Engineering</b> Mentor(s): Adrienne Phillips; Catherine Kirkland <i>Assessing the use of a multifunctional bio-mineralized composite to treat contaminated stormwater runoff.</i>	AM	35	50
<b>Grant McNamara, Civil Engineering; Ethan Turner</b> Mentor(s): Mohammad Khosravi; Kathryn Plymesser <i>A GIS-Based Feasibility Study of Using Geothermal Energy as an Alternative Bridge Deicing Method</i>	AM	36	43
<b>Cash Cota, Civil Engineering</b> Mentor(s): Michael Berry <i>Effects of Cure Temperature on Strength Gain in Ultra-High Performance Concrete</i>	AM	37	14
<b>Tigan Donaldson, Civil Engineering</b> Mentor(s): Erika Espinosa-Ortiz <i>Investigating the mechanisms of bacterial transport along fungal hyphae</i>	AM	38	18
<b>Alixandra Huhta, Civil Engineering</b> Mentor(s): Kirsten Matteson <i>Development of a Guarded Hot Plate Apparatus to Test Thermal Conductivity of Hempcrete</i>	AM	39	31
<b>Martina Du, Chemical &amp; Biological Engineering</b> Mentor(s): Ross Carlson <i>Using Synthetic Ecology to Quantify Consortial Interactions in Biofilm and Planktonic Cultures</i>	AM	40	18
<b>Camryn Dubois, Mechanical &amp; Industrial Engineering</b> Mentor(s): Scott Monfort <i>Effects of Peripheral Nervous System Impairments on Postural Control</i>	AM	41	19
<b>Rachel Elander, Chemical &amp; Biological Engineering; Matt Skuntz</b> Mentor(s): Ryan Anderson <i>Computational Fluid Dynamics Modeling and Determination of Pressure Drop Effects of Radial Flow Enhancing Geometries in a Packed Bed Thermal Energy Storage (TES) System</i>	AM	42	21
<b>Shannon Hamp, Electrical &amp; Computer Engineering; Riley Logan</b> Mentor(s): Joseph Shaw <i>Calibrating a Multispectral Imager for Detecting Harmful Algal Blooms</i>	AM	43	27
<b>Jonathon Kilen, Electrical &amp; Computer Engineering; Alexander Nordstrom</b> Mentor(s): Todd Kaiser; Maryam Bahramipناه <i>Increasing Resiliency of the Power System using Electric Vehicles as Distributed Energy Storage</i>	AM	44	35
<b>Lealem Amedie, Computer Science; Malcolm Cusack; Alec Vanderkolk</b> Mentor(s): Clemente Izurieta <i>Barfly</i>	AM	45	1
<b>Matt Gotta, Computer Science; Marnie Manning; Ryan Fitzgerald</b> Mentor(s): Clemente Izurieta <i>Social Optics</i>	AM	46	25
<b>Sarah Montalbano, Computer Science; Byron Norman; Brian Jore</b> Mentor(s): Clemente Izurieta <i>Designing a Graph Database for Alaska School Districts Expenditures</i>	AM	47	46
<b>Mark Mousel, Computer Science; John Hartman; Marcus Twichel</b> Mentor(s): Clemente Izurieta <i>Kreig! - The Video Game</i>	AM	48	49
<b>Caleb Hayes, Computer Science; Christian Hess Hess; Josiah Schwahn; Caden Senitte</b> Mentor(s): Clemente Izurieta <i>Motivity</i>	AM	49	28
<b>Natalia Eigner, Computer Science; Grayson O'Leary</b> Mentor(s): Clemente Izurieta <i>Yellowstone Ecological Research Center Mobile Application</i>	AM	50	21
<b>Hannah Madsen, Computer Science; Kieran Ringel</b> Mentor(s): Clemente Izurieta <i>YERC Spatial Data Ingestion</i>	AM	51	41
<b>Joaquin Monterrosa, Computer Science; Ben Holmgren; Nic Dzomba</b> Mentor(s): Clem Izurieta <i>Topo Health: AI Lung Cancer Diagnosis</i>	AM	52	47

<b>Walker Ward, Computer Science;</b> Michael Heidal Mentor(s): Clemente Izurieta <i>Detection of Malware Injection on the MSP430 Microcontroller Family</i>	AM	53	70
<b>Joseph Winjum, Mathematical Sciences</b> Mentor(s): Mark Greenwood <i>Replicating the Replication of Social Science Experiments</i>	AM	54	72
<b>Jake Horstmann, Physics</b> Mentor(s): John Neumeier <i>Heat Capacity, Magnetic Susceptibility, and Resistivity Measurements of NbO12</i>	AM	55	30
<b>William Jardec, Physics;</b> Lin Shi Mentor(s): John Sheppard <i>Rule Extraction from Decision Forests Via Weighted Graph</i>	AM	56	31
<b>Nathan Kuehl, Physics</b> Mentor(s): Randy Babbitt <i>Construction of Hong-Ou-Mandel Interferometer for Quantum Network Research</i>	AM	57	38
<b>Charlie Siders, Physics</b> Mentor(s): David Nidever <i>Searching for Variability in APOGEE Spectra</i>	AM	58	63
<b>Abigail Sites, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>Outlaws and the Law in Montana</i>	AM	59	64
<b>Isaac Bennett, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>Messaging and Opinions in Times of Conflict</i>	AM	60	5
<b>Joaquin Bodine, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>Crossroads of Conflict: American Foreign Policy and the Koreans of Japan</i>	AM	61	7
<b>Elsa Bentz, English</b> Mentor(s): Kent Davis; Gretchen Minton <i>Orpheus Ascending: A Myth Re-Imagined</i>	AM	62	6
<b>Phoebe Zea, Film &amp; Photography</b> Mentor(s): Alexis Pike <i>Touched Landscapes: Americans' changing perceptions and interactions with the West</i>	AM	63	73
<b>Morgan Chamberlin, Health &amp; Human Development;</b> Stephanie Wilson; Chantal Vella Mentor(s): Mary Miles <i>Inflammation Variability And Relationship To Physical Activity And Visceral Adipose Tissue In Metabolically Healthy Adults</i>	AM	64	10
<b>Emily Peterson, Health &amp; Human Development;</b> Stephanie Wilson; Marcy Gaston; Sarah Bronsky; Wan-Yuan Kuo Mentor(s): Mary Miles <i>Impact of sedentary time and habitual glycemic load on glucose responses from a 12-week dietary lentil intervention</i>	AM	65	55
<b>Stephanie Wilson, Health &amp; Human Development;</b> Chantal Vella Mentor(s): Mary Miles <i>Impact of Moderate-to-vigorous physical activity and visceral adiposity on postprandial triglycerides in metabolically at-risk adults</i>	AM	66	71
<b>Storrs Bishop, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Native American Ledger Art: Montana Iconography</i>	AM	67	7
<b>Kaitlin Murdy, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Native Miniatures: Appropriation in the Art of Miniatures</i>	AM	68	49
<b>Kaitlyn McCormick, Gallatin College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Ponnow</i>	AM	69	42
<b>Madelyn McFall, Gallatin College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Suquamish Tribe and the Importance of Cedar</i>	AM	70	43
<b>Jacob Ogurek, Gallatin College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>The Sioux: Chef breathes life into a lost tradition</i>	AM	71	52

<b>Madison Wellman, Gallatin College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Native American Stereotypes</i>	AM	72	71
<b>Mackayla Kennedy-Harris, University College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Stolen: Investigating the Americanization of Native American culture, and the normalization of cultural appropriation in America</i>	AM	73	34
<b>Tegan Old, Psychology; Peyton Vining</b> Mentor(s): Kalli Decker; Brianna Routh <i>Nutrition and Movement Project</i>	AM	74	72
<b>Abigail Sparks, Health &amp; Human Development; Peyton Vining</b> Mentor(s): Kalli Decker; J. Mitchell Vaterlaus <i>Parent's Experience of Parent Child Interaction Therapy</i>	AM	75	65
<b>Prabina Bhattarai, Health &amp; Human Development; Sarah Bronksy; Marcy Gaston</b> Mentor(s): Mary Miles; Stephanie Wilson <i>Dietary Fat, Sedentary Behavior and Blood Triglycerides in Adults With High Waist Circumference</i>	AM	76	6
<b>Kylie Moore, Earth Sciences</b> Mentor(s): Madison Myers; Natali Kragh <i>Petrographic, Geochemical, and Age Dating of Unknown Dacite Units in the Greater Yellowstone Region</i>	AM	77	48
<b>Johnathon Hobgood, Ecology</b> Mentor(s): Lindsey Albertson; Zach Maquire <i>The Effect of Flushing Flows on Macroinvertebrate Community Structure in the Madison River, Montana</i>	AM	78	28
<b>Kellan Karch, Ecology; Lorelle Berkeley; Claire Gower</b> Mentor(s): Elizabeth Leipold; Lance McNew <i>Effects of Survey Conditions, Date, and Time on Dusky Grouse Counts in Montana</i>	AM	79	33
<b>Olivia Gervacio Jakobosky, Ecology; Rebecca Smith; Jorge Damian Ayala Santacruz</b> Mentor(s): Lance McNew <i>Evaluating the Effects of Electric Cables on Howler Monkeys with Local Knowledge and Naturalistic Observation</i>	AM	80	24
<b>Samuel Koeshall, Land Resources &amp; Environmental Sciences; Clain Jones Kevin Wanner;</b> Mentor(s): Perry Miller <i>Pea Leaf Weevil Management in Yellow Pea to Optimize Yield and Protein Content</i>	AM	81	36
<b>Thomas Austin, Agricultural Economics &amp; Economics</b> Mentor(s): William Kleindl <i>Expanding Ecosystem Service Flow Models to Account for Ecosystem Dynamics</i>	AM	82	2
<b>Conrad Collins, JJCBE Center for Entrepreneurship; Naomi Kaku; Mark Jankauski</b> Mentor(s): Michelle Flenniken <i>Examining the effects of sublethal virus infection on boney bee health using flight assays and immune gene expression analyses</i>	AM	83	14
<b>Sophia Hojnacki, Health &amp; Human Development; Alice Heriza</b> Mentor(s): Mitch Vaterlaus <i>Womens Longitudinal Experiences with Social Media during a Global Pandemic</i>	AM	84	29
<b>Katy Kropatsch, Health &amp; Human Development; Stephanie Wilson; Marcy Gaston; Wan-Yuan Kuo</b> Mentor(s): Mary Miles <i>The relationship between appetite, fat-free mass, and resting metabolic rate in overweight and obese adults</i>	AM	85	37
<b>Lauren Potyk, Chemical &amp; Biological Engineering</b> Mentor(s): Joseph Seymour <i>Geometry Based Fluid Rheology Comparison: Cone and Plate vs. Concentric Cylinder Geometry</i>	AM	86	56

## AFTERNOON POSTER PRESENTATIONS

SUB Ballrooms

1:30 – 4:30PM

Primary Author, Department; Coauthors Mentor(s) TITLE	SESSION (AM/PM)	Poster Number	Page
<b>Nicole Hopkins, English</b> Mentor(s): Tess Meacham <i>From Philosophy to Practice: Introducing ePortfolios in University Curriculum</i>	PM	01	30
<b>Christopher Dyrland-Marquis, English;</b> Lauren Warrenfeltz; Linden Morse Mentor(s): Doug Downs <i>Bridging the Gulf between Rhetoric Scholarship and Antagonistic Public Discourse: Reciprocity, Identity, Accessibility</i>	PM	02	20
<b>Ingrid Peters, Environmental Studies</b> Mentor(s): Margaret Eggers; Adam Sigler <i>Drinking Water Cumulative Risk Analysis: Yellowstone Watershed</i>	PM	03	54
<b>Quincy Balius, American Studies</b> Mentor(s): Alex Harmon <i>Monumental Memories: The Bear River Massacre, Gender, and Public History</i>	PM	04	3
<b>Cody Crowley, History &amp; Philosophy</b> Mentor(s): Molly Todd; James Meyer <i>What can Travel Guides tell us about Orientalism?: A look into the Thomas Cook Archives</i>	PM	05	15
<b>Dillon Fatouros, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>From the Weimar Republic to Hitler's Reich: Germany's Political Transition and Evolving Global Relationships Through the Lens of the 1930s World's Fairs</i>	PM	06	22
<b>Tanner Lawson, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>What Might Have Been: Thomas Battey, Companion of the Caddo and Kiowa Tribes</i>	PM	07	39
<b>Tyler Schwarzbach, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>The Use of the Internet as a Historic Primary Source: War in Iraq</i>	PM	08	61
<b>Eliana Boylan, Psychology</b> Mentor(s): Keith Hutchison <i>Heart rate variability biofeedback as a training mechanism for working memory capacity</i>	PM	09	8
<b>Sydney Brown, Psychology;</b> Tabitha Horton Mentor(s): Mitchell Vaterlaus <i>Mother-Child Relationship's During the COVID-19 Pandemic: A Longitudinal Qualitative Approach</i>	PM	10	8
<b>Olivia Moran, Psychology</b> Mentor(s): Aaron Grusonik <i>The Effect of the COVID-19 Pandemic on College Varsity Athlete and Non-Athlete Anxiety and Depression</i>	PM	11	48
<b>Zoe Waddell, Psychology;</b> Jade Larsen; Taylor Kampf Mentor(s): Neha John-Henderson <i>Moderating the Effects of Childhood Trauma Through Gratitude and Mindfulness Meditation</i>	PM	12	69
<b>Paul Ashmore, Psychology</b> Mentor(s): Neha John-Henderson; Cory Counts <i>Anxiety and Depression Symptom Trajectories Predicted by Childhood Adversity</i>	PM	13	1
<b>Nievalinda Strong, Psychology</b> Mentor(s): Benjamin Oosterhoff; Zack Wood <i>Parental and Peer Influences on Adolescent Eating Behaviors and Beliefs</i>	PM	14	66
<b>Katherine Kalebich, Psychology</b> Mentor(s): Brandon Scott	PM	15	32

<i>Understanding Children's Emotional Development During a Mask Mandate: Do Masks Decrease Children's Ability to Recognize Emotions in Peers?</i>			
<b>Samantha DesLauriers, Psychology;</b> Kathryn Heiser Mentor(s): Mitchell Vaterlaus <i>"This whole year has been really hard": A longitudinal qualitative study on women's experiences and well-being during the COVID-19 Pandemic in the United States</i>	PM	16	16
<b>Kierstyn Toth, Psychology</b> Mentor(s): Mariana Olsen <i>Autism-Relevant Behavior in Doodles</i>	PM	17	68
<b>Nina Denny, Civil Engineering</b> Mentor(s): Ellen Lauchnor; Chris Allen <i>Root Biofilms and Oxygen Transport in Treatment Wetlands</i>	PM	18	15
<b>Kaylin Clark, Mechanical &amp; Industrial Engineering;</b> Ethan Viles; Robin Gerlach Mentor(s): Sobia Anjum <i>Durability of Microbially Produced Calcium Carbonate Adhesives</i>	PM	19	12
<b>Kylee Rux, Civil Engineering</b> Mentor(s): Chelsea Heveran <i>Plastic-Reinforced Cement Mortar: A Sustainable Solution for Reducing Global Carbon Emissions</i>	PM	20	59
<b>Catherine Bauer, Chemical &amp; Biological Engineering;</b> Hannah Koepnick Mentor(s): Brent Peyton; Ellen Lauchnor <i>Isolation of Nitrate-dependent Iron Oxidation Bacteria from a Coal Mine Bioreactor for Reduction of the Toxin Selenium</i>	PM	21	4
<b>Kristen Gregg, Chemistry &amp; Biochemistry;</b> James Larson; Grace Ludlow; Jordan Pauley; Brooklyn Brekke Mentor(s): Brian Bothner; Martin Lawrence <i>Understanding Aerobic Methane Production</i>	PM	22	26
<b>Madeleine Miller, Mechanical &amp; Industrial Engineering</b> Mentor(s): Stephan Warnat <i>Biofilm Growth on NASA-relevant Materials based on Substrate Conditions</i>	PM	23	46
<b>Alex Johnston, Computer Science;</b> Tanner Rubino; John Dolph Mentor(s): Clemente Izurieta <i>IntelliCompose</i>	PM	25	32
<b>Dawson Kanehl, Computer Science;</b> Zoe Norden; Maria Gallivan; Connor Lowe Mentor(s): Clemente Izurieta <i>PIQUE GUI and database expansion</i>	PM	26	33
<b>Lenin Lewis, Computer Science;</b> Joshua Anderson; Gregory Fulbright Mentor(s): Clemente Izurieta <i>Recreational Aviation Foundation Project</i>	PM	27	40
<b>Marie Steiger, Mathematical Sciences;</b> Michael Bruner; Heidi Steiger Mentor(s): Atish Mitra <i>Non-face-to-face tilings of the Euclidean plane and their duals</i>	PM	28	65
<b>Cassie Baker, Mathematical Sciences</b> Mentor(s): Mary Alice Carlson; Katherine McWalters <i>Montana Models: How Does a Language Survive</i>	PM	29	2
<b>Gracyn Ross, Physics;</b> Jaiverdhan Chauhan Mentor(s): Anne Lohfink <i>Phase Spectroscopy as an Alternative for Analyzation of the Black Hole GRS 1716-249</i>	PM	30	58
<b>Sophia Kennedy Overfelt, Physics;</b> Kyle Olson; Aaron Marsh; Philip Woodburn Mentor(s): Rufus Cone; Charles Thiel <i>Diffusion Doping and Characterization of Rare-Earth Ions in Lithium Niobate for Quantum Transduction</i>	PM	31	34
<b>Silas Andrews, Physics</b> Mentor(s): John Sample <i>Electron Microbursts from Dawn to Dusk: Investigating Whistler Mode Chorus as a Source of Microbursts</i>	PM	32	1
<b>Sam Fritsch, Physics</b> Mentor(s): Brian D'Urso <i>Optimizing blockMesh for a Magnetic Trap in OpenFOAM</i>	PM	33	23
<b>Steven Mattson, Physics</b> Mentor(s): Brian D'Urso <i>Convolutional Neural Network Data Filtering for Quantum Limited Detection of particles</i>	PM	34	42
<b>Alex Mausshardt, Physics;</b> Nathan Chellman	PM	35	42

Mentor(s): Dave McWethy <i>Reconstructing Greenland's Paleoclimate with an Oxygen Isotope Analysis of the GISP2 Greenland Ice Core</i>			
<b>Sage McNulty, Physics</b> Mentor(s): Brian D'Urso <i>Correcting Beam Refraction</i>	PM	36	44
<b>Meilo Seiter, Physics</b> Mentor(s): Carla Riedel <i>Simulating Solutions to The Schrödinger Equation for Generalized One-dimensional Piece-wise Constant Potential Wells: A Web-hosted Teaching Tool</i>	PM	37	62
<b>Celina Sanchez, Chemistry &amp; Biochemistry</b> Mentor(s): Martin Lawrence <i>Crystallization of Methanogenic Aspartate Aminotransferase from Burkholderiales sp.</i>	PM	38	60
<b>Connor Devine, Chemical &amp; Biological Engineering; Brady Hislop</b> Mentor(s): Chelsea Heveran <i>Subchondral Bone Microarchitecture and Cell Activity Changes Early After Injury in a Murine Model of PTOA</i>	PM	39	16
<b>Lauren Johnsrude, Chemical &amp; Biological Engineering</b> Mentor(s): Stephanie Wettstein <i>Composition Analysis of Native Montana Plants and Grasses for Renewable Chemical Production</i>	PM	40	32
<b>Clarice Burger, Microbiology &amp; Cell Biology</b> Mentor(s): Diane Bimczok; Katrina Lyon <i>Developing a chronic infection model to study the effects of Helicobacter pylori reinfection of human gastric organoids</i>	PM	41	9
<b>Maya Moody, Chemistry &amp; Biochemistry; Kenna Brown; Ghazal Vahidi; Kat Paton</b> Mentor(s): Chelsea Heveran; Stephen Martin <i>The influence of sex, age, and dietary fat content on bone remodeling in mice</i>	PM	42	47
<b>Rachel Balko, Microbiology &amp; Cell Biology; Lindsey Albertson; Geoffrey Poole</b> Mentor(s): Frank Stewart; Anthony Bertagnolli <i>Temporal and microhabitat variation among caddisfly-influenced microbial communities in a montane stream</i>	PM	43	3
<b>Pilar Santos, Microbiology &amp; Cell Biology</b> Mentor(s): Margaret Eggers <i>Big Hole Watershed Impacting Human Health due to Contaminants Affecting Water Quality</i>	PM	44	60
<b>Alessandra Miller, Microbiology &amp; Cell Biology; Heather Walk</b> Mentor(s): Frances Lefcort <i>The Impacts of Familial Dysautonomia on the Neuroimmune System of the Gut</i>	PM	45	46
<b>Taylor Olsen, Microbiology &amp; Cell Biology</b> Mentor(s): Susy Kohout <i>Investigating What Mutations Break the Voltage-Sensing Phosphatase Dimer</i>	PM	46	52
<b>Conner Killeen, Microbiology &amp; Cell Biology; Connor Beck</b> Mentor(s): Anja Kunze <i>Utilizing nanomagnetic forces to guide firing patterns in cultured neuronal networks</i>	PM	47	36
<b>Lydia Diehl, Ecology</b> Mentor(s): Brent Peyton <i>Microbiome Assembly in the D. lanuginosum rhizosphere across a temperature gradient in Yellowstone National Park</i>	PM	48	17
<b>Siri Christopherson, Agricultural Economics &amp; Economics</b> Mentor(s): William Kleindl <i>Rapid Assessment of Wetland Services</i>	PM	49	12
<b>Madeline Metcalf, Agricultural Economics &amp; Economics</b> Mentor(s): Sally Moyce <i>Community Health Fairs as Health Promotion for the Latino Community</i>	PM	50	45
<b>Meghan Robinson, Land Resources &amp; Environmental Sciences</b> Mentor(s): Adam Sigler <i>Trend Analysis for Volunteer Water Monitoring Groups</i>	PM	51	57
<b>Andrew Glennie, Department of Agricultural and Technology Education</b> Mentor(s): Shannon Arnold <i>Continuing the Family Farm/Ranch</i>	PM	52	25
<b>Nicole Holt, Animal &amp; Range Sciences</b> Mentor(s): Laura Larsson	PM	53	29

<i>The Effectiveness of Illustrations Depicting the Use of Silver Diamine Fluoride in an Oral Health Campaign delivered via GoodHealth TV</i>			
<b>Parker Lambourn, Department of Agricultural and Technology Education</b> Mentor(s): Shannon Arnold <i>Investigating the Price Increase of Agricultural Inputs: Finding Solutions Through Montana's Young Farmers</i>	PM	54	39
<b>Marki Sharkey, Department of Agricultural and Technology Education</b> Mentor(s): Shannon Arnold <i>An Exploration of Alternatives for Landowners with Small Acreage</i>	PM	55	62
<b>Anna Slivka, Department of Agricultural and Technology Education</b> Mentor(s): Shannon Arnold <i>Assessing College of Agriculture Students' Perceptions of Agricultural Images through Heat Mapping</i>	PM	56	64
<b>Garrett Tutvedt, Department of Agricultural and Technology Education</b> Mentor(s): Shannon Arnold <i>Perception of winter canola by producers in the Flathead Valley</i>	PM	57	68
<b>Knoll Williams, Department of Agricultural and Technology Education</b> Mentor(s): Shannon Arnold <i>An Examination of MSU Students' Perceptions of Farmland Sales and Development</i>	PM	58	71
<b>Ian McRyhew, University College; Virgil Dupuis</b> Mentor(s): Jane Mangold <i>Evaluation of Grassland Restoration and Pollinator Conservation on Tribal Lands Degraded by Invasive Annual Grasses</i>	PM	59	44
<b>Sarah Budeski, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Decolonizing Visual Art and Culture in American Contemporary Museums</i>	PM	60	8
<b>Halee Head, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Exploring Modern Native Art in Native Communities through Apache skateboard artist, Douglas Miles</i>	PM	61	28
<b>James Hubbell, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Contemporary Native American Pop Art: Creating Native American Representation through American Pop Culture</i>	PM	62	30
<b>Elle Olsztyn, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Contemporary Dye Selection in Navajo Weavings</i>	PM	63	52
<b>Derek Perry, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Sustainability in Pacific Northwest Indigenous Art</i>	PM	64	54
<b>Olivia Ross, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>New Growth: Protecting and Sustaining Indigenous Cultural Rites</i>	PM	65	59
<b>Rachel Towery, Art</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>The Indigenous Futurisms Movement</i>	PM	66	68
<b>Noah Bennett, Gallatin College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>The Checkerboarding of Native American Lands</i>	PM	67	5
<b>Maria Dominguez, Gallatin College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Pow Wow in America</i>	PM	68	17
<b>Chloe Maciag, Gallatin College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Basketball: How the Game Changed Native Lives in Montana</i>	PM	69	41
<b>Elise Russell, Gallatin College</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Saving young lives by addressing native youth suicides and preventions</i>	PM	70	59
<b>Sophia Thompson, Nursing</b> Mentor(s): Sally Moyce <i>Exploring Health Anxiety Impacts on Quality of Life of Nursing Students During the COVID-19 Pandemic</i>	PM	71	67

<b>Genevieve Devitt, Health &amp; Human Development;</b> Kelsea Hertel Mentor(s): Wan-Yuan Kuo <i>Decolonized, Indigenous, International Food Enterprise Certificate</i>	PM	72	16
<b>Sumedha Garg, Health &amp; Human Development;</b> Emily Mayhew Mentor(s): Wan-Yuan Kuo <i>Combining napping and consumer acceptance tests to identify sensory drivers of liking and consumer clusters for novel cold-hardy berry smoothie premixes</i>	PM	73	23
<b>Jennifer Nicevski, Health &amp; Human Development;</b> Gianna Migliaccio; Emma Kerkerling Mentor(s): Jason Carter <i>Afternoon Napping Does Not Impact Autonomic Function in Healthy Adults</i>	PM	74	50
<b>Ryland Schmidt, Education</b> Mentor(s): Jennifer Woodcock-Medicine Horse <i>Imagery of Native Americans in Children's Books and Films</i>	PM	75	61
<b>Candace Fredericks, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>How the Globalization of Sugar Created an Everlasting Impact on the Indigenous Communities in the New World</i>	PM	76	23
<b>Jason Fly, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>Slavish Imitator: How the American annexation of the Philippines cemented white supremacy within the US</i>	PM	77	22
<b>Caitlynn Gaston, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>Germans in the American Revolution</i>	PM	78	24
<b>Colin Gillespie, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>The Effect of Foreign Motion Pictures on Chinese Society.</i>	PM	79	25
<b>Caleb Battersby, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>How Conservative Christians Shaped the way Reagan Fought the Cold War</i>	PM	80	4
<b>Stone Sherman, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>The States and the Reich</i>	PM	81	63
<b>Paul Velk, History &amp; Philosophy</b> Mentor(s): Molly Todd <i>Adverts and Indians: Selling the American West</i>	PM	82	69

## STUDENT PRESENTATION ABSTRACTS

*\*Alphabetically by last name\**

### **AM-45: Barfly**

**Lealem Amedie, Computer Science;** Malcolm Cusack; Alec Vanderkolk – College of Engineering  
Mentor(s): Clemente Izurieta, Computer Science

Throughout the years, we've seen various iterations of online food/drink delivery apps with the goal of maximizing the convenience of their customers. However, a use case that's yet to be widely employed is an application for in-establishment ordering to bring that same convenience to customers who choose to be at the venue. Places like bars and nightclubs aren't known for the ease at which you can get service and a better solution is needed.

Barfly is a product that aims to streamline the in-establishment ordering experience by allowing users to utilize their smart devices to place orders and by allowing establishments to utilize theirs to accept and deliver them. The development of Barfly has hit major strides with our functional website [www.barfly.llc](http://www.barfly.llc), where users can create accounts and explore various “dummy bars and menus,” along with operations such as order selection, and order tracking, with payments already in place. Bars/restaurants will use the Barfly-E application, the enterprise version of Barfly, to manage the orders from their side. The next steps for the Barfly project are to refine the user experience to make it as pleasing and intuitive as possible, then ensure that the architecture of our program is scalable to the point of serving tens and even hundreds of customers simultaneously.

### **PM-32: Electron Microbursts from Dawn to Dusk: Investigating Whistler Mode Chorus as a Source of Microbursts**

**Silas Andrews, Physics**  
Mentor(s): John Sample, Physics

It has been observed that the distribution of whistler mode chorus favors the dawn side of the Earth. Consequently, observed electron microbursts have a significant distribution favoring the dawn side. Previous observation and analysis show more microbursts in this region, however there is still a significant distribution of microbursts present where whistler mode chorus is minimal on the dusk side. This project investigates this distribution of microburst events on the dusk side and its ratio to whistler mode chorus. Data from the Solar Anomalous Magnetospheric Particle Explorer (SAMPEX) satellite, specifically from the Heavy Ion Large Telescope (HILT), is used to analyze microbursts. Algorithmic studies on this data isolated around regions of the subject of investigation, including the South Atlantic Anomaly (SAA), will address ratios of microbursts to whistler mode chorus on the dawn and dusk sides of the Earth. This study approaches characteristics of specific microburst activity to explain known distributions.

### **PM-13: Anxiety and Depression Symptom Trajectories Predicted by Childhood Adversity**

**Paul Ashmore, Psychology**  
Mentor(s): Neha John-Henderson, Psychology; Cory Counts, Psychology

Childhood adversity has been linked to poorer physical and mental health outcomes later in life. Specifically, prior research has indicated childhood adversity as a risk factor for depression and anxiety. The present body of literature lacks sufficient evidence of this phenomenon in college students. The current study's main focus is to investigate childhood adversity in relation to symptom trajectories of depression and anxiety in college students. It was hypothesized that college students who experienced

more adversity during childhood would have a more gradual decline in depression and anxiety symptoms. Longitudinal data was collected from 100 Montana State University students during their undergraduate degrees. The Risky Family Questionnaire was utilized to measure each participant's exposure to adversity during their childhood. To measure depression and anxiety symptoms from year to year, the Hospital Anxiety and Depression Scale (HADS) was used. The Risky Family Questionnaire predicted increased depression and anxiety symptoms from time 1 (freshman year) to time 3 (junior year), after controlling for age, race, gender, and measures of subjective social status using the MacArthur Ladder. These findings provide further evidence that childhood adversity affects later health outcomes, and they are among the first to indicate the significance of childhood adversity on depression and anxiety symptom trajectories in college students.

*Acknowledgments: USP - Undergraduate Scholars Program*

### ***AM-82: Expanding Ecosystem Service Flow Models to Account for Ecosystem Dynamics***

**Thomas Austin, Agricultural Economics & Economics**

Mentor(s): William Kleindl, Land Resources & Environmental Sciences

Ecosystem services are dependent on the flow of products from ecosystem functions to realized goods and benefits through the interaction of natural, human, and cultural capital. Through a review of the ecosystem service literature, I have found that the production of natural capital is generally treated as a 'black box'. These capital flow models generally do not consider many of the foundations of ecosystem science that attempt to understand the dynamics of systems that would produce natural capital. There appears to be a disconnect between the foundations of economics and ecology in the field of ecosystem services. For economists to fit ecosystems into economic models, they simplify the interaction of ecosystem structure and functions so that the ecosystem products can be evaluated by the market. This may be necessary to evaluate the flow of capital in ecosystem services but presents a problem if the supply of that capital is not stable due to ecological variability. The disconnect between ecosystem science and neoclassical economic theory provides an interesting opportunity to explore ecosystem service flow models. Here I expand on economic-centered capital flow models to include ecological dynamics.

### ***PM-29: Montana Models: How Does a Language Survive***

**Cassie Baker, Mathematical Sciences**

Mentor(s): Mary Alice Carlson, Mathematical Sciences; Katherine McWalters, Mathematical Sciences

Culturally responsive mathematics teaching not only improves student learning, it also communicates to students that they are valued. An example of culturally responsive mathematics teaching is the following language task.

How a language survives depends on two things. First, on how many people speak the language. Second, on how many people the language holders pass on their language to. The United Nations Educational, Scientific and Cultural Organization (UNESCO) declared 2022-2023 the International Decade of Indigenous Languages. They estimate 7,000 languages are spoken worldwide with approximately 40% that are in some form of endangerment. Most Native American tribes are experiencing near extinction of their indigenous languages. Some languages, such as that spoken by the Coeur d'Alene Tribe, have become extinct, meaning their last fluent language speaker has died. In order to combat this language epidemic, we are creating a task for students to model how a language survives or becomes extinct. Students will create their solution using the mathematical tools and knowledge they already possess. We will analyze their use of these tools to see how students use their resources.

During our research, we have found that very little data, especially current data, exists about the number of Native American language speakers. Our research will bring awareness to this issue while also empowering students to create an actionable plan for their community.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

#### ***PM-04: Monumental Memories: The Bear River Massacre, Gender, and Public History***

**Quincy Balius, American Studies (Graduate Student)**

Mentor(s): Alex Harmon, American Studies

Though the Bear River Massacre (also known as the Baker Massacre or Marias River Massacre) remains an important part of Blackfeet tribal history today, the only permanent public historical representation of the massacre is a marker installed by the Montana Department of Transportation. Through examining the Montana Historical Highway marker program's development from tourist attraction to public historical tool, my work revealed the entanglement of collective memory, Indigenous peoples, and gender in Montana history. I examined the role of Blackfeet women in surviving the massacre and current-day massacre commemorations. I also analyzed current-day decolonization efforts at public historical institutions, including museums and historic marker programs. Through reframing the massacre from the perspective of Blackfeet women, I showed how Indigenous women's stories are silenced in public history and how Blackfeet women push back on these silences. Overall, my project discussed how marker programs can function as sites of decolonization, especially when markers center the voices of Indigenous peoples and recognize both colonialism and survivance in Indigenous history.

#### ***PM-43: Temporal and microhabitat variation among caddisfly-influenced microbial communities in a montane stream***

**Rachel Balko, Microbiology & Cell Biology; Lindsey Albertson<sup>1</sup>; Geoffrey Poole<sup>2</sup>**

<sup>1</sup>Ecology; <sup>2</sup>Land Resources & Environmental Sciences

Mentor(s): Frank Stewart, Microbiology & Cell Biology; Anthony Bertagnolli, Microbiology & Cell Biology

Caddisflies (Trichoptera) are aquatic invertebrates that produce protective rock retreat and silk nets for filter feeding. Caddisflies are found in high abundance in montane streams (Oswood, 1979). These macroinvertebrates are often bioindicators of stream quality, decreasing due to poor water quality (Jehamalar et al., 2010). Caddisflies also impact streambed hydrology such that decreased hydrologic exchange is associated with increased caddisfly abundances (Albertson et. al. 2019). Caddisfly retreats and nets often form biofilms that contain microorganisms with roles in nutrient cycling (e.g., denitrification). However, the extent to which these communities differ over time with changing environmental conditions and relative to other stream habitat (e.g., stream channel waters, sediments) remains unknown. Similarly, the extent to which observations from field environments can be replicated in a laboratory setting remains relatively unknown but may be of interest for remediation purposes. To explore these uncertainties, stream microbial taxonomic diversity using 16S rRNA gene amplicon data, comparing communities in stream channel water, surface sediment, and caddisfly influenced microhabitats from two sampling dates in spring 2021 were examined. Three-dimensional non-metric multidimensional scaling of unfrac distances consistently revealed differences between caddisfly-influenced microhabitat communities (retreats, nets) and those from un-influenced stream water and sediments, as well as community change over time. The data support the hypothesis that caddisflies create niches for distinct and dynamic microbial communities within the hyporheic zone.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-80: How Conservative Christians Shaped the way Reagan Fought the Cold War*****Caleb Battersby, History & Philosophy**

Mentor(s): Molly Todd, History &amp; Philosophy

My senior research project in political history focuses on how the newly mobilized political force of conservative Christians impacted the Reagan administration's approach to foreign policy. I chose focus in on the National Archives Catalog and specifically sources held within the Ronald Reagan Presidential Library archive. Within this archive, memos, letters, newspaper clippings, and other kinds of correspondence from the Office of the Public Liaison revealed that the Christian Right leaders and groups were exerting pressure on the Reagan administration. In addition, interviews, speeches, and public statements revealed that the Reagan administration responded to pressures from the Christian Right. While the agenda of these conservative Christian groups mostly focused on domestic issues, they also had influence when it came to foreign policy as well. They pressured the Reagan administration to take a tougher approach with the "godless communists" of the Soviet Union and elsewhere which prompted Reagan to call the USSR the "evil empire." Conservative Christian groups and leaders were very involved in White House operations through lobbying. As one of Reagan's most important constituencies according to administration documents regarding election strategy, the interests of conservative Christians had to be heeded. Their activism led the Reagan administration to take a tougher approach to dealing with the Soviet Union and other communists abroad. The election of Reagan in 1980 marked the beginning of the Christian Right's takeover of the Republican Party which has, in many ways, persisted through today.

*Acknowledgments: Senior Capstone****PM-21: Isolation of Nitrate-dependent Iron Oxidation Bacteria from a Coal Mine Bioreactor for Reduction of the Toxin Selenium*****Catherine Bauer, Chemical & Biological Engineering; Hannah Koepnick, Civil Engineering**

Mentor(s): Brent Peyton, Chemical &amp; Biological Engineering; Ellen Lauchnor, Civil Engineering

Toxins released by mining practices invade nearby watersheds posing serious impacts to public health. Selenium, a metalloid known as the "essential" toxin due to the thin margin between recommended and toxic intake, is found in coal bearing rock, accumulating significantly in watersheds near coal mines. Nitrate dependent iron oxidation (NDFO), mediated by denitrifying bacteria, occurs when iron donates an electron to nitrate producing iron (oxy)hydroxide minerals which are capable of adsorbing elements such as selenium. The objectives of present research are to isolate bacteria capable of NDFO from a coal-mine bioreactor. To determine if bacteria found in coal-mine bioreactors are capable of NDFO, samples were first enriched in NDFO selecting a growth medium. After iron precipitates appeared indicating occurrence of NDFO capable bacteria, enrichments were plated onto fresh-water mineral medium (FWMM) agar, obtained isolates, which were selected and transferred to a denitrifying selection medium. After additional growth is observed, Ion Chromatography will allow for quantification of denitrification, and transfer to an Fe(II)-containing denitrifying medium will determine whether isolates are capable of NDFO. NDFO-capable isolates will be sequenced and identified. This study will identify NDFO capable bacteria native to coal mining waste, which will allow for greater understanding of NDFO facilitated bioremediation .

*Acknowledgments: USP - Undergraduate Scholars Program  
INBRE - IDeA Network for Biomedical Research Excellence*

### **AM-03: COMPARING THE CARBON AND WATER FOOTPRINTS OF EXTRUDED LENTIL PUFFS AND WHEAT PUFFS**

**Grace Beck, Chemical & Biological Engineering**

Mentor(s): Paul Gannon, Chemical & Biological Engineering; Wan-Yuan Kuo, Health & Human Development

The carbon and water footprints of food products are major influencers in maintaining the health of consumers and in fighting climate change. The goal of this research was to conduct a life cycle analysis (LCA) from farm to processing of an extruded lentil puffs to compare to an extruded wheat puffs. To calculate the carbon and water footprint of the product, desirable extruded lentil and wheat puffs must be developed using a 30 mm twin screw Buhler extruder. From communication with Timeless seeds, an organic lentil company in Montana, the carbon footprint was estimated to be about 0.2545 kg CO<sub>2</sub> per kg lentil puff product on CarbonScope (CleanMetrics 2.0). On the extruder the lentil flour used about 0.1 kg of water and 0.2 kWh per kg of puffs produced. Wheat semolina flour was used to produce wheat puffs that used 0.42 kg of water and 0.053 kWh per kg of puffs produced. The carbon footprint of durum wheat semolina flour puffs was calculated to be 0.4841 kg CO<sub>2</sub> per kg of wheat puffs and the water footprint during plant growth was found to be 0.004 kg per kg of wheat by a previous study conducted by University of Idaho in the CarbonScope database. Overall, the wheat puffs produced in the FPDL had a larger carbon and water footprint than the lentil puffs and can persuade consumers to pursue lentil products over traditional products, which can result in overall greater health benefits and environmental benefits.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **AM-60: Messaging and Opinions in Times of Conflict**

**Isaac Bennett, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

The purpose of this research project is to ascertain how much similarity existed between the views of the government, media, and citizenry of the United States in regards to the Gulf War (17 January 1990 – 28 February 1991) during 1990 and 1991. The project assesses this query by comparing the rhetoric and ideas surrounding the Gulf War from the perspective of the government, media, and citizens. The scope of this project's research has been the George H.W. Bush Presidential Library's collection titled Records of the Persian Gulf War. The sources in this collection are letters from the public, press releases by the White House, and news articles and op-eds from the media. This research has shown that the American people were divided in regards to whether or not the war should occur, yet commonly affirmed their support for the American troops, and expressed hopes for their safe return to the US. The White House's communications were typically focused on the necessity and just nature of the Gulf War, while also expressing hopes for the safe return of American forces. The press was often critical of the necessity and benefits of fighting a war in the Middle East, while frequently focusing on the safety of American troops. In summary, the nation's people, media, and government were divided over whether or not the war was good, but unified in their support for the military. These findings can assist in grappling with the mixed reactions and messaging that come when conflicts ensue.

### **PM-67: The Checkerboarding of Native American Lands**

**Noah Bennett, Gallatin College**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Past the damage caused by Native American removal and relocation acts alike, "checkerboarding" refers to the dividing of (traditionally communal) native settlements into multiple individual plots. One significant landmark in the creation of checkerboarding is the Dawes Act of 1887, which distributed

specific amounts of acreage to individuals within Native communities, but also created the rift in keeping Native people in control of their own land. Fracturing Native communities' lands and their ability to keep the land out of non-Native's hands has had a devastating and continuously discouraging effect on the ability to farm, regulate, or utilize the land taken in many ways. My research will mostly take a look at the steps the federal government took in establishing these "checkerboarding" issues (such as the Dawes Act and railroad land grants) and not only how they continue to affect Native Americans today, but how/if there are any ways to improve upon this situation.

### ***AM-62: Orpheus Ascending: A Myth Re-Imagined***

**Elsa Bentz, English**

Mentor(s): Kent Davis, Nursing; Gretchen Minton, English

In researching the Orpheus myth-type in traditions across the globe, I found that the story more often than not ended with Orpheus failing to bring his loved one back from the dead. I wanted to know what it would take to break this Orphic cycle; what narrative alteration could produce a different ending – an ending in which Orpheus was successful. To write a thought-provoking, wholly original, dramatic take on the myth of Orpheus and Eurydice I began by scouring the realms of entertainment, literature, art, and media for every portrayal of the Orpheus myth that I could find. The second half of my research consisted in the more academic analysis of a number of different examples of the Orpheus myth from numerous countries and cultures including: Japan, Peru, a Maori legend, a Nez Perce story, numerous Hopi, Navajo, and Zuni stories, Scandinavian stories, and tales from Eastern Europe. This research confirmed my hypothesis of a global bias towards a tragic ending for Orphic figures. With this research in mind I set about my own process of myth-making in the form of playwriting. The result was a live theatre show, three hours in length that ran for five performances. I cast, directed, designed, and produced a play that was attended by an audience of over 400. The resulting show served to demonstrate the power that myths have not only in the lives of those who first told them millenia ago, but in the lives of us here and now.

*Acknowledgments: USP - Undergraduate Scholars Program*

### ***AM-76: Dietary fat, sedentary behavior, and Blood Triglycerides in Adults With High Waist Circumference***

**Prabina Bhattarai, Health & Human Development (Graduate Student); Sarah Bronksy<sup>1</sup>; Marcy Gaston<sup>1</sup>**

<sup>1</sup>University Health Partners; Health and Human Department

Mentor(s): Mary Miles, Education; Stephanie Wilson, Health & Human Development

**Background:** Postprandial lipemia, a well-known risk factor of cardiovascular diseases, is characterized by an abnormal level of triglyceride (TG)-rich lipoproteins in circulation after fat consumption. Sedentary behavior is known to impact postprandial lipemia; however, there is a paucity of data on how objectively measured sedentary behavior relates to postprandial lipemia in adults with high waist circumference (WC) at greater risk of developing lipemia.

**Purpose:** To examine the relationship between sedentary behavior and high-fat meal-induced blood TG in adults with high WC.

**Methods:** Non-diabetic adults (n=31) with high WC (> 35" for women and > 40" for men) underwent a high-fat meal challenge. Blood was collected within 3-5 h after fat meal consumption, with TG determined by lipid panels. Body composition was measured using bioelectrical impedance analysis. Participants were asked to wear the accelerometer for seven days (>10 h/day). Percent time spent in sedentary behavior/day was determined. A linear regression model was created to test the impact of sedentary behavior on the log triglyceride response, adjusting for interaction between meal fat load and

time of the meal consumption, and the time difference between high-fat meal consumption and blood draw.

**Results:** Percent sedentary time spent per day was not statistically significant with median postprandial triglyceride ( $p=0.19$ ) adjusting for the other variables in the model. The amount of fat and time difference jointly affected the median triglyceride response ( $p=0.03$ ), accounting for sedentary time and time of the meal consumption. Participants with the longer time differences (time (mins) = 310, 270, and 240 vs. 200, and 170) had less TG with higher fat load but higher TG with a lower fat load. Time of the meal consumption did not impact blood TG ( $p= 0.43$ ).

*Acknowledgments: Supported by USDA-ARS Pulse Crop Health Initiative 58-3060-9-040*

### **AM-67: Native American Ledger Art: Montana Iconography**

**Storrs Bishop, Art**

Mentor(s): Jennifer Woodcock-Medicine Horse, Native American Studies

This paper examines the state of modern Native American ledger art in Montana. Starting with a history of the art form in the northern plains, it traces the evolution of the form, its purpose, and its symbology from the 1860s until 1910. Using this historical narrative as a starting point, the paper delves into the many modern interpretations and expressions of the art form.

Starting in the 1990s, Native artists used ledger art to interrogate identity, gender, marginality, and humor. This shift from the communal record-keeping and storytelling purposes of the original form to the individualized and political intentions of today's artists reflects (in part) the state of indigenous artistic expression today. Many artists continue to use traditional motifs and symbols, like horses and hunting, while others reflect modern life with pickup trucks and cell phones. Whether it is women taking up the art of a traditionally male art form or the creation of images through non-traditional techniques like collage, modern ledger art is proving to be a highly influential and important mode of communication.

This paper will rely on historic collections of ledger art in the MSU-Billings Library, Barstow Collection and slides of contemporary work.

### **AM-61: Crossroads of Conflict: American Foreign Policy and the Koreans of Japan**

**Joaquin Bodine, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

Koreans and Japanese contributed to the forceful movement of Koreans during the Japanese imperial war in the Pacific. The Japanese government brought 700,000 to 800,000 Koreans to Japan's factories and mines. Upon surrender in 1945, Japan submitted under Allied military occupation with the United States in a leading role. How did Koreans react under American policies and how did American officials respond? What was the transition like for Koreans? Research to answer these questions includes utilizing the United States National Archive and documents from the Japan at War and Peace, 1930-1949: U.S. State Department Records collection. Indeed, American foreign policy during the military occupation of Japan had significant negative impacts on Koreans living in Japan and former imperial Japanese territories. American unpreparedness in communicating with Korean populations and reluctance to engage American authority over Japanese authority alienated Koreans and damaged the relationship between the US and Korea. This research is my attempt to bring insight into the lives and situations Koreans faced under the American Allied occupation of Japan from 1945-1952. Korean education, employment opportunities, autonomy of government, and political influences from communism all were key issues for American officials and Koreans alike during occupation. Understanding these American military policies over Korean populations and their effects acts as a case study to study American foreign policy and showcase Korean transition from Japanese occupation to American occupation. Awareness of 20th century

minority Korean communities in Japan also adds value in shared cross-cultural history and the role Koreans played in post-imperial Japan.

***PM-09: Heart rate variability biofeedback as a training mechanism for working memory capacity***

**Eliana Boylan, Psychology**

Mentor(s): Keith Hutchison, Psychology

The goal of this research is to investigate the relationship between heart rate variability (HRV) and working memory capacity (WMC). The construct of working memory capacity is a stratified system based upon two main components: short-term memory and executive attention. For the purposes of this research, the focus is on the capability of the executive-attention component. Working memory capacity is a crucial component of learning and it predicts performance in many real-world settings. Using the Automated Operation Span task (AOSPAN), an initial baseline will be established for the working memory capacity of the participant. After the initial training session, the participant will return in one week and WMC will be tested again. During the week, training sessions will be conducted to stabilize the physiological and behavioral components associated with WMC. This data could suggest that higher WMC people may improve their performance partially by better regulating their respiration and heart rate. This is done in order to physiologically cope with changing environmental demands. The stabilization of respiration and heart rate should effectively lead to the improvement of the individual on the AOSPAN task after the training period. If there is an improvement in the HRV and WMC of the individual this will provide evidence towards a positive correlation between HRV and WMC. A null finding could potentially suggest that HRV is related to improved performance on tasks through a different mechanism than working memory capacity.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-10: Mother-Child Relationship's During the COVID-19 Pandemic: A Longitudinal Qualitative Approach***

**Sydney Brown, Psychology; Tabitha Horton, Health and Human Development**

Mentor(s): Mitchell Vaterlaus, Health & Human Development

Research on global and economic health crises indicates that women experience more deleterious impacts than men. Women are more likely to have more responsibilities regarding child-rearing and household care, which have both been exemplified during the COVID-19 pandemic. In the current study, mothers (n=82) completed online surveys in March 2020 and April 2021 (23 also completed in-depth interviews) about how their mother-child relationships were impacted over time during the COVID-19 pandemic. Three themes were identified through qualitative analysis: (1) Mother-Child Time, (2) Activities and Relationships Outside the Home, and (3) Perceived Relational Change. Results indicate that there were differences between how young, middle-aged, and older adult mothers in their perceptions of the impact of COVID-19 on their relationships with their children.

*Acknowledgments: USP - Undergraduate Scholars Program. EHHD*

***PM-60: Decolonizing Visual Art and Culture in American Contemporary Museums***

**Sarah Budeski, Art**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

The IAIA Museum of Contemporary Native Arts in Santa Fe, NM is the United States' primary museum dedicated to the sole exhibition of contemporary Indigenous visual culture. Their mission, while instrumentally important in uplifting the collective American Indian voice, is virtually alone in its approach

to exhibit holistic histories and their lasting effects on Native communities. Historically, museums have been battlegrounds of history, saturated in bias and inaccuracies that directly reflect colonization practices. In the face of changing socio-political landscapes, we must ask how to integrate Indigenous art paradigms and culture into telling the story of Western art histories. Currently, there exists a transition point in creating valid spaces for native art and culture to be presented as an integral and grounding part of American history. This includes the decentralization of curatorial practices to reflect indigenous knowledge systems, as well as redefining the way all American peoples ingest knowledge through cultural institutions. By decolonizing these narratives in visual art institutions we can continue to unmask the painful effects of western expansion in the Americas. Moving forward, we have the distinct opportunity to share a more accurate narrative of Western art that for too long has categorized Native people as ‘the other’ instead of pivotal influencers of art and culture.

***PM-41: Developing a chronic infection model to study the effects of Helicobacter pylori reinfection of human gastric organoids***

**Clarice Burger, Microbiology & Cell Biology**

Mentor(s): Diane Bimczok, Microbiology & Cell Biology; Katrina Lyon, Microbiology & Cell Biology

This project is designed to create a chronic infection model by repeatedly re-exposing Human Gastric Organoids with Helicobacter Pylori. Chronic infections lead to peptic ulcers and gastric cancers; being able to model this type of infection can increase the understanding of cancerogenesis. The acute infection leads to gastroenteritis, models have been produced, but less is known for chronic illnesses.

The organoids will be reinfected once a week for six weeks, and before the organoids are reinfected, a small portion of the infected organoid will be analyzed through Click EdU assays, Western blot, and imaging. The experiment will be repeated with new organoids four times to increase the significance of the data.

*Acknowledgments: INBRE - IDeA Network for Biomedical Research Excellence*

***AM-15: Risk of Injury and Biomechanics of Beginner and Advanced Rock Climbers***

**Brad Burns, Microbiology & Cell Biology**

Mentor(s): Bernadette McCrory, Mechanical & Industrial Engineering

A biomechanical analysis using Electromyogram and Kinematic data to evaluate the risk of injury in climbers, particularly comparing the risk of injury of climbers between a group of beginner climbers, and a group of more advanced climbers. EMG data during climbing trials is compared to a standard maximum voluntary contraction, while APDM kinematic data is compared to the standardized range of motion tests. It is hypothesized that beginner rock climbers are at a higher risk of common climbing musculoskeletal injuries due to their lack of experience, and lack of physiological adaptation to the activity. This project is still in the data-analysis phase, and conclusions based on the data collected are still in the process of being made.

*Acknowledgments: USP - Undergraduate Scholars Program*

***AM-06: The flying insect thoracic cuticle is heterogeneous in structure and in thickness-dependent modulus gradation***

**Cailin Casey, Mechanical & Industrial Engineering (Graduate Student);** Claire Yager, Mechanical and Industrial Engineering

Mentor(s): Chelsea Heveran, Mechanical & Industrial Engineering; Mark Jankauski, Mechanical & Industrial Engineering

The thorax is a specialized structure central to insect flight. In the thorax, flight muscles are surrounded by a thin layer of cuticle. The structure, composition, and material properties of this structure may influence thorax efficiency during flight. However, cuticle properties, as well as their variation across anatomical regions of the thorax and between insect taxa, are not known. We investigated the microscale properties of the thorax cuticle, a crucial step to determine its role in flight. Through techniques including histology, confocal laser scanning microscopy, and nanoindentation we found that thorax cuticle properties are highly dependent on anatomical region and species. Modulus gradation, but not mean modulus, differed between fliers with asynchronous (honey bee; *Apis mellifera*) and synchronous (hawkmoth; *Manduca sexta*) muscles. This variation highlights the importance of high resolution thorax cuticle assessment to understand variation occurring within and between flying insects and points to factors that may (modulus gradation) and may not (average modulus) contribute to different flight forms. In some regions, *A. mellifera* had a positive linear modulus gradient from cuticle interior to exterior of about 2 GPa. In *M. sexta*, modulus gradients through cuticle thickness varied and were not well represented by linear fits. Through finite element modeling we assessed how modulus cuticle gradients influenced stress. Stress was reduced when cuticle with a linear gradient was compressed from the high modulus side. Our multi-faceted assessment advances our understanding of thorax cuticle structural and material heterogeneity and the potential benefits of material gradation to flying insects.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

***AM-64: Inflammation Variability And Relationship To Physical Activity And Visceral Adipose Tissue In Metabolically Healthy Adults***

**Morgan Chamberlin, Health & Human Development;** Stephanie Wilson<sup>1</sup>; Chantal Vella<sup>1</sup>

<sup>1</sup>Health & Human Development

Mentor(s): Mary Miles, Health & Human Development

Physical Activity (PA), visceral adipose tissue (VAT), and inflammation are modulators of metabolic disease risk. However, the relative contribution of VAT and PA on inflammation and the variability of inflammation over time is unknown. It was hypothesized that low inflammation correlates with increased PA and low VAT. **PURPOSE:** To determine the variability of inflammation over time and the impact of PA volume and VAT on inflammation. **METHODS:** Preliminary analysis (n=13) in an ongoing study (expected n=36) of adults with waistline circumference >35 in (women) and >40 in (men) was completed for resting concentrations of interleukin (IL)-1 $\beta$ , IL-6, IL10, IL17-, IL-23, interferon gamma (IFN- $\gamma$ ), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), and granulocyte-macrophage colony stimulating factor (GM-CSF) before and after a 12-week period. PA data was collected with ActiGraph accelerometers for seven consecutive days in the week prior to re-test inflammation markers. PA was classified as sedentary (0-150 count), light (150-2689), moderate (2690-6166) and vigorous (>6167). VAT was measured via bioelectrical impedance analysis (BIA) before and after the 12-week period. **RESULTS:** Test, re-test values of all mean cytokine concentrations were highly correlated ( $r = 0.87-0.99$ ,  $p < 0.01$ ). An inverse correlation was identified between moderate PA and IL-10 ( $p = 0.04$ ) and light PA and IL-6 ( $p = 0.04$ ). VAT positively correlated with IL-17 ( $p = 0.04$ ), IFN ( $p = 0.02$ ), and IL-10 ( $p < 0.01$ ) at baseline and with IL-17 ( $p = 0.02$ ), IL-10 ( $p < 0.01$ ), and IL-1B ( $p = 0.03$ ) at 12 weeks. **CONCLUSION:** Repeat measures of inflammation are

consistent over a 12-week period. VAT more closely correlated with inflammation in test, re-test analysis than PA.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### ***AM-08: Enhancing the Mechanical Properties of Wood via Cellulose Nanocrystal (CNC) Impregnation***

**Ashton Chan, Mechanical & Industrial Engineering (Graduate Student)**

Mentor(s): Dilpreet Bajwa, Mechanical & Industrial Engineering

A major challenge in the lumber industry today is the shortage of trees aged for harvest, resulting in builders resorting to the use of alternative and expensive building materials. Cellulose nanocrystals (CNCs) have excellent potential to be used as a reinforcement in wood because of their inherent biodegradability, universal accessibility, and exceptional mechanical properties. The objective of this research project is to design a method to impregnate Cellulose Nanocrystals into softwood to enhance its mechanical properties. In this research, southern yellow pine (SYP) wood underwent sodium hydroxide treatment to remove lignin obstructing the wood's pores. Then, SYP samples were submerged in CNC solution and subjected to ultrasonication treatment for CNC penetration. This was followed by a vacuum pressure treatment for air pocket removal and CNC impregnation. After treatment, the wood was dried and underwent mechanical testing. It was found that vacuum pressure treatment increased Modulus of Rupture (MOR) by 9% and Modulus of Elasticity (MOE) by 15%. Additionally, the cross-sectional areas of the samples were examined under an atomic force microscope, and upon running a cantilever beam across a  $1 \mu\text{m}^2$  area of the sample, it was found that the areas with a CNC presence have a significantly greater modulus of elasticity ( $>3.37$  GPa) compared to the wood (0.63-3 GPa). The results support a novel methodology to improve the mechanical properties of wood.

*Acknowledgments: USDA-NIFA*

### ***AM-09: Nano Boron Oxide Incorporation to Cellulose Nanocrystals and Lignin containing Cellulose Nanocrystals to Improve the Thermal, Mechanical and Flammability Properties of high-density polyethylene polymer***

**Saptarni Chanda, Mechanical & Industrial Engineering (Graduate Student)**

Mentor(s): Dilpreet S Bajwa, Mechanical & Industrial Engineering

Cellulose nanocrystal (CNC) and its derivatives are used as bio-based sustainable nanofillers for the production of functional polymer composites. Poor fire retardancy (FR) of polymers influenced the search for nanoscale-based FRs for the production of FR polymer composites. Recently, inorganic nano oxides have garnered special attention because of their ability to improve the fire behavior of polymers by modifying their degradation pathway. The superior flame retardancy, low toxicity and ecofriendly nature of boron-based compounds made them potential FR candidates. In this research, hybrid systems of nano  $\text{B}_2\text{O}_3$ /CNC and  $\text{B}_2\text{O}_3$ /lignin-containing cellulose nanocrystal (LCNC) were prepared and incorporated in HDPE matrix to improve physical, mechanical and FR properties. Nano  $\text{B}_2\text{O}_3$  was produced by ultrasonication of  $\text{B}_2\text{O}_3$  powder and was coated onto CNC and LCNC particles in different concentrations. These hybrid systems of  $\text{B}_2\text{O}_3$ /CNC and  $\text{B}_2\text{O}_3$ /LCNC were added to HDPE separately for the production of composites via melt blending extrusion process. The composite properties were evaluated using FT-IR, SEM, EDX, TGA, DSC, DMA, and tensile testing. SEM micrographs and EDX images confirmed the fibrillar morphology of the cross-section and presence of  $\text{B}_2\text{O}_3$  in the system. The composites containing CNC:  $\text{B}_2\text{O}_3$  (2:1) and LCNC:  $\text{B}_2\text{O}_3$  (2:1) showed higher crystallinity, higher storage modulus, higher yield strength, lower flame spread rate compared to the other systems. The  $\text{B}_2\text{O}_3$ /CNC and  $\text{B}_2\text{O}_3$ /LCNC complexes provided an insulating and shielding effect to the polymer composites.

Incorporation of more B<sub>2</sub>O<sub>3</sub> to the system accelerated the degradation of the polymer at higher temperatures causing degradation of mechanical and thermal properties.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### **PM-49: Rapid Assessment of Wetland Services**

**Siri Christopherson, Agricultural Economics & Economics**

Mentor(s): William Kleindl, Earth Sciences

In 1990, the EPA and Army Corps of Engineers signed a memorandum of agreement to have “No Net Loss” of wetland ecosystem function and values. This policy established much of today’s management, restoration, and mitigation of wetlands in the US. Although there has been significant advancement in the assessment of wetland functions in Montana, there are no such tools to assess wetland values. While functions refer to the physical and biological processes that occur within wetlands, values imply a measure of how wetlands benefits humans. Ecosystem services (ES) literature has provided a theoretical foundation to measure those values. In my work, I examine how wetland services are currently assessed around the globe by conducting an in-depth literature review of preexisting ES assessment tools. Using online libraries of ES tools, such as the EPA EcoService Models Library, I summarize the metrics used in various wetland service assessment models. These metrics are compiled into a document that will assist the Kleindl Lab in developing a Montana wetland service rapid assessment tool. As our lab builds conceptual ES assessment models suitable for Montana wetlands, we will determine if the metrics used by other tools are feasible for Montana application.

### **PM-19: Durability of Microbially Produced Calcium Carbonate Adhesives**

**Kaylin Clark, Mechanical & Industrial Engineering; Ethan Viles<sup>1</sup>; Robin Gerlach<sup>2</sup>**

<sup>1</sup>Molecular Biosciences; <sup>2</sup>Chemical & Biological Engineering

Mentor(s): Sobia Anjum, Civil Engineering

Volatile organic compounds (VOCs) are major indoor air pollutants released by common adhesives. Bio-based adhesives can reduce pollutant concentrations to create healthier living and working environments. One bio-based adhesive with promise is a Microbially Induced Calcium Carbonate Precipitation (MICP) composite. MICP is induced by ureolysis, which generates carbonate ions which can then bind with calcium ions to produce calcium carbonate. Soy protein isolate (SPI) is added to the solution to produce an MICP-SPI adhesive – previous optimization work has shown that this composite can be an effective bio-adhesive for glass and stainless steel surfaces. The durability of this adhesive was tested at different temperatures and relative humidities (RH): -20°C, 100°C, 300°C, and at 50%, 80%, and 100% RH in water at room temperature (23 ± 2 °C) for 7 days. When compared to control samples, which were given no temperature or humidity exposure, the single lap shear strength of the adhesive increased by about 41% after exposure to -20°C, with most of the glass slides themselves experiencing failure before the adhesive failed. As temperature increased, shear strength decreased, with an observed 27% decrease from the control when exposed to 100°C; at 300°C most of the adhesive joints failed without any external applied force. The shear strength of the adhesive increased from the control by approximately 16% after exposure to 50% RH for 7 days, and decreased by about 90% at 80% RH; the lap joints fell apart quickly even during gentle handling after exposure to 100% RH for 7 days.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **AM-16: Sex Differences in Heart Rate Variability after Evening Binge Alcohol Consumption**

**Emily Cleveland, Microbiology & Cell Biology;** Sarah Hagenruber, Microbiology & Cell Biology

Mentor(s): Jason Carter, Health & Human Development

**Introduction:** Binge alcohol consumption is associated with decreased heart rate variability (HRV) during sleep. Presently, it is unknown whether nocturnal HRV differs between men and women after alcohol consumption during key polysomnographic sleep stages. Based on epidemiological literature, we hypothesized that women would exhibit a more dramatic reduction after binge alcohol consumption.

**Methods:** Twenty-four participants (11 male, 13 female, Age: 25.2 years, BMI: 27 kg/m<sup>2</sup>) were tested following an alcohol and fluid control condition. The alcohol condition simulated a binge-drinking episode of a 4-5 drink-equivalent within two hours. Overnight polysomnography and a two-lead electrocardiogram were recorded during an 8-hour sleep opportunity. 5–10-minute periods of stable sleep were selected for each participant in stage II (N2), slow wave (SWS), and rapid eye movement (REM) sleep absent of scorable arousals and apneic events.

**Results:** Time-domain HRV quantified as pNN50 and RMSSD were reduced during N2 ( $p=0.003$ ,  $0.007$ ) and SWS ( $p<0.001$  for both) after evening binge alcohol compared to fluid control, but these reductions were not different between sexes. pNN50 ( $p=0.018$ ) was reduced in REM sleep similarly in both sexes after evening alcohol, but not RMSSD ( $p=0.068$ ). High-frequency (HF) HRV was reduced in N2 sleep in women ( $p=0.049$ ) after evening binge alcohol consumption, but not men ( $p>0.05$ ). HF HRV was reduced in SWS similarly between men and women ( $p=0.002$ ). REM sleep HF HRV was not different between conditions and sexes ( $p<0.05$ ).

**Conclusions:** These results support epidemiological evidence that alcohol consumption may be more detrimental to women's cardiovascular health when compared to men.

*Acknowledgments: INBRE - IDeA Network for Biomedical Research Excellence  
Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### **AM-07: A Multispecies Biofilm Growth Model**

**Malakai Coblentz, Mechanical & Industrial Engineering**

Mentor(s): Mark Owkes, Mechanical & Industrial Engineering; Phil Stewart, Chemical & Biological Engineering

Biofilms are colonies of bacteria adhered to a surface where they form a structure and propagate by dispersing plankton into the surrounding medium. In the study of bacteria, these structures are important because they develop a protective layer that provides some resistance to antibiotics and other attacks. Some of the applications of biofilm research include medicine, wastewater management, and material corrosion. The aim of this project is to produce a program to model the growth of multiple biofilms in the presence of multiple substrates. This program would be used for instructional and research purposes in the Center for Biofilm Engineering. The program uses numerical methods including the Runge Kutta and Finite Difference schemes to solve growth equations for specified initial conditions and biofilm species. The results from this model have been compared to test cases with known analytical solutions and a previous program. The model has been shown to accurately predict biofilm growth in simplified cases where a solution is known. The program developed in this project is easier to use and more versatile than previous tools. This program can be used as an agile tool in the research and instructional setting to get preliminary results without the time-consuming process of cultivating biofilm colonies for each initial test.

*Acknowledgments: USP - Undergraduate Scholars Program*

### ***AM-83: Examining the effects of sublethal virus infection on honey bee health using flight assays and immune gene expression analyses***

**Conrad Collins, JICBE Center for Entrepreneurship; Naomi Kaku<sup>1</sup>; Mark Jankauski<sup>2</sup>**

<sup>1</sup>Plant Sciences and Plant Pathology, <sup>2</sup>Mechanical and Industrial Engineering

Mentor(s): Michelle Flenniken, Plant Sciences & Plant Pathology

Honey bees are integral pollinators of plants, including crops worth nearly \$15 billion annually. Like all organisms, honey bees are susceptible to viral infections that negatively impact honey bee health. Transcriptome level assessment of the impact of viruses on honey bee hosts revealed that in addition to immune genes, genes involved in metabolism and stress responses are differentially expressed in virus-infected bees. Flight is an essential but energetically taxing bee behavior; therefore, we hypothesized that sublethal virus infections negatively impact flight distance. To investigate this, flight mills were used to measure the distance flown by virus-infected bees. Viral abundance and antiviral immune gene expression were assessed using quantitative polymerase chain reaction (qPCR). It was hypothesized that higher viral abundance would be correlated with higher antiviral immune gene expression and shorter flight distances. The data analyzed to date indicates that bees with higher viral loads flew shorter distances. Furthermore, bees with more severe virus infections expressed higher levels of genes in the RNA interference pathway (i.e. argonaute-2 and dicer-like) and the heat shock stress response pathway (i.e. hsp-40 and hsp-90). Other immune genes such as bee antiviral protein-1 showed no significant change in expression. Overall, the data support the hypothesis that sublethal virus infections negatively impact bee flight distance, and this may have larger implications on colony health. The immune gene quantification results were more nuanced and will require further analysis.

*Acknowledgments: USP - Undergraduate Scholars Program*

### ***AM-37: Effects of Cure Temperature on Strength Gain in Ultra-High-Performance Concrete***

**Cash Cota, Civil Engineering**

Mentor(s): Michael Berry, Civil Engineering

Ultra-high-performance concrete (UHPC) is considered to have a compressive strength that is approximately five times greater than normal concrete. Previous experience with UHPC has shown that the compressive strength of UHPC is not affected by mixing it at low temperatures (40°F). However, mixing in high temperatures tended to cause a decrease in the 28-day compressive strength. This study analyzed how various curing environments affected the compressive strength of UHPC throughout its curing process and provided information on ideal temperature conditions for real world applications of UHPC. The main goal was to verify previous findings. Over 50 cylinders were cast and placed in various curing environments including room temperature in the lab (70°F), elevated temperature in an oven (100°F), and decreased temperature in a freezer (34°F). Half of the cylinders were only in these conditions for the first 48 hours before being moved to ideal curing conditions in the cure room. Compressive strengths were measured with a hydraulic press incrementally at 24 hours, 48 hours, 7 days, and 28 days. Maturity meters were utilized to help track compressive strength using an alternate time-temperature factor method. Contrary to the hypothesized behavior, compressive strengths were observed to increase with increasing cure temperature, with this effect being most prominent in early strengths (first 48 hours). Applying this knowledge will allow contractors to schedule mixes accordingly in real world applications of UHPC.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-05: What can Travel Guides tell us about Orientalism? A look into the Thomas Cook Archives***

**Cody Crowley, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy; James Meyer, History & Philosophy

This senior project examines travel guides from 1872 to 1928, illustrating the complex relationship between historical depictions and the contemporary understanding of the Middle East and its people. In looking at these materials, held by the Thomas Cook Archives, I have explored answers to the following questions: How do the authors depict local populations, including their dress, dialogue, and religion? What locations do the authors discuss, and what activities are incorporated on these guided trips? What references do the authors use in relation to ancient and modern history? And lastly, how do the authors interpret their own experiences placed within the context of their time? Based on my research, I argue that these guidebooks have contributed to our contemporary understanding of “the Orient” as a place of antiquity, religious significance, and colonial "triumph" as they have come to represent the beginnings of modern tourism. Modern perceptions are often viewed as innate truths. However, they stem from a series of historical developments and cultural portrayals in one’s own society, community, and family over generations of time. These constructed paradigms are apt to influence how one sees both religion and culture outside regular contact zones. Only by reevaluating the past, are we able to question the contemporary representations of certain peoples and begin to understand when and where these perceptions took hold. Examining portrayals of Middle Eastern cultures in guidebooks from the late-nineteenth and early-twentieth centuries is one such step in the process towards reassessing modern interpretations and correcting their inaccuracies.

***PM-18: Root Biofilms and Oxygen Transport in Treatment Wetlands***

**Nina Denny, Civil Engineering**

Mentor(s): Ellen Lauchnor, Civil Engineering; Chris Allen, Civil Engineering

Treatment Wetlands (TW) offer a better solution to wastewater treatment than conventional systems because they are energy and space efficient yet treat water as effectively. TW are also effective year-round in cold climates, which makes them a better alternative to unplanted systems like lagoons or gravel beds. This project aims to increase TW implementation by improving understanding of the complex and interrelated biogeochemical processes that drive TW treatment, specifically the relationship between microbial communities and oxygen exudation from roots.

Wastewater treatment is facilitated by microbes performing chemical transformations such as nitrification, denitrification and decomposition of organic matter. In TW, these microbial processes benefit from the influence of plant roots to facilitate biofilm formation and might also benefit from the nutrients and oxygen that roots exude in the subsurface. Information about the difference in oxygen exudation between plant species, root ages and wastewater composition can inform TW design and optimization.

The experiment includes the wetland plant species *Carex*, *Phragmites*, and *Schoenoplectus* growing in individual columns and being fed artificial wastewater. Root chambers attached to the plant columns allow roots to grow between glass slides, giving us access to the root zone. The chambers are used for tracking root growth and measuring oxygen transfer with Unisense Microsensors, which measure oxygen levels while the probe moves closer to the root sample. The data is then used to calculate radial oxygen loss from the roots. After oxygen measurements, the root is cut off the plant and the biofilm is observed under a compound microscope.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-16: "This whole year has been really hard": A longitudinal qualitative study on women's experiences and well-being during the COVID-19 Pandemic in the United States***

**Samantha DesLauriers, Psychology;** Kathryn Heiser, Health and Human Development

Mentor(s): Mitchell Vaterlaus, Health & Human Development

This qualitative study aimed to identify changes in women's well-being and their lived experiences in the United States during the COVID-19 pandemic. Women (n=124) recruited through snowball sampling completed surveys at two time points (March 2020 and April 2021) and follow-up interviews were conducted with 33 women in April 2021. Four themes emerged through longitudinal qualitative analysis: (1) Role Management and well-being, (2) From crisis to a desirer for normal, (3) politically divisive and unified response, and (4) "A bit tarnished" silver lining. Results provide insights to the long-term experience of women within the on-going pandemic and can highlight opportunities for improvement in future public health crisis.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-39: Subchondral Bone Microarchitecture and Cell Activity Changes Early After Injury in a Murine Model of PTOA***

**Connor Devine, Chemical & Biological Engineering;** Brady Hislop, Mechanical & Industrial Engineering

Mentor(s): Chelsea Heveran, Mechanical & Industrial Engineering

ACL tears comprise ~30% of all high school sports injuries. On average, upwards of 50% of people who experience ACL injuries develop post-traumatic osteoarthritis (PTOA). PTOA is characterized by a catastrophic loss of cartilage leading to chronic pain and inflammation. Previous studies have found that the bone adjacent to cartilage, subchondral bone, experiences significant bone loss within a week of injury. However, the mechanism driving these changes remains a critical gap in our current understanding of PTOA pathogenesis. The goal of this study was to elucidate the mechanisms driving early bone loss after joint injury. To accomplish this goal, the following methods were employed: a histological stain (i.e., to visualize microanatomy) for bone-resorbing osteoclasts, bone histomorphometry (i.e., fluorescent calcium labeling) for measuring changes in bone formation rate, and three-dimensional X-ray (microCT) tomography to measure bone microarchitecture. Subchondral bone volume fraction was diminished with injury when compared to sham injured mice (-10.8%,  $p = 0.002$ ). Similarly, osteoclast number density increased in injured mice (+287.2%,  $p = 0.017$ ), compared to uninjured controls. Bone formation rate was unchanged by injury, indicating no effect on bone-building osteoblast cells. Results from this study suggest that increased osteoclast activity is responsible for reduced bone volume 7 days after injury. Future studies will expand these findings by studying the effects of age on early changes to subchondral bone following traumatic injuries.

*Acknowledgments: USP - Undergraduate Scholars Program*

*Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

***PM-72: Decolonized, Indigenous, International Food Enterprise Certificate***

**Genevieve Devitt, Health & Human Development;** Kelsea Hertel, Health and Human Development

Mentor(s): Wan-Yuan Kuo, Health & Human Development

The purpose was to examine the need for a Food Enterprise Certificate at Montana State University built on diversity and inclusion principles, what courses would effectively instruct students for their careers as food entrepreneurs and that can cater to students' interests in their field. A round table was held of four community members, two men and two women, in fields of sustainable foods, culinary, and dietetics. The roundtable revealed that community members see use for a Food Enterprise certificate in their various

fields. After the roundtable, a preliminary certificate outline was made that considered different interests' students may have when considering adding the certificate. This version included a baseline of required courses focused on business, food science, sustainability, Native American studies with additional courses students could choose from to cater towards their specific interests. A Qualtrics survey was distributed to students, and community stakeholders in the Bozeman, MT area who are involved in Native American studies, business, food and nutrition, community health, and sustainability to gain feedback on their perceived need of the certificate. 6 people, an even split of men and women, have completed the survey. The participants were split on the importance of the certificate but identified hesitation was based on how cultural competence and community collaboration are added to the certificate. The overall feedback is that members of the Montana State University community deem a Food Enterprise Certificate a step towards a more diverse and inclusive atmosphere at Montana State University while students interested in Food Enterprise.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-48: Microbiome Assembly in the *D. lanuginosum* rhizosphere across a temperature gradient in Yellowstone National Park***

**Lydia Diehl, Ecology**

Mentor(s): Brent Peyton, Chemical & Biological Engineering

*D. lanuginosum* is a species of panic grass that grows in extreme thermal conditions (detected up to 65 °C) enabled by a symbiotic relationship with a fungal endophyte (*Curvularia protuberata*) and a mycovirus. The goal of this project was to investigate how the rhizosphere bacterial community of *D. lanuginosum* varies along a temperature gradient at different geographic locations in Yellowstone National Park (YNP). Analyzing how plant microbiomes assemble under environmental stresses could be integral in further understanding the development of thermotolerance in *D. lanuginosum*. Soil samples (rhizosphere and bulk soils) were collected from various geographic locations in YNP. Bacterial DNA was extracted from the samples and was amplified using a universal 16S rRNA gene marker then sequenced using Illumina paired-end sequencing. Operational taxonomic units (OTUs) were classified using the online Bayesian classifier of the Ribosomal Database Project. R-studio was used to conduct data analysis and determine comparative relative abundances with R packages *vegan* and *phyloseq*. We detected a strong thermal gradient structuring the rhizosphere communities across and within sites and identified several bacterial species that are enriched at higher temperatures in rhizosphere vs. bulk soil. Similar microbiomes at high heat locations could indicate that there is bacterial influence in the symbiotic thermotolerance of *D. lanuginosum*. Further research to determine specific bacterial species that influence this thermotolerance could be beneficial in understanding how specific bacterial species interact with *D. lanuginosum*, the fungal endophyte, and the mycovirus. This symbiosis could potentially be applied to the development of thermotolerance in other plant species.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-68: Pow Wow in America***

**Maria Dominguez, Gallatin College**

Mentor(s): Jennifer Woodcock-Medicine horse, Art

Pow wow is really important for Native Americans because their traditions are something that they used to do in each tribe many years ago, but now they do it all together with friends and family. In the modern world, Native people may live far from home, and powwows are a good reason to get together with family members and friends who are not living close or don't see each other often. Powwows are a great opportunity to show or introduce new babies or kids to the rest of the tribe and family.

This is a great tradition where Natives dance for fun and for competition. They have many different dance styles and they compete in different kinds of categories like dance and drums. For example, the Chicken dance is very popular and includes a little kids competition division with good prize money for all the age divisions. Everyone can compete and participate, including boys and girls, young adults, adults, women, and men, and the old people as well. They can go with the whole family and enjoy themselves together like their ancestors did many years ago.

### ***AM-38: Investigating the mechanisms of bacterial transport along fungal hyphae***

**Tigan Donaldson, Civil Engineering**

Mentor(s): Erika Espinosa-Ortiz, Center for Biofilm Engineering

Fungi and bacteria are commonly found in nature and are known to interact with each other. One interaction of interest between these organisms is the translocation of bacteria along fungal hyphae. Through this mechanism, pollutant-degrading bacteria can be translocated along fungal hyphae – which can extend several miles in unsaturated media – having access to otherwise inaccessible pollutants. This project investigates this phenomenon by (1) identifying compatible microbial partners, (2) quantifying the extent of bacterial translocation, and (3) evaluating the ability to direct hyphal growth and bacterial translocation via chemotaxis. Different species of bacteria (*Pseudomonas putida* and *Pseudomonas stutzeri*) and fungi (*Neurospora crassa*, *Phanerochaete chrysosporium*, and an environmental isolate) were evaluated for compatibility as co-cultures and potential to transport bacteria using fungal hyphae. We performed bacterial motility tests to assess whether bacteria can travel along hyphae, hyphal hydrophobicity measurements to determine the potential of the fungi to transport bacteria, and co-culture growth inhibition tests to evaluate if the microbial partners can grow together. The results indicated that *P. putida*, *P. stutzeri*, *P. chrysosporium*, and the environmental isolate are appropriate species for bacterial transport and chemotaxis experiments. The findings of these experiments can aid the understanding and use of fungal-bacterial co-cultures in in situ soil bioremediation processes.

*Acknowledgments: USP - Undergraduate Scholars Program*

### ***AM-40: Using Synthetic Ecology to Quantify Consortial Interactions in Biofilm and Planktonic Cultures***

**Martina Du, Chemical & Biological Engineering**

Mentor(s): Ross Carlson, Chemical & Biological Engineering

From chronic wounds to nitrogen cycling in soils, microbial cross-feeding is essential for ensuring the stability, resilience, and productivity of communities. Most natural communities are very complex and live as interacting consortia, so replicating these multispecies interactions with defined, engineered cocultures can help gain a better understanding of the exchange of nutrients such as amino acids and organic acids, which help bacteria thrive. This synthetic ecology project studied the cellular economics of amino acid and organic acid exchange between obligate cross-feeding *Escherichia coli* mutants. A coculture model comprised of two engineered strains (an arginine secreting strain that cannot catabolize the sugar lactose, and an arginine auxotroph which can catabolize lactose and secrete organic acid byproducts) was studied under steady-state conditions with various nutrient limitations through the design and implementation of 10 mL continuous stirred tank reactors (CSTR). These conditions allowed for the study of cell dynamics and growth behavior under physiochemical constraints including nutrient and oxygen availability. Experimental findings determined that despite different starting strain ratios in a community, consortia compositions stabilized in response to stressors and resource availability. This was additionally supported with COMETS modeling using parameters from monoculture metabolomics data to reveal trends of strain final fraction as a function of oxygen availability. When comparing results from planktonic experiments and previously acquired biofilm data, it was determined that mass transfer limitations resulted

in spatially dependent strain distributions. Synthetic systems with known lab strains can decode bacterial interactions in complex natural systems by reducing the number of unknown variables.

*Acknowledgments: USP - Undergraduate Scholars Program  
INBRE - IDeA Network for Biomedical Research Excellence*

### **AM-41: Effects of Peripheral Nervous System Impairments on Postural Control**

**Camryn Dubois, Mechanical & Industrial Engineering**

Mentor(s): Scott Monfort, Mechanical & Industrial Engineering

Peripheral nervous system (PNS) impairments are risk factors for falling, and cognitive-motor dual-task scenarios (e.g., walking while talking) can exacerbate movement deficiencies in individuals with PNS impairments. The overall purpose of this study was to investigate changes in balance with central and peripheral nervous system interference. We hypothesized that vibration induced PNS interference would be associated with maintained balance while standing without a cognitive load, but impaired balance when vibration is present in addition to the cognitive load. Linear (ellipse area) and nonlinear (sample entropy) measures of center of pressure movement were used to characterize postural sway during 30-second balance assessments. Four balance conditions included: single-task and dual-task with and without ankle vibration. For dual-task trials, participants were given a cognitive task (counting backward by sevens). The cognitive task and vibration each were associated with increased postural sway compared to normal, quiet standing; however, there was no significant interaction between these effects. Cognitive tasks and vibration seem to have isolated influences on linear and nonlinear measures of postural sway, but their effects do not seem to interact. Additional work is needed to understand how temporary adaptations may relate to chronic adaptations for PNS impairments (e.g., peripheral neuropathy).

*Acknowledgments: USP - Undergraduate Scholars Program  
INBRE - IDeA Network for Biomedical Research Excellence  
MSU Faculty Excellence Grant*

### **AM-11: Biodegradable Composite Hydromulches for Sustainable Organic Horticulture**

**Andrew Durado, Mechanical & Industrial Engineering (Graduate Student)**

Mentor(s): Dilpreet Bajwa, Mechanical & Industrial Engineering

In agriculture, mulch helps retain soil moisture and soil temperature while preventing weed growth. Currently, the most common material used for commercial mulching is polyethylene. At the end of the growing season, this plastic is typically buried or burned, creating a large impact on the environment. Another issue with this type of mulch is it can not be used for organic farming. The goal of this research is to develop an alternative to polyethylene mulch that is organic and biodegradable while still providing the same benefits. The hydromulch treatments being tested contain a mixture of either paper pulp, wood fiber, or hemp hurds in combination with a tackifier. The tackifiers being used are guar gum, psyllium husk, and camelina meal, which are being tested at various concentrations. These treatments have been tested for tensile and puncture strengths using a universal testing device. The treatments were also compared to control samples containing no tackifier to determine if the addition of tackifier at increased concentration resulted in enhanced mechanical properties. The results have shown that the samples containing tackifier performed better in both tests than the control samples that didn't contain any, and the mulches containing paper were far superior to those containing wood or hemp hurds. It has also been observed that increased tackifier improves mechanical properties. Further testing is being conducted to test other properties including rain fastness and soil adhesion. When all lab tests are complete, the best performing formulations will be studied outdoors in a large-scale field study.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

***PM-02: Bridging the Gulf between Rhetoric Scholarship and Antagonistic Public Discourse: Reciprocity, Identity, Accessibility***

**Christopher Dyrland-Marquis, English;** Lauren Warrenfeltz, Linden Morse – English

Mentor(s): Doug Downs, English

Pedagogic strategies implemented by instructors affect cooperative engagement in classroom settings, potentially nurturing recursive, ongoing processes of knowledge building. Benefits of such practices may ultimately foster student familiarity and rhetorical awareness across individual backgrounds—through the development of clear, mutual understanding. As a result, instructor strategies may determine how earnest searches for acknowledgement, respect, and acceptance of contributions are perceived: both from those who implement them, and the students they teach.

Data collected on cooperative engagement strategies and potential impacts of rhetorical awareness took place through preliminary interviews with MSU English Department faculty, observations from English classrooms (literature, teaching, and writing courses), post-observation focus groups with students, and post-observation faculty interviews. Preliminary faculty interviews explored individuals' pre-observation understandings and implementations of rhetorical awareness within a pedagogic framework. Next, a class session from each instructor underwent observation: utilizing classroom recordings and researcher fieldnotes. Following each observation, student volunteers attended post-classroom sessions to explore perceptions on faculty intent, reception, and discrepancies between instruction objectives. Finally, post-observation faculty interviews investigated specific rhetorical instances noted within classroom observations, and any relevant implications.

Based on methods of data collection and research observations carried out by the study, several instances provoked future interest into the roles of power dynamics and performativity in classroom settings. Additionally the study raised further questions on how rhetorical awareness is structured, promoted through cooperative engagement strategies, and either fostered or dampened through instructor-specific pedagogies.

*Acknowledgments: USP - Undergraduate Scholars Program*

***AM-04: Formability of Stretch-Broken Carbon Fiber***

**Matt Egloff, Mechanical & Industrial Engineering (Graduate Student)**

Mentor(s): Roberta Amendola, Mechanical & Industrial Engineering; Doug Cairns, Mechanical & Industrial Engineering

Replacing sheet metal with carbon fiber composite materials requires new and novel testing methods and forming techniques. Plastic deformation is necessary for many forming processes. Continuous carbon fiber filaments are brittle, allowing only a few percent of elongation before failure. Stretch-broken carbon fiber composites exhibit pseudo-plastic deformation, albeit by different mechanisms. Once cured, they exhibit comparable strength to materials made with continuous carbon fiber. The use of temperature (formability relates to effective viscosity of filaments in resin), forming rate (viscoelastic response of resin), and forming geometry (local state or stress) to characterize and control forming processes will be examined. Transient techniques such as forming above the nominal curing temperature before appreciable curing occurs (a brief period where the effective viscosity is lowered), and the effects of spot curing (analogous to tack welding) will also be examined. The results of testing and data fitting will be presented.

*Acknowledgments: U.S. Army Combat Capabilities Development Command Aviation & Missile Center (DEVCOM AvMC)*

**AM-50: Yellowstone Ecological Research Center Mobile Application****Natalia Eigner, Computer Science;** Grayson O'Leary, Computer Science

Mentor(s): Clemente Izurieta, Computer Science

The Yellowstone Ecological Research Center (YERC) aims to provide communities surrounding the Greater Yellowstone Region with comprehensive data on the health and changes of this ecosystem in order to empower data-driven decision making. YERC utilizes various forms of data collection including satellite imagery, weather history, environmental sensors and infield data collection. Currently, users manually transfer this data to YERC's online database, EPIIC. This method is not only inefficient for users, but also increases errors and creates a lack of standardization in the data. This cross-platform mobile application will replace manual collection and transfer thus streamlining the data collection process. Users log in with their YERC credentials and the user preferences associated with their account will determine which data forms they have access to. Users are then able to access these data forms remotely and are able to upload them to the EPIIC platform when they are back in service. The data forms are populated directly from YERC's database and can thus be updated by administrators asynchronously without need to update the mobile application. This will also allow YERC to develop new data forms in the future as needed. In sum, this mobile application will streamline the data collection process of the Yellowstone Ecological Research Center resulting in more accurate and standardized data.

**AM-42: Computational Fluid Dynamics Modeling and Determination of Pressure Drop Effects of Radial Flow Enhancing Geometries in a Packed Bed Thermal Energy Storage (TES) System****Rachel Elander, Chemical & Biological Engineering;** Matt Skuntz, Mechanical and Industrial Engineering

Mentor(s): Ryan Anderson, Chemical &amp; Biological Engineering

Concentrated Solar Power (CSP) provides a promising source of renewable energy in regions of intense solar radiation. A downside of CSP is the inconsistent quantity of power produced, particularly during periods of decreased sunlight. Thermal Energy Storage (TES) systems provide a potential solution by storing excess energy produced via CSP thermally by pumping heated air through cylindrical packed beds, where heat transfer to the packing material occurs. Thermal energy is discharged through the reverse process of pumping cool air through the packing in the opposite direction.

Because traditionally studied axial air flow has been shown to lead to thermal inefficiencies, several radial flow promoting geometries have been proposed. While these will likely reduce thermal losses, the expansions and contractions associated with the additional structuring within the packed bed may lead to increased pressure drops, potentially resulting in an overall energy loss. The goal of this research is to quantify the pressure drop contribution of each component of radial flow promoting internal structuring using experimental data as well as develop computational fluid dynamics and heat transfer models of the proposed TES systems using COMSOL Multiphysics. Thus far, all experimental data has been gathered by encouraging radial flow from a porous central pipe to four porous receiving pipes along the bed walls. Simulations ran using COMSOL models and experimentally gathered thermal data both indicate that this geometry fails to produce sufficient radial flow and therefore future models and experiments will be conducted with the four receiving tubes replaced by a porous annulus.

*Acknowledgments: USP - Undergraduate Scholars Program  
Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

***PM-06: From the Weimar Republic to Hitler's Reich: Germany's Political Transition and Evolving Global Relationships Through the Lens of the 1930s World's Fairs***

**Dillon Fatouros, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

During the 1930s, Germany's government made the transition from a democracy to an authoritarian state headed by Adolf Hitler. While there is a considerable amount of scholarship on this era and transitional period of political ideology and governance, there are still questions needing further analysis. How did Germany interact with the rest of the world during this period? How did its international image change during this period? Using archival materials from the World's Fair: A Global History of Expositions archive, this project attempts to analyze these global interactions through the lens of the 1930s World's Fairs. Through the use of personal correspondence, diplomatic documents, and exhibit information, this project constructs a historical narrative focused on Germany's evolving public image during this era. Essentially, by comparing these documents with one another by their date and specific exposition, it is apparent that international attitudes both personally and professionally change as the decade progresses. Therefore, while American and international opinion on Germany during the 1933 World's Fair was relatively positive, this opinion changed considerably by the 1939 World's Fair. However, there are indicators of this coming change as early as 1930. Overall, this project aims at adding to the ongoing discussion around the National Socialist era in Germany and provides further insight into Germany's governmental transition during the 1930s and its relationship with the rest of the world; all essential aspects when discussing and learning about the rise of German National Socialism, the Holocaust, and the Second World War.

***PM-77: Slavish Imitator: How the American annexation of the Philippines cemented white supremacy within the US***

**Jason Fly, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

In 1898, the United States' participation in foreign imperialism arguably began with the annexation of the Philippines. The annexation was widely written about throughout the US's imperialistic period. Regardless of their personal backgrounds, writers had a common white supremacist tilt. Thus, a research question was formed, to what extent did the US's annexation of the Philippines cement white supremacist ideals within America? I sought to answer this question by analyzing sources from the American Imperial Period (1898-1943) contained in the Hathi Trust's 1926 Collection. The Filipino-American viewpoint is represented by successive issues of the pro-Philippine independence periodical "The Philippine Republic", while the Euro-American viewpoint is represented by the writings of former president Theodore Roosevelt and Swiss political observer Maurice Muret. The sources show that the American government infantilized the Filipino people. This infantilization provided support for the strengthening of white supremacy within the US. To earn independence, Philippine representatives had to prove that their people had grown out of racial "childhood". This paper brings a new perspective to the discussion around American Racism. Philippine annexation occurred during the era of Jim Crow; thus, the annexation gets over-shadowed. However, the same racist themes applied to African-Americans were applied to US colonial subjects. This poster is based upon my senior research project in history.

***PM-76: How the Globalization of Sugar Created an Everlasting Impact on the Indigenous Communities in the New World***

**Candace Fredericks, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

Has the globalization of certain foods – like sugar – caused a lasting effect on the communities present in North America? In order to answer these questions, my senior capstone project is focusing on archival research. By utilizing the Global Commodities archive and the Native American Ethnobotany Database, this research will focus on how sugar was brought to the New World and the period of history thereafter. The sources I intend to use vary but mainly focus on the history and globalization of sugar, along with a book written by an Inupiat woman explaining the traditional foods her people ate. By using these sources, I aim to trace the pattern sugar had in the early stages of colonization and after, gaining knowledge on the commercialization of the commodity and how it was incorporated into traditional foods, and subsequently, how sugar affected the health of Native Americans. I also intend to explore the health crisis plaguing many tribes today by incorporating scholarly evidence surrounding sugar-related illnesses in order to cross-reference that with the globalization of sugar into the New World. This research is set primarily around the beginning of both the nineteenth and twentieth centuries, concluding with evidence from the present day. The significance of this research is intended to show how a commodity has the potential to create a lasting effect on a population, changing the course of their history, and ultimately, explore how Native Americans are still negatively affected as a result of the globalization of sugar.

***PM-33: Optimizing blockMesh for a Magnetic Trap in OpenFOAM***

**Sam Fritsch, Physics**

Mentor(s): Brian D'Urso, Physics

A magnetic quadrupole trap uses four magnets oriented in such a way that there is a magnetic field minimum in the center of the four magnets. This local minimum is used to trap various particles. In our research, we are using a program called OpenFOAM in order to simulate this particle trap and see the resulting magnetic field. The most important field data is in the center of the trap where the particle will be. We do not need high-resolution information for the entire trap. In this paper we will go through defining the tools in OpenFOAM used to create a high-resolution magnetic field simulation in the center of a particle trap while keeping the unnecessary field data at a lower resolution. This method is being used to speed up the computation time of the simulation. We were ultimately able to reduce the blockMesh size in the correct area using mergePatchPairs and topoSet, but the blending between the blockMesh and the magnetic trap itself was not smooth enough for a final export. In the future, it is possible that other OpenFOAM functions will produce a cleaner overall blockMesh in order to accurately export a magnetic field simulation.

***PM-73: Combining napping and consumer acceptance tests to identify sensory drivers of liking and consumer clusters for novel cold-hardy berry smoothie premixes***

**Sumedha Garg, Health & Human Development (Graduate Student); Emily Mayhew, Food Science & Nutrition**

Mentor(s): Wan-Yuan Kuo, Health & Human Development

Novel cold-hardy berries can increase crop biodiversity in the Intermountain West region, USA, but present unique taste and textural qualities. A prior study indicated that some of these berries have an unpalatable flavor. Thus, value-added product development shows potential to optimize their sensory profiles. In this study, we formulated freeze-dried smoothie premixes and identified their sensory drivers of liking. First, eight chefs participated in a napping exercise to confirm the sensory profiles of the 8 formulations and identified four attributes (sweetness, fruitiness, overall mouthfeel and color) to be

assessed in the following consumer acceptance test. Consumers (n=71) then evaluated the formulations for overall liking (OL) on a 9-pt hedonic scale and rated the identified attributes on a Just-About-Right (JAR) scale. Overall, blackcurrant-containing smoothies had an OL between  $5.7 \pm 1.6$  -  $5.0 \pm 2.0$  and aronia-containing smoothies had an OL between  $4.6 \pm 2.1$  -  $4.6 \pm 1.8$ . Blackcurrant-containing smoothies received “JAR” in color by 43 - 96% consumers. Between 58 - 59% consumers rated aronia-containing smoothies as “too dark.” All smoothies received a “too gritty” mouthfeel (15 - 45%), hence indicates as a common area of product improvement. We found three distinguishable consumer clusters: Cluster 1 was most sensitive to formulation changes (OL 3.4 - 6.5), Cluster 2 rated smoothies higher (OL 4.4 - 6.8), and Cluster 3 lower (OL 3.0 - 4.6) ( $p < 0.05$ ). To the best of our knowledge, this is the first study on drivers of liking for products utilizing novel berries of the Intermountain West. By combining chef and consumer panel, we identified important attributes and observed cluster separation for these products.

*Acknowledgments: Speciality Crop Block Grant*

### **PM-78: Germans in the American Revolution**

**Caitlynn Gaston, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

Many of the Germans that came over during the 1770s and 1780s were mercenaries hired by the British for support in the American Revolutionary War. Hesse and Brunswick were just two German states of many that were allies with the British at this time, which is why they answered the British call for military support. As such, Hessians were the most numerous of this group of Germans, followed by Brunswickers. The following questions are: what were their feelings about the war? What did they think of the Americans and the British? Finally, what did they think about this new land they were on? I will be looking at two specific German men in this war: Lieutenant von Krafft, a man from Saxony, but in the Hessian regiment; and Brunswicker General Baron von Riedesel. My sources are a translation of letters by Germans during the war and a translated Lieutenant von Krafft's journal. Both are from the Library of Congress. Some, like Lieutenant von Krafft, had a mostly pleasant time with the Americans; while others, like Baron von Riedesel, did not. That being said, they both had problems with the British, even though they were all on the same side. This was due to lack of rations and interpersonal fights between British and German soldiers. This led the Germans to be less sympathetic to the British cause. Many Germans would end up deserting due to this. This poster is based upon my research project in Historical Methodology.

### **AM-80: Evaluating the Effects of Electric Cables on Howler Monkeys with Local Knowledge and Naturalistic Observation**

**Olivia Gervacio Jakobosky, Ecology; Rebecca Smith<sup>1</sup>; Jorge Damian Ayala Santacruz<sup>1</sup>**

<sup>1</sup>Para La Tierra

Mentor(s): Lance McNew, Animal & Range Sciences

Black-and-gold howler monkeys (*Alouatta caraya*) commonly inhabit urbanized areas of South America and often use electric cables to travel across urban environments, resulting in increased rates of mortality. The howler monkey troops in Pilar, Paraguay, offer a unique opportunity to understand the dynamic between humans, wildlife, and complex urban habitats. With very little research existing on howler monkey populations in Paraguay, this study aims to provide baseline understanding of the relationship between urban howler monkeys and human populations through an interdisciplinary research approach. During summer 2021, we studied the two most-at-risk monkey troops in Pilar to evaluate whether proximity to electric cables is influencing monkey behavior. We grouped proximity to electric cables into 3 groups, < 5 ft, 5-15 ft, and > 15 ft, and we grouped behavior into 7 classes. We found evidence that the behavior of the monkey troops had a significant behavior difference across three levels of proximity to electric cables ( $\chi^2 = 225.8$ ,  $df = 12$ ,  $P < 0.001$ ). Next, we will fit a multinomial model to further assess the

effect of electric cable proximity on monkey behavior. We also explored the human dimensions of the monkey-cable issue by interviewing 104 community members. In the future, the results of this study will provide valuable sociological and ecological tools to further assess the nuances and complexities of social-ecological issues in Paraguay.

*Acknowledgments: USP - Undergraduate Scholars Program*

*Other funding or support; The Garden Club of America*

### ***PM-79: The Effect of Foreign Motion Pictures on Chinese Society.***

**Colin Gillespie, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

The Shanghai International Settlement was a foreign enclave run by a council of international merchants and bankers known as the Shanghai Municipal Council. Extraterritoriality rights allowed the settlement to operate outside of Chinese rule. Extraterritoriality allows citizens immunity from the jurisdiction of the country in which they are present. With motion pictures becoming a popular form of media, conflict quickly arose between the International Settlement and China over the right to film regulation during the 1920s. To research the conflict, I delved through a collection titled “Policing the Shanghai International Settlement, 1894-1895” from Archives Unbound. Through comparing manuscripts, I was able to identify a narrative that illustrates growing hostilities between the International Settlement and China. China’s inability to regulate film evoked feelings of humiliation, resulting in the fanning of nationalism and a growing call for sovereignty.

### ***PM-52: Continuing the Family Farm/Ranch***

**Andrew Glennie, Department of Agricultural and Technology Education**

Mentor(s): Shannon Arnold, Department of Agricultural & Technology Education

In this project I did an interview style survey to learn more about the transition from one generation to the next in family farms and ranches. I interviewed 3 fathers and 3 sons and am taking data collection on their responses. I want to know what some of the most common challenges are so that I could look into solutions for the problems. Agriculture is changing rapidly and less and less of the next generation want to come home. Are there better jobs out there? Is it the risk that they are worried about? Are internal family problems the issue? There could be all kinds of options for the next generation not wanting to come home and I want to get to the bottom of it.

### ***AM-46: Social Optics***

**Matt Gotta, Computer Science; Marnie Manning<sup>1</sup>; Ryan Fitzgerald<sup>1</sup> – <sup>1</sup>Engineering**

Mentor(s): Clemente Izurieta, Computer Science

Social Optics is a Social-Emotional Learning platform developed for a client who specializes in neurodiverse education. The Social Optics team is creating a platform that delivers a learning experience for young neurodiverse students to develop interpersonal communications skills that are usually lacking in a typical curriculum. The platform presents the different parts of the curriculum as individual lessons, and tracks student results and progress, allowing students to work at their own pace and instructors to check student progress. The implementation of the stakeholder’s idea into a web based application was paramount in creating the experience that Social Optics intends to deliver. Containing all aspects of the stakeholder goal, into a formulated and straightforward software application, was the main objective of the project. Social Optics hosts student account data, course progress, and assignment completion. This information is hosted on a database that records student progress and details about their attempts on the assignments. Instructors have their own access to the learning platform, allowing them to modify the course and view assignment completion details. The intended deliverable by the end of the semester is a

prototype demonstrating account creation, avatar generation, and the functionality of the database. This prototype will be in the form of a demonstration that the stakeholder can use to garner investors.

### **AM-23: Cytochemical Characterization of Grey-Headed Flying Fox (*Pteropus poliocephalus*) blood cells**

**Amelia Graves, Chemistry & Biochemistry;** Brooklin Hunt<sup>1</sup>; Caylee Falvo<sup>1</sup>; Manuel Ruiz<sup>2</sup>

<sup>1</sup>Microbiology & Cell Biology; <sup>2</sup>Bat OneHealth

Mentor(s): Raina Plowright, Microbiology & Cell Biology

Because of their vulnerability and importance to their ecosystems and risk of spillover, grey-headed flying foxes, *Pteropus poliocephalus*, are prevalent to research. Hematology provides a primary starting point, because it gauges health and wellbeing. The morphology and biochemical properties of each type of leukocyte was identified via Dip Quick, Hematoxylin & Eosin, Sudan Black B, and Toluidine Blue stains. After performing differentials using blood smears stained with Dip Quick, biomarker ranges were recorded and compared to black flying foxes, *Pteropus alecto*, baseline ranges published in previous literature. Differences in morphology and biomarker ranges were predicted to be seen between the two species. As seen in black flying fox baseline ranges, it was also expected that previously published biomarker ranges may differ significantly from the biomarker ranges found here, due to counting methods and morphological standardization. Finally, hemoparasites were anticipated to be in low quantities. In this presentation, the first published images of each grey-headed flying fox leukocytes are shown, and the updated biomarker ranges are listed. This data enables proper identification of grey-headed flying fox blood cells in future studies and clinical settings as well as furthers our knowledge of grey-headed flying fox immune function and physiology.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-22: Understanding Aerobic Methane Production**

**Kristen Gregg, Chemistry & Biochemistry;** James Larson<sup>1</sup>; Grace Ludlow<sup>2</sup>; Jordan Pauley<sup>1</sup>; Brooklyn Brekke<sup>3</sup>

<sup>1</sup>Biochemistry; <sup>2</sup>Microbiology and ecology; <sup>3</sup>Cell Biology and Neuroscience

Mentor(s): Brian Bothner, Chemistry & Biochemistry; Martin Lawrence, Chemistry & Biochemistry

Methanogens have long been thought of as the only source of biogenic methane production. Methanogens function under strictly anaerobic conditions, making the presence of methane in well oxygenated environments an unexpected finding. This dilemma is now termed the ‘methane paradox’, and it has become a rich area of study. Many explanations have been proposed to explain this phenomenon, including a novel non-methanogenic mechanism for methane production. An *Acidovorax* bacterial species was isolated from Yellowstone Lake in an area of high methane and high oxygen concentrations. This bacterium was found to have a gene that allowed for growth on MeA as a sole nitrogen source while generating methane. Genetic screening identified a single gene responsible for the reaction, a PLP dependent Aspartate Aminotransferase. A sequence homology program, BLAST, was used to identify several orthologs that have the same gene. These constructs were used to study and identify the mechanism behind methane production in Yellowstone Lake. Solubility tests were performed on these constructs to isolate several that were promising for further study. We then performed activity assays on the constructs. We determined potential substrates used by these novel proteins via Differential Scanning Fluorimetry. In addition to working with several orthologs, we attached the original *Acidovorax* AAT to a Maltose Binding Protein to increase solubility. This MPB-AAT was then subjected to the same activity assays I used on the various constructs. It is hopeful that with these studies, the mechanism behind this novel aerobic methane production will begin to come to light.

***AM-01: Thermal consolidation of metallic tin porous membranes with ammonium chloride*****Thomas Halvorson, Mechanical & Industrial Engineering**

Mentor(s): Stephen Sofie, Mechanical &amp; Industrial Engineering; David Driscoll, Mechanical &amp; Industrial Engineering

Metallic tin porous structures prepared by slurry based freezing methods can behave multifunctionally as both mechanical support and catalyst for the production of formic acid in the presence of CO<sub>2</sub> and water, acting as a carbon sequestration technique that can produce useful byproducts. The formation of prevalent surface oxides and the exceptional temperature variation between oxide reduction and melting point of the metal requires a non-standard approach sintering approach. To yield sufficient mechanical properties after casting, tin is sintered at ~180°C in which surface oxides prevent particle coarsening. The low temperature presents a unique challenge, in that hydrogen containing reducing atmosphere will not effectively reduce the surface oxide which inhibits sintering and thus mechanical properties of porous supports. This work explores a novel route of sintering tin with the addition of NH<sub>4</sub>Cl to reduce the oxide layer by the formation of water soluble chlorides. Residual chlorine in the system present contaminants. Experimental studies showed that surface application of NH<sub>4</sub>Cl does not yield oxide reduction through the porous scaffold, and mixing of NH<sub>4</sub>Cl into the slurry is required. NH<sub>4</sub>Cl concentrations from 1-5wt% in increments of 0.5wt% was explored. The sintered tin was washed in deionized water to remove chlorides. Using electron microscopy evaluate the porous structure and x-ray photoelectron spectroscopy to quantify residual chlorine. Using 1-2 micron tin powder, the lowest viable NH<sub>4</sub>Cl concentration was 2.5wt% of the tin, yielding mechanically robust and electrically conductive tin with a porosity of 41%. After washing a sintered cast, XPS shows negligible chlorine concentration.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

***AM-43: Calibrating a Multispectral Imager for Detecting Harmful Algal Blooms*****Shannon Hamp, Electrical & Computer Engineering; Joseph Shaw<sup>1</sup>; Riley Logan<sup>1</sup>**<sup>1</sup>Electrical and Computer Engineering

Mentor(s): Joseph Shaw, Electrical &amp; Computer Engineering

The health of inland waterways is threatened by the increasing frequency and intensity of harmful algal blooms. In addition to contributing to oxygen depletion, algal blooms also indicate damaging nutrient enrichment and can be directly related to water quality through metrics such as chlorophyll concentration. Remote sensing enables continuous imaging of large areas of river ecosystems to quantify chlorophyll concentration. Methods such as drone-based hyperspectral imaging provide a promising alternative to in-situ spot-sampling to quantify water quality; however, the high data density and cost associated with the technology limit its ability to provide long-term algae monitoring. To move toward a more compact, lower-cost system, this research aims to demonstrate the feasibility of a low-cost, bridge-mountable multispectral imager for continuous, long-term monitoring of river chlorophyll and algae along large sections of Montana rivers. This multispectral imager was developed with Raspberry Pi components to sense *Cladophora* spp. and blue-green algae species using information from four wavelength bands in the visible and near-infrared. A spectral characterization and radiometric calibration were completed for the imager to enable conversion from image digital numbers to units of reflectance for comparison with hyperspectral data from a drone system and in-situ river sampling data.

*Acknowledgments: USP - Undergraduate Scholars Program*

**AM-49: Motivity****Caleb Hayes, Computer Science**; Christian Hess; Josiah Schwahn; Caden Senitte – Engineering

Mentor(s): Clemente Izurieta, Computer Science

Motivity, the application aimed at correcting the habits of young adults. The busy lives of young adults, primarily college students, often come with a disregard for healthy life choices. Physical and mental wellbeing are forgotten about, and personal goals quickly grow out of reach when young adults are faced with packed schedules. Time is mindlessly wasted in passing time on mobile apps because these apps are structured to give users instant gratification. Growing up in the smartphone era, kids who are now young adults made bad habits with how much time they spent on their phones. Because of this, young adults now are far too indolent which leads to reluctance to make healthy life choices and to work to achieve their goals. Our application provides users with an easy-to-use planner that has recommendations and tips to help users make the most of their time as well as providing users with rest periods that reward hard work. When people take breaks many times they feel guilty because their responsibilities are not yet finished. This application aims to help users relieve their brains without feeling guilty for procrastinating. To help users achieve their goals, we create a sense of accountability via notifications, weekly reports, and visual representations of their progress. The intent is to encourage the user by focusing on their progress rather than how far away their goals are. The ultimate goal is to change people's lives for the better via streamlining and simplifying time management.

**PM-61: Exploring Modern Native Art in Native Communities through Apache skateboard artist, Douglas Miles****Halee Head, Art**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Native Peoples have been creating art since time immemorial. However, forced assimilation efforts 19th and 20th centuries disrupted many traditional art practices. Despite this, today, many Native artists are flourishing within their communities as well as outside of them. This research addresses the functions that contemporary Native American art serves within communities. This research focuses on one artist, in particular, Douglas Miles. Miles is an Apache artist who is giving back to his community through his art by creating and distributing skate decks featuring Apache art. This kind of participation makes a positive impact on Native communities by making kids feel like they are being represented by connecting sports and art together in a cultural way. The work of Native artists is making stronger and more connected communities, thus helping children to feel a sense of belonging and family within their community.

*Acknowledgments: Other funding or support*

**AM-78: THE EFFECT OF FLUSHING FLOWS ON MACROINVERTEBRATE COMMUNITY STRUCTURE IN THE MADISON RIVER, MONTANA****Johnathon Hobgood, Ecology**

Mentor(s): Lindsey Albertson, Ecology; Zach Maquire, Ecology

Aquatic organisms rely on high-flow events to flush fine sediment downstream and encourage habitat heterogeneity in the benthic substrate. Flushing flows intended to restore some level of historic flooding and support suitable habitat for macroinvertebrates are anthropogenically controlled using dams within the Madison River, MT. Few studies have evaluated how flushing flows designed by the dam operation affect aquatic organisms. We studied effects of flushing flows by comparing macroinvertebrate drift densities (ind./m<sup>3</sup>) across a flushing flow year and a non-flushing flow year at two different sites. A linear mixed effects model determined how drift density was affected by the fixed effects of flushing flow year,

suspended sediment, and distance from the flushing flow origin, with a random effect of local sample location. There was no significant difference in macroinvertebrate density between a flushing flow and non-flushing flow year, but there was a significant difference between sites ( $t_{10}=3.23$ ,  $P=0.008$ ). No interaction effect was found between year and site. Significant difference was found in suspended sediment between years ( $t_{11}=-2.29$ ,  $P=0.0424$ ), and between sites ( $t_{11}=-6.94$ ,  $P<0.001$ ). Suspended sediment was higher in the flushing flow year. Our findings suggest the current flushing flow design does not substantially alter macroinvertebrate drift. However, it is possible that flushing flows do have effects that are short-lived over days to weeks, which our sampling design would not have captured. Future work could investigate how drift community structure might be affected by flushing flows and how trout feeding preferences and rates vary in years with or without flushing flows.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **AM-84: Womens Longitudinal Experiences with Social Media during a Global Pandemic**

**Sophia Hojnacki, Health & Human Development;** Alice Heriza

Mentor(s): Mitch Vaterlaus, Health & Human Development

The COVID-19 pandemic has influenced everyone differently, however emerging research on the pandemic shows that women are disproportionately affected (Carli, 2021). This longitudinal study explores women's ( $n = 124$ ) lived experiences with social media in the United States during the COVID-19 pandemic. Women completed surveys at two points in time (March 2020 and April 2021). Follow-up interviews were conducted with 33 women in April 2021. A phenomenological qualitative approach was used to identify 3 major themes among responses, which included feeling connected to friends, family, and community, access to information, fake news, and misinformation, and the "echo chamber" of other people's opinions being shared on social media platforms. Subsequently, a trajectory qualitative longitudinal analysis approach was implemented to then conduct an additional analysis to identify consistencies or changes over time within each participant's experience. These findings exemplify the large impact social media has had on women during COVID-19 and reinforces the need to study women's lived experiences with technology and social media throughout the entire pandemic.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-53: The Effectiveness of Illustrations Depicting the Use of Silver Diamine Fluoride in an Oral Health Campaign delivered via GoodHealth TV**

**Nicole Holt, Animal & Range Sciences**

Mentor(s): Laura Larsson, Nursing

American Indian pre-school children experience almost three times the rate of untreated decay as children from other groups. There are many aspects to this problem but among them is the slow arrival of information to rural and remote areas. GoodHealthTV (GHTV) is designed to address this information gap and equip parents and families with information to improve overall oral health literacy and confidence in pursuing treatments for their loved ones. This project will consist of two parts; the first is the creation of scientific illustrations explaining a new dental procedure, and the second part is a survey measuring the effectiveness of the illustrations.

Broadcasting high-quality information using the GHTV Network depends on strong communication skills, which will be demonstrated through the illustrations. The illustrations will depict complicated chemical processes in a way that benefits the lay audience member. GHTV provides healthcare information to waiting-room patients in 48 Montana IHS clinics. The scientific illustrations will show how silver diamine fluoride (SDF) acts on the tooth so that people will be more likely to allow dental hygienists

to use SDF on their children's teeth. Illustrations will be paired with voice-over text, music, and live footage to create a quality production for statewide viewership.

While the drawings are being aired on GHTV in the IHS clinics, surveys will be given to viewers to measure the effectiveness of the illustrations. If the illustrations are effective, parents will have an increased understanding of how SDF works and confidence in electing this new treatment.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-01: From Philosophy to Practice: Introducing ePortfolios in University Curriculum***

**Nicole Hopkins, English**

Mentor(s): Tess Meacham, Academic Technology & Outreach

ePortfolios are important educational tools that foster engagement, active learning, and retention at universities. They are most effective when integrated into the existing curriculum, but that integration is often neither seamless nor graceful. In my research, I examine the work that has already been done internationally to implement ePortfolios at colleges and universities including testimonies on best practices that are highly efficient – and mistakes that are reported so that other programs can avoid them. This information then informs a curriculum integration proposal specific to Montana State University in alignment with MSU's already robust Core requirements and qualities. ePortfolios can enhance these well-established learning goals by improving university assessment of student achievement of Core qualities, assisting professors in impressing upon students the importance of these qualities, and allowing students to more fully understand the core requirements and the merit they bring to any education. To this end, the best place to introduce ePortfolios into the curriculum is in first-year seminars and in senior capstones. MSU's ePortfolio program is still in its infancy, but it has already demonstrated great potential for students, faculty, and staff.

***AM-55: Heat Capacity, Magnetic Susceptibility, and Resistivity Measurements of NbO<sub>12</sub>***

**Jake Horstmann, Physics**

Mentor(s): John Neumeier, Physics

Materials that form strong bonds in the plane, but bond very weakly outside of that plane are known as Van der Waals materials. These 2D materials are easily split into atomically thick layers and have been shown to have widely different properties as a sheet versus a bulk material. A new Van der Waals material known as NbO<sub>12</sub> may show interesting properties, but these have not all been explored. We will investigate the heat capacity and magnetic susceptibility through the use of the Physical Property Measurement System (PPMS) while using the Keithley 6517A for resistivity due to high material resistance.

***PM-62: Contemporary Native American Pop Art: Creating Native American Representation through American Pop Culture***

**James Hubbell, Art**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

There is a biased and inaccurate representation of Native Americans in American television, film, advertising, and on the web. In the rare cases that Native Americans are represented in American mass media, it is usually in a reductively stereotypical manner or within a historical context. Because American mass media is the most accessible form of American culture, it has the largest influence on how individuals in social groups understand themselves and how they are understood by others. I am examining the psychological effects on both individuals in Native communities and those in non-Native communities, resulting from the limited and homogenizing representation of Native Americans in

American mass media. I am also looking at various works of Native American Pop Art to see how Native artists are responding to this underrepresentation, reclaiming their identity and introducing their vision of modern Native American representation through the lens of contemporary American pop culture. I will use various studies and surveys, as well as a variety of works by Native visual artists as sources to draw my conclusions.

### ***AM-39: Development of a Guarded Hot Plate Apparatus to Test Thermal Conductivity of Hempcrete***

**Alixandra Huhta, Civil Engineering**

Mentor(s): Kirsten Matteson, Civil Engineering

Hempcrete, a concretion material that incorporates hemp hurd, has been proven by previous research to be an innovative, environmentally-conscious building material. Past research at Montana State University has been done to establish viable hempcrete mix designs for use in structural applications. Due to the high insulative properties of hemp, this mix may also prove to be an effective insulating material. Thus, hempcrete panels of the previous mix design have been constructed in an effort to determine the R-value, or thermal conductivity, of the panels.

A mixture of hemp hurd, cement, lime, and water was assembled to create two (21 $\frac{3}{8}$ " x 21 $\frac{3}{8}$ " x 3") panels and eight cylinders. The two panels include the installation of two heat flux sensors and will be surrounded with foam board insulation to assure one-direction heat flow. The panels are scheduled to be tested in the psychrometric testing facility within the Montana State University HVAC Research Facility to measure thermal conductivity. The eight cylinders are scheduled to be tested for compressive strength at 21 days and at the time of thermal conductivity testing. No data for thermal conductivity or compressive strength is available at this time.

The establishment of an R-Value of this mix design will allow the hempcrete developed by Montana State University to gain relevance within the construction sector. An established measure of thermal conductivity will further the validation of hempcrete as an effective insulation material, and will thus further its application as a viable building material.

*Acknowledgments: USP - Undergraduate Scholars Program*

### ***AM-56: Rule Extraction from Decision Forests Via Weighted Graph***

**William Jardee, Physics; Lin Shi, Computer Science**

Mentor(s): John Sheppard, Computer Science

Decision trees are a common machine learning algorithm choice in real-world applications, such as medicine and business, because of their adequate performance and interpretability. To improve the accuracy of the model, an ensemble approach to decision trees, often called a decision forest, is employed at the sacrifice of interpretability. Some work has been done to combine the trees in a decision forest into one tree that best represents the important characteristics provided by the ensemble. Some results seem promising in this regime, but the resulting tree can still be very large, and the final tree's accuracy can be hard to judge. We present a novel method for combining the characteristics of all the trees in the forest into one undirected, weighted graph that can be manipulated to extract a list of logical rules that accurately describe the decisions in the forest. Computational complexity and spatial complexity analysis are provided for the algorithm. The final algorithm is tested against current decision forest and tree extraction algorithms to test accuracy, training speed, and final model speed.

### ***PM-40: Composition Analysis of Native Montana Plants and Grasses for Renewable Chemical Production***

**Lauren Johnsrude, Chemical & Biological Engineering**

Mentor(s): Stephanie Wettstein, Chemical & Biological Engineering

To move towards a less fossil fuel-dependent economy, biomass energy and biochemicals have been recognized as promising solutions to reducing reliance on petroleum-based fuels and materials. When upgrading biomass to fuels and chemicals, the composition of the major fractions (cellulose, hemicellulose, and lignin) must be known to determine product yields. However, analyzing the composition of biomass accurately can be difficult since non-structural components, such as inorganic or nitrogenous materials, can affect the composition values. Therefore, pre-analysis extractions may need to take place to ensure the most accurate composition values. In this research, 20 different native Montanan lignocellulosic biomasses were analyzed to determine their respective carbohydrate and lignin compositions. Additionally, extractions of three biomasses with ethanol and water were performed to investigate how this could affect the experimentally determined compositions. Ethanol, water, and water + ethanol extractions were completed by following National Renewable Energy Laboratory (NREL) and Technical Association of the Pulp and Paper Industry (TAPPI) procedures using a Soxhlet apparatus. Non-extracted and extracted biomass compositions were determined with an NREL method. The compositions of the biomasses were compared overall and based on extraction solvent(s), growing location, and type of seed.

*Acknowledgments: USP - Undergraduate Scholars Program*

### ***PM-25: IntelliCompose***

**Alex Johnston, Computer Science; Tanner Rubino<sup>1</sup>; John Dolph<sup>1</sup>; Computer Science<sup>1</sup>**

Mentor(s): Clemente Izurieta, Computer Science

Composers of all experience levels often run out of ideas and find themselves stuck with “writer’s block” where they can no longer come up with new musical compositions. Half-written compositions end up never completed and musical ideations are lost. Inexperienced composers also often struggle coming up with ways to begin a piece of music or transition between sections. This project explores creating a software solution to help solve this problem. By using the Python programming language and an open source library called Magenta, a Windows program was created that is usable by musicians and composers to harness machine learning algorithms to aid in the creation of music. Using only a mouse and keyboard, users can harmonize or extend existing melodies, create new melodies, or even generate complex performances with no knowledge of machine learning or coding. This prototype application could pave the way for further development to take place in creating more accessible software solutions that aid composers.

### ***PM-15: Understanding Children’s Emotional Development During a Mask Mandate: Do Masks Decrease Children’s Ability to Recognize Emotions in Peers?***

**Katherine Kalebich, Psychology**

Mentor(s): Brandon Scott, Psychology

Recent research with 7-13 year-old children suggests that a mask mandate may have little impact on children’s emotion development in older children (Ruba & Pollack, 2020) however, there is evidence that masks do impede emotion recognition for preschoolers. The purpose of our study is to investigate whether masks decrease 4- to 5-year-old children’s ability to recognize emotions in other children’s faces. We are still in the data collection process and have no preliminary findings at this point. Parents are completing a demographic survey. Forty facial expressions (10 happy, 10 sad, 10 anger, 10 fear) of

children wearing a mask (20 expressions) or not wearing a mask (20 expressions) are being presented randomly to child participants. We are asking them to verbally tell us whether the child's face is happy, sad, angry, or afraid and the proportion of correct to incorrect responses (overall, negative, and positive emotions) will be used as the dependent variable. We expect children will: (1) correctly identify more emotions when there is no mask as compared to a mask, and (2) correctly identify more negative emotions (anger, sadness, and fear) than positive emotions when mask is present. This study will add to the literature by identifying whether 4-to-5-year-old children are able to just as effectively recognize both positive and negative emotions in the presence of a mask as opposed to no mask. Our study may have practical implications when it comes to informing policy makers of the possible consequences of mandating masks at such a young age.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-26: PIQUE GUI and database expansion**

**Dawson Kanehl, Computer Science; Zoe Norden<sup>1</sup>; Maria Gallivan<sup>1</sup>; Connor Lowe – Computer Science**  
Mentor(s): Clemente Izurieta, Computer Science

The PIQUE (Platform for Investigative Software Quality Understanding and Evaluation) software was developed to help analyze code against current standards to evaluate its quality. This is done through a weighted system that gives a score to each characteristic. However, the description of the characteristics is currently done by importing manually written JSON lines. We aim to automate this process by creating JSON files through a web interface that allows for the user to drag and drop linkable nodes that generate the JSON file without the need for a developer. We created a web application using React and Node JavaScript libraries that allows users to craft an individualized hierarchical tree of sub characteristics that is contextual and allows for customizations that meet the needs of stakeholders. Users are able to save their trees to a cloud database to then be edited and saved. The tree can now be populated with actual scores obtained by measuring quality through selected tools. With future integration into the rest of the PIQUE framework, users will be able to ease the development of models. By removing the need for a developer to manually enter data and create files we created a more efficient product that facilitates customer independence.

### **AM-79: Effects of Survey Conditions, Date, and Time on Dusky Grouse Counts in Montana**

**Kellan Karch, Ecology; Lorelle Berkeley; Claire Gower – Montana Fish, Wildlife, and Parks**  
Mentor(s): Elizabeth Leibold, Animal & Range Sciences; Lance McNew, Animal & Range Sciences

Dusky grouse (*Dendragapus obscurus*) are a species of upland game bird for which monitoring methods are still being developed. Understanding factors that influence the detections of grouse is crucial for developing survey protocols that maximize the observability of grouse and provide unbiased estimates of population size and trends. Our objective was to explore relationships between grouse counts and survey conditions to inform future statewide survey protocols. We conducted multiple 4-minute point counts during the spring mating season from late April–early June 2020. We explored the effect of wind speed, temperature, cloud cover, precipitation, minutes since sunrise, and date on the maximum number of dusky grouse counted at each site using generalized linear models and information theory. The number of grouse observed declined with wind speed ( $\beta = -0.06 \pm 0.04SE$ ), and increased with ambient temperature ( $\beta = 0.02 \pm 0.01SE$ ). The number of grouse counted for date and minutes since sunrise had a positive quadratic relationship, with peak counts occurring from May 5th – May 20th, and between 100-150 minutes post sunrise. Higher counts were observed when cloud cover was low, and snow had the strongest negative impact compared to other forms of precipitation. These results provide valuable insight for identifying favorable conditions for surveying dusky grouse.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

**AM-02: Thermophilic bioconversion of degraded plastic wastes to Polyhydroxyalkanoates (PHAs) utilizing *T. thermophilus***

**Samantha Kelderman, Chemical & Biological Engineering**

Mentor(s): Dana Skorupa, Center for Biofilm Engineering; Brent Peyton, Chemical & Biological Engineering

The goal of this project is to produce value-added Polyhydroxyalkanoates (PHA) bioplastics from *Thermus thermophilus* HB8 with oxidized plastic wastes as the sole carbon and energy source. Currently, industrial manufacturing of value-added PHAs is infeasible because the microorganisms capable of producing PHAs require expensive substrates like glucose. The use of oxidized plastic wastes offers a cheaper and more sustainable alternative for PHA bioproduction. Research proposed here focuses on maximizing the growth of *T. thermophilus* on depolymerized and oxidized plastic wastes and aims to explore potential thermophilic production PHAs. Preliminary experiments centered on growing *T. thermophilus* to high cell densities to have enough cells to extract from. This occurs at an optical density of 1.0 at 600 nm on a UV-Visible Spectrophotometer. Growth conditions mimicked that of Kyriakidis et al., 2003. Unfortunately, the highest optical density that any of the test cultures reached was 0.200, indicating low cell densities and subsequent chloroform extraction yielded no PHAs. A slew of experimental variations were tested to increase cell density: higher shaking speed, media with higher nitrogen concentration, different inoculation volumes, different incubation temperatures, and higher culture volumes. None of the varied conditions increased the culture cell density. However, *T. thermophilus* did reach a maximum cell density of 0.864 when growing in nutrient rich Basal Rich Culture media. Therefore, current work is focused on maximizing growth in this nutrient rich media and quantifying PHAs using fluorescent microscopy. Results will establish methods need to eventually grow *T. thermophilus* on degraded plastic wastes and produce PHAs.

*Acknowledgments: USP - Undergraduate Scholars Program*

**PM-31: Diffusion Doping and Characterization of Rare-Earth Ions in Lithium Niobate for Quantum Transduction**

**Sophia Kennedy Overfelt, Physics; Kyle Olson; Aaron Marsh; Philip Woodburn – Physics**

Mentor(s): Rufus Cone, Physics; Charles Thiel, Physics

In the development of a practical quantum computer, it has become apparent that one of the most pressing needs is to create a “quantum transducer”, a device capable of transferring quantum information from microwaves to optical photons. To transfer quantum information from one photon to another, crystal waveguides with a doped diffusion layer of rare earth elements must be fabricated. Many doping methods can cause damage to the crystal’s lattice and surface, but new doping methods enabling the indiffusion of chemical dopants into lithium niobate crystal wafers show promise in improving the quality of crystal waveguides used in quantum transducers. By doping the commercial crystal wafers (0.5 mm thick, x-cut or z-cut) via indiffusion with Erbium or Thulium ions and optically analyzing the crystal we show that the crystal has similar quality to that of a bulk doped crystal and retains minimal structural damage.

*Acknowledgments: USP - Undergraduate Scholars Program*

**AM-73: Stolen: Investigating the Americanization of Native American culture, and the normalization of cultural appropriation in America**

**Mackayla Kennedy-Harris, University College**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Living in Montana and the United States, Native American imagery and culture is all around us, but how often is credit given where credit is due? From sports team names to luxury fashion brands, cultural

appropriation is everywhere. Recognizing that America is built on stolen land is crucial, but more importantly, we must respect the Indigenous peoples the land was stolen from. From the beginning of the United States, Native Americans were assimilated and Americanized by colonizers and their governments. Now, Natives are being taunted by statues of prominent historical figures like Christopher Columbus, who in 2022 is not nearly as highly commended as he was when the statues were put up. In addition to the past Americanization of Native Americans, American pop culture is filled with offensive and embarrassing examples of non-Native people appropriating Native culture. This research paper aims to discover how to educate and teach those around us how to appreciate Native culture, without appropriating and stealing Native culture.

### ***AM-18: Reliability of Heart Rate Variability during Stable and Disrupted Polysomnographic Sleep***

**Emma Kerkering, Microbiology & Cell Biology;** Gianna Migliaccio<sup>1</sup>; Ian Greenlund<sup>2</sup>; Jeremy Bigalke<sup>2</sup>

<sup>1</sup>Microbiology and Cell Biology; <sup>2</sup>Psychology

Mentor(s): Jason Carter, Health & Human Development

**Introduction:** Heart rate variability (HRV) is a common metric to estimate autonomic activity during sleep. Despite high HRV use, it is unknown whether sleep disturbance changes overall reliability of frequency-domain HRV. The purpose of the present study was to determine if HRV was reliable across arousal-free and arousal-containing periods of sleep.

**Methods:** Twenty-seven participants (11 male, 16 female, 26±1 years, 27±1 kg/m<sup>2</sup>) were given an 8-hour sleep opportunity, equipped with continuous two-lead electrocardiography (ECG) and overnight polysomnography. The ECG recordings were analyzed via fast-Fourier transformation for frequency-domain HRV in a custom software as low (LF) (0.04-0.15 Hz) and high frequency (HF) (0.15-0.4 Hz) HRV. Two separate stable sleep periods (range, 5-10min) absent of arousals were recorded, along with two separate disrupted periods of sleep with at least one arousal were selected in stage II sleep (N2), slow wave sleep (SWS), and rapid eye movement (REM) sleep. Statistical analysis included intraclass correlations (ICC) of HRV across the four stable and disrupted periods of sleep, with separate ICC analyses across sleep stages ( $\alpha=0.05$ ).

**Results:** HF HRV was reliable across all three sleep stages (ICC>0.9, p<0.001). LF HRV was reliable in two stages of stable and disrupted sleep in N2 (ICC=0.903, p<0.001), REM (ICC=0.907, p<0.001) sleep, and trending in SWS (ICC=0.616, p=0.089) sleep.

**Conclusions:** Frequency-domain HRV was reliable between stable sleep with and without cortical arousals, with the exception of LF HRV during SWS. Taken together, HRV may provide a reliable, indirect index of autonomic activity across stable and disrupted sleep.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### ***AM-44: Increasing Resiliency of the Power System using Electric Vehicles as Distributed Energy Storage***

**Jonathon Kilen, Electrical & Computer Engineering;** Alexander Nordstrom, Electrical and Computer Engineering

Mentor(s): Todd Kaiser, Electrical & Computer Engineering; Maryam Bahramipناه, Electrical & Computer Engineering

Electrical outages have been trending upward direction since the late 20th century. This has necessitated research of power systems to increase resiliency; the measure by which the system can prepare, absorb, and recover from a low probability high consequence event such as a natural disaster. This project will model base resiliency of the power grid in Waco, TX using known system data gathered from public

records during the February 2021 winter storm event. Due to an expansion of private Electric Vehicles (EVs) in the United States it is feasible to use them as energy storage devices to increase the resiliency of the power grid by injecting power into the system. The Newton-Raphson power flow algorithm was written in MATLAB to simulate the 38-bus system over a 120-hour period that encompasses the time before the event under normal operation, during the degradation of the system while the storm was occurring, and the recovery of the system to normal operation levels. By using real world data on EVs the project attempts to decrease the overall losses in the system as well as the time to recovery thereby increasing the resiliency.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-47: Utilizing nanomagnetic forces to guide firing patterns in cultured neuronal networks**

**Conner Killeen, Microbiology & Cell Biology;** Connor Beck, Electrical and Computer Engineering

Mentor(s): Anja Kunze, Electrical & Computer Engineering

Controlling the connectivity and firing patterns in neuronal networks is key to information processing in the brain. Recent efforts are based on using magnetic nanomaterials as a mechanical cue to orient the growth of neurite networks, e.g., within magnetic field gradients. It remains, however, unclear if mechanically oriented neurite networks would exhibit a predefined connectivity or firing pattern. Here, we grew dissociated primary cortical neurons on microelectrode arrays under one distinct mechanical force pattern (including magnetic nanoparticles). The directed neurite growth was assessed fourteen days in vitro (DIV), using Hough Transform as an analytical tool to extract the orientation of neurite growth. At fourteen DIV, extracellular recordings were performed. The extracellular firing patterns were analyzed using two different methods, spike raster plots, and Granger causality. The raster plots were extracted from filtered extracellular field potentials with a high pass and a low pass filter. The same extracellular firing patterns were then used unfiltered to determine Granger causality and uncover potentially directed signal causality. We found that spatiotemporal firing patterns align with the gradient ascent in the force gradient pattern. The Granger causality test indicated randomized firing patterns for our control growth conditions (no force or no magnetic field gradient). These observations hold great promise to engineer neuronal growth and spatiotemporal firing patterns using nanomaterials in next-generation neurotherapeutic devices.

*Acknowledgments: INBRE - IDeA Network for Biomedical Research Excellence*

### **AM-81: Pea Leaf Weevil Management in Yellow Pea to Optimize Yield and Protein Content**

**Samuel Koeshall, Land Resources & Environmental Sciences (Graduate Student);** Clain Jones<sup>1</sup>; Kevin Wanner<sup>2</sup>

<sup>1</sup>Land Resources & Environmental Sciences; <sup>2</sup>Plant Sciences

Mentor(s): Perry Miller, Land Resources & Environmental Sciences

Yellow field pea (*Pisum sativum* L.), has gained popularity across the Northern Great Plains due to its farm-scale benefits, especially in wheat systems. However, with approximately 323,000 ha of pea planted in 2020 in Montana and North Dakota alone, challenges have appeared that threaten the long-term sustainability of pea. The pea leaf weevil (PLW) (*Sinota lineata* L.) has become a primary economic insect of concern for major pea growing regions. PLW causes damage to pea plants through two mechanisms. Adult PLW causes foliar damage to the pea by feeding on the outer edges of leaflets with larvae feeding on rhizobium nodules, which are the N fixing structures of legumes. PLW also threaten the ability for farmers to receive protein premiums for high protein pea grain. Three rates of seed-coat applied thiamethoxam (control, 30, and 50 g ai per 100 kg seed) and three timings of the foliar insecticide lambda-

cyhalothrin (control, 2nd, and 5th node stage) were used, totaling nine treatments. This experiment was conducted in 2020 and 2021. Applying a foliar insecticide increased grain yield by 204 (early spray) and 209 (late spray) kg ha<sup>-1</sup> over the control, resulting in an increased net return of \$42.23 and \$43.53 ha<sup>-1</sup>, assuming \$0.26 kg, and cost of insecticide at \$10.38 ha<sup>-1</sup>. Using thiamethoxam increased grain protein by 0.3 and 0.6 units for the 30 and 50 g ai rates, respectively. This experiment shows that chemical pest management tools to mitigate PLW can increase both grain yield and protein.

*Acknowledgments: Western SARE*

### **AM-25: Isolation of new algal and bacterial strains from high pH/high alkalinity habitats**

**Kayla Kozisek, Chemical & Biological Engineering;** Molly Taylor; Charles Hocomb

Mentor(s): Robin Gerlach, Chemical & Biological Engineering; Huyen Bui, Chemical and Biological Engineering

As the world's population continues to rise there is an increasing urgency in finding an alternative to fossil fuels and a way to reduce atmospheric carbon. A promising solution to both these problems can be found in algae. Much of commercial algal cultivation is being attempted with axenic (free of other organisms) algal cultures, these cultures are prone to becoming contaminated by other microorganisms from the surrounding environment. In their natural setting algae grow in a complex network with other microorganisms including bacteria, other species of algae, or even protists like ciliates. This research provides further insights into the algal-bacterial interactions in cultures with high biomass productivity for biofuel production. Water samples with visible algal growth were collected from several alkaline lakes in Soap Lake (WA, USA). Algae and bacteria from enriched cultures were then isolated by streaking cultures on agar-plates. Bold Basal Medium (BBM) was used for green algae, BBM supplemented with silica (Na<sub>2</sub>SiO<sub>3</sub>) was used for diatoms, and Blue-Green 11 medium was used for cyanobacteria. Non-phototrophic bacteria were isolated using BBM with 20% Luria-Bertani (LB). Individual colonies were selected through three rounds of re-streaking before being reintroduced to liquid media. The isolated algal samples will be used in further research. They will be imaged and genetically sequenced for taxonomic identification. Once identified, their growth will be characterized by determining the growth rate in lag and log phase, as well as the maximum cell density. They will then be used to determine how they interact with isolated bacterial samples.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **AM-85: The relationship between appetite, fat-free mass, and resting metabolic rate in overweight and obese adults**

**Katy Kropatsch, Health & Human Development;** Stephanie Wilson<sup>1</sup>; Marcy Gaston<sup>1</sup>; Wan-Yuan Kuo<sup>1</sup>

<sup>1</sup>Health and Human Development

Mentor(s): Mary Miles, Health & Human Development

Increased appetite leads to greater energy intake which is a known factor in obesity development. Physical activity introduces a caloric deficit and promotes an increased resting metabolic rate (RMR) with changes in fat-free mass (FFM). Macronutrient composition of foods is important and fiber rich foods, such as lentils, promote increased satiety.

**PURPOSE:** To study the relationship between appetite, FFM, and RMR in individuals with a high waist circumference (WC) prior and after a 12-week diet intervention.

**METHODS:** Adults with increased WC (>35" women, >40" men) aged 29-69 years consumed 0 or 140g of lentils daily as a mid-day meal for 12 weeks. Participants completed online satiety surveys at 4PM once a week. Participants rated their level (1-10) of hunger, desire to eat, satisfaction, fullness, and amount could eat. FFM (%) and RMR (kcal) were measured before and after the intervention using bioelectrical impedance analysis. Participants wore an accelerometer for 7 days (10 hrs/day) during the first and last

week of the 12-week study and measured the average time spent in moderate-vigorous physical activity (MVPA) per day. Changes in appetite were assessed through a mixed effects model accounting for RMR, FFM, and MVPA.

**RESULTS:** Dietary intervention did not have an impact on self-reported hunger, fullness, satisfaction, desire to eat, and amount could eat. However, hunger decreased 0.1 ( $p=0.03$ ) for every percentage gain of FFM. FFM, MVPA, and RMR ( $p>0.05$ ) had no impact on the satiety measures.

**CONCLUSIONS:** Investigating FFM affects on hunger may have applications for reducing obesity development in adults.

### ***AM-57: Construction of Hong-Ou-Mandel Interferometer for Quantum Network Research***

**Nathan Kuehl, Physics**

Mentor(s): Randy Babbitt, Physics

The research field of quantum communications is relatively new and very exciting. Quantum communication research seeks to utilize the intrinsic physical properties of matter and energy to protect data and improve cyber security. Unlike classical communication bits that are modulated deterministically to be zeros or ones and can therefore be easily intercepted by an unwanted eavesdropper unbeknownst to the communicating parties, if a quantum entangled source signal is eavesdropped on it fundamentally changes the behavior of the photons which can be detected by the parties in communication. Since quantum communication is a new field, it still requires researchers to lay much of the groundwork and basic infrastructure for experimentation. Spectrum Lab in coordination with Montana State University and Applied Research Lab are beginning the construction of a quantum communications network here in Bozeman, MT. Spectrum Lab has three internal teams working towards the realization of this goal (entangled photon generation, photon transportation, and detection). To support the detection team, we are constructing a Hong-Ou-Mandel (HOM) interferometer apparatus to expand the effectiveness of our experimental capabilities and to determine how pragmatic it is to build a HOM interferometer from available off-the-shelf optical components. Our goal is to determine the cost-effectiveness of constructing a HOM interferometer and refine our methodology for design and construction to a point where we can transition from a simpler 810 nm apparatus to an apparatus capable of characterizing photons from the telecom C band (1550 nm).

*Acknowledgments: USP - Undergraduate Scholars Program*

*Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### ***AM-33: Developing an Aptamer Against Acetaminophen to Detect Acetaminophen Toxicity at the Point-of-Care***

**Kenedee Lam, Chemical & Biological Engineering; Matthew Magoon, Biological Engineering**

Mentor(s): Stephanie McCalla, Chemical & Biological Engineering

Acetaminophen toxicity is a leading cause of acute liver failure, and the diagnosis and treatment of this condition are based heavily on laboratory findings. While there are several antibody-based and enzymatic assays available for detecting acetaminophen toxicity, they have several drawbacks including restrictive shipping and storage requirements and the need for a clinical lab to conduct the tests. An alternative, which is particularly well suited to limited resource settings, could be to use DNA aptamers, or short strands of DNA that bind to a specific target. Work is being done to design a new DNA aptamer through an in vitro technique called Systematic Evolution of Ligands by Exponential Enrichment (SELEX). We aim to evolve an aptamer that specifically binds to acetaminophen in human plasma, and then incorporate the aptamer into a lateral flow assay capable of rapidly providing results at the point of care. The advantages to using DNA aptamers instead of antibodies or enzymes are that aptamers are more robust

against denaturing conditions like heat, aptamers are easier to produce in large quantities, and aptamers are less expensive than proteins. By incorporating DNA aptamers into a lateral flow assay with gold nanoparticles, it should ultimately be possible to design a simple, inexpensive, point of care diagnostic test with visual detection that has less rigorous shipping and storage requirements than existing tests. This can increase access to testing for acetaminophen toxicity, which is a prevalent and widespread condition that can be effectively treated if it is caught early.

*Acknowledgments: USP - Undergraduate Scholars Program*

*INBRE - IDeA Network for Biomedical Research Excellence*

*Empower Program*

*Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### ***PM-54: Investigating the Price Increase of Agricultural Inputs: Finding Solutions Through Montana's Young Farmers***

**Parker Lambourn, Department of Agricultural and Technology Education**

Mentor(s): Shannon Arnold, Department of Agricultural & Technology Education

This research will address the question: How will farmers change their cropping practices to still be profitable with the current price increase of inputs? Solutions to this question can be found through insights from the future generation of farmers at Montana State University. This exploratory research project examines the challenges of recent fertilizer, fuel, and herbicides drastic price increases. Precision agriculture is a developing management tool for future farmers. Precision spraying and precision fertilizer application are two major factors to cut costs on the farm. A group of College of Agriculture students in a field crop production class will be surveyed to assess their knowledge and aspirations with precision agriculture practices and different cropping rotations. This study is in progress and results, conclusions, and recommendations will be reported at the symposium. Findings will help Montana State University students discover solutions and implement them so we can have prosperous farmers again.

### ***PM-07: What Might Have Been: Thomas Battey, Companion of the Caddo and Kiowa Tribes***

**Tanner Lawson, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

In the 16th century with the arrival of the Spanish and English, the lives of indigenous peoples in America would begin to change forever. Growing up we are taught in schools about the 'glorious' victories the United States won at the hands of figures like George Custer against the indigenous tribes in the West, or Andrew Jackson against the tribes in the East. Relations between indigenous peoples and the United States government have not always been the most friendly or peaceful. Yet, there were those who tried to immerse themselves into the lives of different indigenous cultures and help the people of those tribes thrive in this changing world. Thomas Battey was a 19th century Quaker and schoolteacher from Vermont, who became a friend of the Caddo and Kiowa tribes that were relocated to Oklahoma in the late 19th century. Battey ran a school for the children of these two tribes and was an advocate for peace between the United States and the indigenous peoples living here. He wrote a book of his time living amongst the Caddo and Kiowa tribes titled *The Life Adventures of a Quaker among the Indians*. In his account Thomas Battey shows incredible compassion for the Caddo and Kiowa people, and makes you wonder what would have been different if Battey was the lead negotiator or peacemaker in treaties between the indigenous tribes and the US government?

**PM-27: Recreational Aviation Foundation Project****Lenin Lewis, Computer Science;** Joshua Anderson<sup>1</sup>; Gregory Fulbright<sup>1</sup> – <sup>1</sup>Computer Science

Mentor(s): Clemente Izurieta, Computer Science

The Recreational Aviation Foundation (RAF) is a 501(c)(3) non-profit based in Bozeman, Montana. The mission of the RAF is to preserve, improve, and create airstrips with recreational value on behalf of the 500,000 general aviation pilots in the United States. One of the ways that the RAF does this is through the Airfield Guide product. The Airfield Guide provides an easy-to-use aviator's atlas to backcountry airstrips, complete with photos, videos, and detailed information about airstrip features and amenities. A drawback of the Airfield Guide is that it does not work if the user does not have an internet connection. Not having access to the internet is problematic for pilots who want to use the Airfield Guide because a majority of the airstrips and locations on the Airfield Guide do not have an internet connection. In order to remedy this problem and help the RAF, a data migration system has been implemented. This system gathers information from the Airfield Guide and helps transfer the information to a common aviation app known as ForeFlight. ForeFlight has the capabilities to work both online and offline, which meets the needs of RAF. The RAF now has a system that allows pilots to manage and access their desired airstrips, even when they are not connected to an internet source.

**AM-34: COMPARISON OF STRETCH BROKEN CARBON FIBER AND CONTINUOUS CARBON LAMINATES LONGITUDINAL MECHANICAL PROPERTIES****Noah Loomis, Mechanical & Industrial Engineering (Graduate Student)**

Mentor(s): Dilpreet Bajwa, Mechanical &amp; Industrial Engineering

Application of carbon fiber prepregs in cost-sensitive, high-volume structural applications is limited due to the difficulty to form deep drawn parts. Stretch broken carbon fiber (SBCF), is an aligned discontinuous form of carbon fiber that is under development at Montana State University (MSU). The improved SBCF has the potential to increase the formability of these carbon fiber prepregs. However, any formability benefits of SBCF would be limited if the laminates have reduced mechanical properties when compared to conventional continuous carbon fiber composites. This study compared the 0° unidirectional tensile mechanical properties of continuous carbon fiber and SBCF laminates at ambient room temperature. Materials included Hexcel IM7-G continuous and SBCF using a Solvay Cytec 977-3 resin as the matrix. The results of the study show that the unidirectional tensile mechanical properties of stretch broken carbon fiber laminates do not significantly differ from continuous laminates when made in the same manner. Normalized for a fiber volume of 60%, the MSU continuous and stretch broken materials have nearly equivalent tensile properties, and their properties are within 15% of stated values for commercial material.

*Acknowledgments: US Army Combat Capabilities Development Command Aviation & 397 Missile Center Technology Development Directorate (Contract number: W911W6-18-0050).*

**AM-13: Characterizing the luminal microenvironment of human organoids for studies of gastric pH regulation****Katrina Lyon, Microbiology & Cell Biology (Graduate Student);** Barkan Sidar<sup>1</sup>; Thomas Sebrell<sup>2</sup>; James Wilking<sup>1</sup>; Rama Bansil<sup>3</sup> – <sup>1</sup>Chemical & Biological Engineering; <sup>2</sup>Microbiology and Cell Biology; <sup>3</sup>Physics, Boston University

Mentor(s): Diane Bimczok, Microbiology &amp; Cell Biology

The stomach is notorious for having the steepest proton gradient in the body, which pathogenic *Helicobacter pylori* must traverse to infect the epithelium. This gradient enables the stomach to maintain a near-neutral pH at the epithelial surface and a strongly acidic environment in the stomach lumen. We use human gastric organoids to study the maintenance and regulation of this pH gradient. Gastric organoids

are 3D cellular constructs derived from patient biopsies that mimic the stomach, as they contain both mucus and gastric acid. Gastric mucus is critical for protection against *H. pylori* infection—the leading cause of gastric cancer. It is unclear how the gastric pH gradient is maintained, and how closely organoids model this microenvironment. First, we detected mucus within the organoids using immunohistochemistry and microrheology. We also used a FITC-conjugated lectin to visualize intraluminal mucus. These data were supported by the production of mucus on the apical side of two-dimensional, organoid-derived cell monolayers. Additionally, we developed a novel method for the measurement of organoid intraluminal pH. Using a micromanipulator to maneuver a microelectrode into the organoid, we measured and manipulated luminal pH using histamine stimulation. We determined that pH remains consistent across organoid lines, and that the lumen is more acidic than the surrounding environment. In ongoing studies, we will develop the spatiotemporal resolution of our microprofiling technique. Our studies are the first to utilize pH microsensors in these models, and will lead to improved understanding of gastric physiology and potential new treatment approaches for gastric disease.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### **PM-69: Basketball: How the Game Changed Native Lives in Montana**

**Chloe Maciag, Gallatin College**

Mentor(s): Jennifer Woodcock-Medicine Horse

If you've heard anything about the Fort Shaw woman's basketball team then you know they're wizards in the game of basketball. In 1896 basketball was introduced to the students who attended Fort Shaw Indian Boarding School and gave the girls an activity to participate in for fun. By 1903 their famed games and undefeated status was well known all over the country, and in 1904 they would attend the World's Fair in St. Louis to participate in the Model Indian School. This was just the start of basketball becoming a huge part of Montana sports culture that we know and enjoy to this day. It has even become a very important sport to the many native communities of Montana, and it is a sport they continue to excel in. This sport in many ways has given kids great opportunities for college and playing sports in college. I would like to delve into the rich history of basketball in Montana and the lives it has changed for the better. Not only has this sport changed the lives of many but it is heavily still appreciated and recognized to this day.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### **AM-51: YERC Spatial Data Ingestion**

**Hannah Madsen, Computer Science; Kieran Ringel, Computer Science**

Mentor(s): Clemente Izurieta, Computer Science

The Yellowstone Ecological Research Center (YERC) is a nonprofit based in Bozeman, MT who collects, stores, and analyzes geospatial and ecological data on the Ecosystem Prognosis Impact Information Cooperative (EPIIC) platform. Previously, YERC used data from the Google Earth Engine, which is a proprietary API, but industry standards favor the SpatioTemporal Asset Catalog (STAC) API, which is used by the Microsoft Planetary Computer. The STAC API is much simpler to use and can be implemented by independent organizations like YERC to provide the equivalent of a "google" search for geospatial and ecological related data. By transitioning to include the data from the Microsoft Planetary Computer, we improved the data that YERC researchers and other interested parties use for predictions, analyses, and modeling on the EPIIC platform. We also updated the EPIIC platform to automatically integrate data from the Microsoft Planetary Computer nightly. Additionally, we transitioned from their previous data storage standards to those used in the STAC API. We subsetted the data from the Microsoft Planetary Computer to contain the regions of interest to YERC and then transformed the data from Lambert conformal conic (LCC) projections to North American LCC, which is more accurate for North

America. To display the data on the EPIIC platform, the data is extracted in the world geodetic system 1984 (WGS84) which is a latitude/longitude form.

***PM-34: Convolutional Neural Network Data Filtering for Quantum Limited Detection of particles***

**Steven Mattson, Physics**

Mentor(s): Brian D'Urso, Physics

Measuring a quantum particle involves using light shot at the particle and collecting the light scattered off in the form of images of this particle. This yields useful information about the particle such as position, velocity, or acceleration. The issue with this approach is intrinsic to quantum mechanics and has to do with the momentum that is imparted to the particle by the light when these two interact. The accuracy of measuring the position is related by the uncertainty principle in quantum mechanics. Namely, the issue we are dealing with is the wide range of values for acceleration that are measured from seemingly identical setups of the experiment. These variations can be very small, close to the theoretical quantum limit, or very large and not within an acceptable variation from the quantum limit. This can be caused by various sources of uncontrolled error for example particles that are aspherical and “tumbling” can cause poor measurements of acceleration. The method that we tried to mitigate or at the very least identify these “bad” images was a Convolutional Neural Network based on a valid metric. This CNN can then in theory identify patterns in these images that we humans cannot, however; we can have two scenarios from this point. We can construct a method to discover the source of error that the CNN has identified. Otherwise, the source of error might be impossible to extract from the CNN and we simply have a method of sorting these images.

***PM-35: Reconstructing Greenland's Paleoclimate with an Oxygen Isotope Analysis of the GISP2 Greenland Ice Core***

**Alex Mausshardt, Physics; Nathan Chellman, Earth Sciences**

Mentor(s): Dave McWethy, Earth Sciences

A warming climate in polar regions is melting ice sheets at an unprecedented rate. Analyzing paleoclimate records from Greenland ice sheets are important for understanding the history of Earth's climate and the urgency to do so is heightened because these records are disappearing as the ice melts. Ice cores are one of the best sources for paleoclimate data due to their large temporal extent. Oxygen isotopes within the ice give valuable information about the temperature and precipitation of the region at the time they were preserved. The purpose of this research is to reconstruct Greenland's paleoclimate with samples taken from the GISP2 ice core collected from central Greenland dating back 20,000-30,000 years. An oxygen isotope analysis was performed using a Picarro gas concentration analyzer at the Desert Research Institute in Reno, Nevada led by MSU collaborator Nathan Chellman. I contributed to this analysis in March 2022. The main goal of this project was to answer the question: What is the climate history of Greenland? We find that Greenland fluctuated between warm and cold periods around 23,000 years ago in agreement with existing temperature and precipitation reconstructions in Greenland.

*Acknowledgments: USP - Undergraduate Scholars Program*

***AM-69: Powwow***

**Kaitlyn McCormick, Gallatin College**

Mentor(s): Jennifer Woodcock-Medicine Horse

Powwows are a very important celebration for many native cultures and tribes. They have a deep rooted history in many tribes. Powwows take place across the nation, and even locally. The MSU powwow is a

huge event that takes place at our campus. Every powwow is unique in why it takes place and what happens. The main idea behind the powwow is the music and dance. Dress is very important to the celebrations. Each regalia has extreme attention to detail and handiwork. They can be small or large. Many powwows today are intertribal and invite spectators. These events take a lot of preparation and organization. It is very important to respect the guidelines and rules for these events. You can always check with the MC or other powwow organizers what is “ok” or not accepted. Powwows can be a fun and educational event for those observing and those who take part in the event. In this project I will discuss the importance of the powwow celebration.

### ***AM-70: Suquamish Tribe and the Importance of Cedar***

**Madelyn McFall, Gallatin College**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Suquamish is an Indian tribe that is located near the Puget Sound in Washington state. The Suquamish people are made up of relatively small villages compared to other Indian tribes. The Suquamish people are known to be gatherers, and make great use of the natural resources found where they reside such as berry picking, fishing, and harvesting cedar. This tribe is often known for their use of cedar to make baskets, canoes, regalia, and other useful items. These items were used in a variety of ways; from daily use, to ceremonial rituals. I want to research how the Suquamish use cedar and what the whole process entails. I will start by looking into the history of the Suquamish people what life was like before westward expansion. Then I will look into the significance of the cedar they use and the process of harvesting it. Why did they chose cedar and how they were able to harvest it without killing the trees. I will then take a look at the items made from the cedar and the process in which they are created. Finally I will find out if this art form as well as the ceremonial process are still being practiced today.

### ***AM-36: A GIS-Based Feasibility Study of Using Geothermal Energy as an Alternative Bridge Deicing Method***

**Grant McNamara, Civil Engineering; Ethan Turner, Civil Engineering**

Mentor(s): Mohammad Khosravi, Civil Engineering; Kathryn Plymesser, Civil Engineering

The buildup of ice on bridge decks during the Montana winters causes significant safety concerns for drivers. GIS will be used to determine the feasibility of using geothermal energy to deice bridges. Ground source heat pumps (GSHP) harness geothermal energy by circulating thermally conductive fluid through the bridge deck in a closed loop. As the fluid circulates, it is heated by the geothermal energy in the ground before flowing through the system and warming the bridge deck. As heat is transferred to the bridge deck, the fluid temperature drops and is cycled underground to reheat. This feasibility analysis will be conducted using ArcGIS Pro to analyze the energy, environmental, and economic cost of the proposed geothermal system at the bridges. The energy analysis will focus on determining the effectiveness of using geothermal energy as a heating source at each site and the likelihood of requiring additional heat sources for bridge deicing. We will quantify the energy balance of the system considering snow accumulation and melting, solar radiation, ambient temperatures, soil properties, and bridge properties. The environmental analysis will examine the energy cost of the GSHP and resulting greenhouse gas emissions. Economic impacts will consider the increased safety of winter driving and the costs of implementing and running the geothermal systems. GIS is a powerful tool for handling large data sets, analyzing energy behavior, climatic, and geographic variability over large areas. Results from this project will produce raster datasets and maps presenting the feasibility of using the GSHP's for bridge deicing.

*Acknowledgments: USP - Undergraduate Scholars Program*

**PM-36: Correcting Beam Refraction****Sage McNulty, Physics**

Mentor(s): Brian D'Urso, Physics

Whenever image readings are taken from a vacuum trap, researchers must consider the refraction of the beams used for image projection. Beam refraction is a phenomenon we all observed as children when rays of light entered a pool of water and bent as it passed through the surface. This light refraction also occurs at varying degrees from the exciting glass median of most vacuum traps, which will warp any data taken. This research illustrates one solution using correction lenses to combat this issue. These lenses being designed to bend the light back into place for the detectors. While the goal of this project was simple, accomplishing it proved anything but trivial.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

**PM-59: Evaluation of Grassland Restoration and Pollinator Conservation on Tribal Lands Degraded by Invasive Annual Grasses****Ian McRyheew, Land Resources and Environmental Sciences; Virgil Dupuis<sup>1</sup>, Laura Burkle<sup>2</sup>, and Jane Mangold<sup>3</sup>,**Tim Seipel<sup>3</sup> – <sup>1</sup>Extension and Outreach Department, Salish Kootenai College; <sup>2</sup>Department of Ecology;<sup>3</sup>Land Resources and Environmental Sciences

Invasive annual grasses threaten the remaining Palouse prairie grasslands in northwest Montana. Our project focuses on controlling the annual grass complex and increasing the stability of historic ecosystem services. Tactics will focus on preserving culturally important species for the local Salish, Kootenai, and Qlipse Tribes, creating habitat for pollinators, and establishing desirable forage for local pollinators. We will test a combination of herbicides, seeding, and plug planting methods, with six replications at two sites on the Flathead Reservation north of Arlee, Montana. Expected results include control of the invasive grass complex, increases in native plant community diversity, and a subsequent increase in pollinator presence and insect species richness.

*Acknowledgments: USDA – NIFA, Sloan Foundation*

**AM-19: Studying convergent extension in animal cap explants induced to become dorsal mesoderm and neural ectoderm****Caden Messer, Microbiology & Cell Biology**

Mentor(s): Christa Merzdorf, Microbiology &amp; Cell Biology

This project aims to establish a reliable method for studying convergent extension in *Xenopus laevis* animal cap explants induced to become dorsal mesoderm and neural ectoderm. Traditionally, convergent extension is studied through Keller explantation; but with inherently rigorous time requirements, Keller explantation is not amenable to high-throughput research. The animal cap procedure begins with isolation of naïve tissue from above the developing blastocoel. For induction of dorsal mesoderm, the explanted caps are cultured in a solution containing Activin A protein. For induction of neural ectoderm, embryos are injected with mRNA transcripts of the neuralizing protein *Xenopus* brain factor 2 (Xbf-2) early in development. The following day, animal caps can be visually assessed for convergent extension. Use of Activin A protein and injection of Xbf-2 mRNA has proven to be a reliable method for producing extension in isolated animal caps. Interference of Aquaporin3b (Aqp3b) has also been explored to determine the ability of the animal cap system to recapitulate findings in Keller explants. Aqp3b expression can easily be attenuated by the addition of morpholino oligonucleotides (MO) during the microinjection of Xbf-2. Preliminary results demonstrate the ability of Aqp3b MO to interfere with the convergent extension of induced animal cap explants, consistent with its role in whole embryos. The

establishment of the animal cap procedure will allow for the study of the molecular mechanisms by which Aqp3b acts in convergent extension in dorsal mesoderm and neural ectoderm that is not possible in whole embryos due to the influence of other inductive mechanisms.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-50: Community Health Fairs as Health Promotion for the Latino Community**

**Madeline Metcalf, Agricultural Economics & Economics**

Mentor(s): Sally Moyce

**Purpose:** The purpose of this research is to describe a community engaged project designed to provide basic health screenings and preventive services to the Latino community in a rural area.

**Methods:** In June and October 2021, we conducted community health fairs to offer basic health screenings including body mass index (BMI), blood pressure, pulse, and hemoglobin A1c measurements. Screenings were delivered by nursing and medicine students with the assistance of other students serving as interpreters. Interpreters administered a health history survey to assess risk factors. A non-profit dental provider offered dental cleanings, sealants, and x-rays. Community organizations were invited to present resources at tables. All results were shared with participants. Abnormal results were referred to a public health nurse or a physician for consultation. Referrals for follow-up care were provided and were coordinated by a bilingual nursing student.

**Results:** We conducted a total of 98 medical screenings and provided dental services to 70 participants in the two health fairs. We found that 85% of participants lacked health insurance and that 83% lacked a usual source of care. We found diabetes in 10%, pre-diabetes in 35%; hypertension in 45%, pre-hypertension in 35%; overweight in 41% and obesity in 37% of the sample. When asked to rate their ability to speak English, 71% responded “poor”. We made 12 referrals for follow up care for dentistry.

The poor health outcomes of participants at the health fair indicate a need for regular medical care for many Latinos in our community.

*Acknowledgments: USP - Undergraduate Scholars Program*

*INBRE - IDeA Network for Biomedical Research Excellence*

### **AM-21: A simplified laboratory model of a Martian saline seep**

**Madelyn Mettler, Center for Biofilm Engineering (Graduate Student);** Hannah Goemann, Microbiology and Cell Biology

Mentor(s): Brent Peyton, Chemical & Biological Engineering

The search for life on Mars has been a major goal of space agencies for decades. Since the existence of water has been confirmed on the Red Planet, the search for life has intensified. On Earth, water equals life, so this idea has extended to the remainder of the solar system. However, much of the water on Mars exists in the form of ice, with liquid water likely only temporarily present due to the cold temperatures of the planet. The temporarily available liquid water will be highly saline as saline water has a lower freezing point than pure water. Though the temperatures on Mars are largely low, the temperature can reach up to 25C on a summer sol. This project sought to determine the ability for halophiles (salt-loving microorganisms) to survive in a simplified laboratory model of a Martian saline seep. The saline seep was modeled in a drip flow biofilm reactor packed with 2 mm sand. The reactors were kept at room temperature (about 21C), under carbon dioxide, and fed saline media (1M NaCl or 1M MgSO<sub>4</sub>). The experiments were left to run for 5-8 weeks with weekly sampling for biofilm (slimy aggregates of microorganisms). Biofilm was quantified by viable cell counts on agar and direct counts via epifluorescent microscopy. Biofilms readily grew in the saline media with high and low carbon content.

Future experiments should employ additional Martian conditions, namely, cold temperatures provided by a traditional refrigerator or freezer.

*Acknowledgments: MSGC - Montana Space Grant Consortium*

### **PM-23: Biofilm Growth on NASA-relevant Materials based on Substrate Conditions**

**Madeleine Miller, Mechanical & Industrial Engineering**

Mentor(s): Stephan Warnat, Mechanical & Industrial Engineering

Abstract

Biofilms are a growing problem in the industry as technology progresses and can be critical to the lifetime of a system. There is a great demand for biofilm reduction in many fields. This project focuses on material conditioning for reliable biofilm growth experiments focusing on NASA-relevant materials and microbial environments. A difference is expected in biofilm growth based on material and variation based on substrate conditions of the material. Six materials were utilized (316L Stainless steel, Inconel 718, Teflon, multi-purpose aluminum 6061, aluminum, and multi-purpose copper). The circular material coupons were prepared by polishing six samples of each material and measuring the surface roughness with a white light interferometer. The coupons were placed in a microbial media (TSB with 10<sup>3</sup> - 10<sup>5</sup> CFUs/ml *Escherichia coli*) and stressed with an orbital shaker for 24 hours. Biofilm growth on the coupons were confirmed through standardized plate count protocols and related to the surface roughness.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-45: The Impacts of Familial Dysautonomia on the Neuroimmune System of the Gut**

**Alessandra Miller, Microbiology & Cell Biology; Heather Walk, Microbiology and Cell Biology**

Mentor(s): Frances Lefcort, Microbiology & Cell Biology

Familial Dysautonomia (FD) is a neurodegenerative disease that arises due to a mutation in the ELP-1 gene. The production of dysfunctional ELP-1 protein results in poor neuron development and survival from birth. This project proposes an investigation into the impacts of ELP-1 gene deletion on the neuroimmune system of the gastrointestinal (GI) tract. Examining the impacts of a damaged nervous system on the complex system as a whole within the gut will allow for the system to be better understood. Furthermore, the investigation into the gut of mice modeling FD may yield explanations of symptoms of FD, specifically GI problems such as diarrhea and reduced gut motility. It is hypothesized that ELP-1 deletion in FD mice models results in a reduction of anti-inflammatory feedback as a difference in immune system coordination. This will be indicated by a change in resting immune cell population and polarization in the gut as well as a change in the immune response of FD mutant mice challenged with a *Citrobacter rodentium* infection.

*Acknowledgments: INBRE - IDeA Network for Biomedical Research Excellence*

*USP - Undergraduate Scholars Program*

### **AM-47: Designing a Graph Database for Alaska School Districts Expenditures**

**Sarah Montalbano, Computer Science; Byron Norman<sup>1</sup>; Brian Jore<sup>1</sup> – <sup>1</sup>Computer Science**

Mentor(s): Clemente Izurieta, Computer Science

Student outcomes in Alaska's schools are habitually dismal, and pandemic disruptions to education have worsened outcomes. Paradoxically, Alaska spends more per pupil than all but six states. Our stakeholder, Alaska Policy Forum (APF), desires a transparent website to examine how Alaska's educational dollars are spent and reveal opportunities to shift expenditures directly to instruction. APF has collected complete expenditure data from 17 school districts and partial data from 13 school districts for 2019 and 2020. We built a prototype of a database and a website for parents, legislators, and the public to access school

district transactions. The database contains expenditure data of 15 school districts and establishes relationships between transaction characteristics to facilitate data analysis by district, fiscal year, and accounting codes. The website contains visualizations of crucial statistics for a particular school district and fiscal year as well as a searchable, filterable, and sortable table of transactions. Our website also contains an administrator section to facilitate data formatting and cleaning. Because this research is unprecedented for Alaska, our database can accommodate the remaining 38 districts and future years to offer a scalable and cost-effective website that may help drive educational reform in a state which desperately needs it.

### ***AM-52: Topo Health: AI Lung Cancer Diagnosis***

**Joaquin Monterrosa, Computer Science; Ben Holmgren<sup>1</sup>; Nic Dzomba<sup>1</sup> – <sup>1</sup>Computer Science**

**Mentor(s): Clem Izurieta, Computer Science**

Lung cancer is the leading cause of cancer-related death in the world. According to the American Cancer Society, the odds of developing lung cancer in one's lifetime is about one in fifteen for men and one in seventeen for women. About 75% of patients have stage three or four cancer at the time of diagnosis, which is unfortunate because early detection can increase chances of five-year survival by two to ten times.

Two significant factors that contribute to the late diagnosis of lung cancer are the cost of screening and the imperfection of radiologists. Topo Health can mitigate these contributing factors. Topo Health is a web-based application that allows clinicians to upload a patient's CT scan and, after running it through our state-of-the-art artificial intelligence model, receive an immediate diagnosis specifying whether or not the patient has lung cancer. The key technology behind Topo Health is the artificial intelligence model used to analyze lung cancer scans. The model uses a combination between cutting-edge topological data analysis (essentially shape analysis) and conventional machine learning.

Ultimately, Topo Health can reduce the cost of screening by replacing or expediting the work of a radiologist and it can improve the reliability of early diagnosis by reducing the current detection error rate of 28%.

### ***PM-42: The influence of sex, age, and dietary fat content on bone remodeling in mice***

**Maya Moody, Chemistry & Biochemistry; Kenna Brown<sup>1</sup>; Ghazal Vahidi<sup>1</sup>; Kat Paton<sup>2</sup> - Mechanical and Industrial Engineering**

**Mentor(s): Chelsea Heveran, Mechanical & Industrial Engineering; Stephen Martin, Mechanical and Industrial Engineering**

High Fat Diet (HFD) and aging impair bone fracture resistance and bone microarchitecture. Bone microarchitecture, material strength, and toughness are maintained through the balanced deposition and resorption of bone. The osteocyte, the most prevalent bone cell, is responsible for orchestrating bone remodeling by osteoclasts/osteoblasts and direct remodeling of the lacunar canalicular system (LCS). Given the impact of LCS remodeling on bone fracture toughness, it is important to understand how LCS remodeling changes with aging and HFD. The purpose of the Aging and Diet (AD) study at Montana State University is to explore the interaction of aging and HFD on bone health using male and female mouse models. AD tibiae were histologically stained with H&E (Hematoxylin and Eosin), TRAP (Tartrate resistant acid phosphatase) or TUNEL (terminal deoxynucleotidyl transferase dUTP nick end labeling). H&E staining was used to determine number density of adipocytes and adipocyte area. Osteoclast number density was determined via TRAP staining. Osteocyte viability and number density was assessed using TUNEL. From H&E staining, young males had a greater adipocyte area and number density than old males. HFD also increased adipocyte area for males.

*Acknowledgments: INBRE - IDeA Network for Biomedical Research Excellence*

*USP - Undergraduate Scholars Program*

### **AM-77: Petrographic, Geochemical, and Age Dating of Unknown Dacite Units in the Greater Yellowstone Region**

**Kylie Moore, Earth Sciences**

Mentor(s): Madison Myers, Earth Sciences; Natali Kragh, Earth Sciences

We use geochemical, petrologic, and geochronological methods to understand dacite units in the Greater Yellowstone Region. Little is known about these dacites, and published research has varying results and interpretations of the rocks. For instance, Love et al. (1976) dated samples from Bunsen Peak to the Tertiary, which contradict Cretaceous ages produced by Tysdal et al. (1986). If the younger ages from Love et al. are correct, the dacites are from the Absaroka Volcanics (53 to 43 Mya; Smedes and Probstka, 1972). However, if the older ages from Tysdal et al. are correct, a new geological interpretation would be required, as the Absaroka Volcanics are currently the oldest magma-derived rocks in the area. There is also contrast in the naming of these units, as dacite is commonly described with extrusive features, but these dacites are considered intrusive. Thus, the motivation of this project is to rename, texturally define, and stratigraphically place these dacites. Twelve samples from across the Greater Yellowstone Region were collected and made into thin sections for petrographic analysis, then analyzed for whole rock geochemistry via X-Ray fluorescence. Three of the samples were chosen for zircon age-dating, where U-Pb age dates will be determined using a Nu multi-collector ICPMS in March 2022. Age dating will confirm if the rocks are from the Absaroka Volcanics, or if a new volcanic history needs to be established. Preliminary results from thin sections show textural differences between samples, suggesting different rates of magma ascent rather than different magma sources.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-11: The Effect of the COVID-19 Pandemic on College Varsity Athlete and Non-Athlete Anxiety and Depression**

**Olivia Moran, Psychology**

Mentor(s): Aaron Grusonik, Psychology

Current research indicates the rates of anxiety and depression have undoubtedly increased as a result of the COVID-19 pandemic. Previous research also indicates high levels of anxiety and depression among college varsity athletes who are faced with retirement. There is speculation that the rates of anxiety and depression may be higher right now, in the midst of return to play and school, than during the 2020 shutdown. In this case, the outbreak of the COVID-19 pandemic is considering an unexpected, forced retirement. This research is intended explore the rates of anxiety and depression among college varsity athletes as well as non-athlete students as a result of the initial lockdowns and return to normal. Two separate surveys utilizing the Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), and Athletic Identity Measurement Scale (AIMS), as well as two surveys utilizing just the BDI and BAI will be used to compare rates of anxiety and depression during the 2020 shutdowns as well as the return to school and play to determine if these rates are similar or dissimilar to rates of mental illness that occur during athlete retirement when a pandemic is not ongoing.

*Acknowledgments: USP - Undergraduate Scholars Program*

**AM-48: Krieg! - The Video Game****Mark Mousel, Computer Science;** John Hartman<sup>1</sup>; Marcus Twichel<sup>1</sup> – <sup>1</sup>Computer Science

Mentor(s): Clemente Izurieta, Computer Science

In the domain of tactical strategy video games, there are few examples that focus their design on multiplayer experiences. To address this gap, we built a two-player turn-based tactical strategy game using multiplayer as a core design pillar. In this game, titled Krieg!, each player will control its own small armies to compete with another player to complete objectives. Armies are made up of units with their own unique skills and combat styles, such as melee combat, archery, or magic. It is up to the player to assemble the best possible army to complete the task at hand. The game features a pixel-art style and is loosely themed with medieval European combat and light fantasy elements.

To build this game, the team used the Unity game engine for creating the maps, characters, and user interface that the players directly interact with. Firebase, a subset of the Google Cloud Platform, is also used in order to facilitate multiplayer functionality and authentication.

**AM-20: Breaking Voltage-Sensing Phosphatase Dimers****Gwendolyn Mueller, Microbiology & Cell Biology;** Heini Miettinen-Granger

Mentor(s): Susy Kohout, Microbiology &amp; Cell Biology

The voltage sensing phosphatase (VSP) is an enzyme which performs catalytic activity in response to changes in membrane potential. It is the only known enzyme to have a direct link between voltage and catalytic activity. VSP is conserved in many organisms, including humans. VSP has the ability to change intracellular phosphatidylinositol phosphate (PIP) concentrations, which have a wide array of physiological effects such as cell growth and synaptic regulation. The Kohout lab found that VSP dimerizes in a concentration dependent manner. However, the functional relevance of VSP dimerization is still unknown. In order to explore this, VSP was altered using mutagenesis. The sites of mutation were determined using the crystalline structure of the voltage sensing domain of VSP to determine likely amino acid interactions between the VSP subunits. Then the mutated VSPs are tested using coimmunoprecipitation (coIP) and Western blots to determine if the alteration has broken the protein interaction, resulting in two VSP monomers, or if the interaction is intact and VSP remains in dimer form. This is accomplished through the use of two different epitope tags on either VSP subunit, allowing for the selection and identification of either subunit. The dimers and monomers can be used in subsequent experiments to further explore the functional difference between VSP monomers and dimers.

*Acknowledgments: USP - Undergraduate Scholars Program*

**AM-68: Native Miniatures: Appropriation in the Art of Miniatures****Kaitlin Murdy, Art (Graduate Student)**

Mentor(s): Jennifer Woodcock-Medicine Horse,

Within the niche space of miniatures, hobbyists and artists do not present at the forefront of one's mind in the question of diversity, representation and appropriation. Yet this is exactly the reason why we should be asking the questions. How much diversity is represented in miniaturized objects, spaces and figures? How many artists and contributors are Native? How many non-Native artists are appropriative in their creation and display of miniatures? These questions will be explored using small artist case studies and observable evidence provided by artists, objects and settings in the miniature artismal sphere. This exploration will emphasize the need to analyze one's own space for signs of appropriation. With this recognition, spaces like miniatures can provide invitation for representation, appreciation, and diversity of participants.

*Acknowledgments: Other funding or support; Montana State University*

**AM-35: Assessing the use of a multifunctional bio-mineralized composite to treat contaminated stormwater runoff.**

**Abigail Murray, Civil Engineering**

Mentor(s): Adrienne Phillips, Civil Engineering; Catherine Kirkland, Civil Engineering

Contamination of natural water sources has become one of the major environmental crises of this generation. One of the most problematic causes of this contamination is stormwater runoff, as rainfall events consistently wash organic and inorganic pollutants into downstream watersheds. A significant amount of this runoff reaches downstream watersheds completely untreated, which can result in large-scale environmental disasters such as algal blooms and the collapse of marine habitats, as well as pose a threat to public health. At present, any stormwater that is treated prior to discharge is typically exposed to one of two mechanisms: either it is treated physically as it flows through natural sediment filters, or it is treated biologically and exposed to microorganisms that can metabolize organic and inorganic aquatic contaminants. This project aimed to test the hypothesis that a novel multi-functional material could be developed that combined these two individual mechanisms into one treatment system. The objective was to assess whether a denitrifying biofilm grown on a bio-cemented sand scaffold could effectively reduce organic load concentrations in contaminated stormwater.

The major outcomes of the project analyze the ability to grow a *Bacillus mojavensis* (*B. mojavensis*) biofilm through a scaffold of sand aggregate bio-cemented by *Sporosarcina pasteurii* (*S. pasteurii*) calcium carbonate precipitation, as well as test the effect of the resulting composite on the Chemical Oxygen Demand (COD) of organically contaminated water.

*Acknowledgments: USP - Undergraduate Scholars Program*

**PM-74: Afternoon Napping Does Not Impact Autonomic Function in Healthy Adults**

**Jennifer Nicevski, Health & Human Development (Graduate Student);** Gianna Migliaccio<sup>1</sup>; Emma Kerkerling<sup>1</sup>

<sup>1</sup>Microbiology and Cell Biology

Mentor(s): Jason Carter, Health & Human Development

**Introduction:** Sleep is important for autonomic nervous system (ANS) function. However, the effects of daytime napping on wake autonomic regulation remain unknown. We assessed autonomic function following a daytime nap in healthy young adults, with the hypothesis that a 90-minute afternoon nap would significantly improve wake heart rate variability (HRV) and mean arterial pressure (MAP).

**Methods:** Fourteen participants (7 female, 24±1 years, 24 ±1 kg/m<sup>2</sup>) were provided either no nap (control condition) or a 90-minute nap opportunity (nap condition) on separate days using a randomized, crossover design. Participants were then fitted with three-lead electrocardiography (ECG), continuous beat-to-beat blood pressure (Finapres NOVA, Netherlands), and respiration (pneumobelt) upon awakening. The autonomic function test consisted of 5-minutes of spontaneous breathing, 5-minutes of controlled breathing (15 breaths/min), and a 2-minute cold pressor test (CPT). Frequency-domain HRV in the low (LF, 0.04-0.15 Hz) and high frequency (HF, 0.15-0.4 Hz) components were determined. Time-domain HRV was quantified using RMSSD and pNN50. Paired sample t-tests were completed between the control and nap sessions.

**Results:** An afternoon nap did not change wake heart rate (HR, Control: 70±3 vs. Nap: 68±3 bpm, p = .31) or mean arterial pressure (MAP, Control: 77±3 vs. Nap: 83±3 mmHg, p = 0.70). Similarly, no differences were observed in HRV measures (p > 0.05). Lastly, changes in HR and MAP during CPT were not different between conditions (p > 0.05).

Conclusion: Afternoon napping does not appear to significantly influence autonomic function at rest or during CPT in young healthy adults.

**AM-10: Tensile Properties of Stretch Broken Carbon Fiber Prepreg**

**Dalton Nold, Mechanical & Industrial Engineering (Graduate Student)**

Mentor(s): Dilpreet Bajwa, Mechanical & Industrial Engineering

Continuous carbon fiber is known to be a superior material for its strength, stiffness, and high strength-to-weight ratio, all these properties rival that of titanium. A major drawback with continuous carbon fiber is that it is not versatile in forming deep drawn geometries, which can require a lot more convoluted manufacturing techniques resulting in expensive components. To overcome this issue, a type of carbon fiber with a random discontinuous fiber alignment called stretch broken carbon fiber (SBCF) is proposed. SBCF has potential to form parts with complex geometries with comparable or better mechanical properties (strengths and stiffness) to that of continuous carbon fiber. Montana State University has been able to manufacture their own version of SBCF, and the research is being conducted to understand how carbon fiber prepreg tow reacts to tensile forming loads at high and low temperatures using Solvay CYCOM® 977-3 and Hexcel HexPly® 8552 epoxy resin systems. True stress and strain curves have been produced at the resin's respective de-bulking temperatures, which showed strain softening behavior. This can be explained considering as the resin heats up, it acts as a lubricant with respect to the load being applied and helping fibers to slide. Future work is investigating whether a quasi-isotropic sample layup will produce the same strain softening behavior or a different mode.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

**AM-24: A novel Experimental unit to evaluate inter-ply and tool-ply friction in carbon fibre reinforced polymer composites prepregs**

**Tasnia Javin Nur, Chemistry & Biochemistry (Graduate Student); Zachary White, Mechanical Engineering**

Mentor(s): Roberta Amendola, Mechanical & Industrial Engineering; Douglas Cairns, Mechanical & Industrial Engineering

There exist many challenges in the design and manufacture of complex geometries using carbon fibre reinforced composite prepregs. Frictional phenomena occur between the tool and the heated laminate and between subsequent prepreg plies within a laminate during the forming stage of composite parts. The constraints imposed by friction during forming operations may generate major defects, which then transfer into the final component. As a result, characterization of tool/ply and ply/ply friction during composite forming is relevant to achieve process optimization along with high manufacturing quality of complex shapes. Since there is no ASTM standardized procedure available for frictional measurement of composites, frictional characterizations are based on different custom-built fixtures. A dedicated experimental unit has been designed and constructed at Montana State University for inter-ply and tool-ply frictional characterization of continuous and stretch broken carbon fibre (SBCF) composite prepregs. The unit uses a pull-through test approach, is designed to be fitted in a universal testing machine. The proposed novel testing unit allows for the evaluation of frictional forces by simulating forming process parameters as temperature, forming rate, normal pressure and ply orientation. Preliminary friction trials are currently being performed using continuous prepreg materials to validate the fixture.

*Acknowledgments: US department of the army*

***AM-71: The Sioux Chef breathes life into a lost tradition*****Jacob Ogurek, Gallatin College**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

The Sioux Chef was co-founded by Native Sean Sherman and works to give access to traditional native foods. Throughout forced assimilation, boarding schools and reservations many cultural traditions have been taken away from Native Americans, including food. Sean Sherman has made it his life's passion to not only cook accessible traditional foods, but also teach generations to follow. Throughout this research project I will share the knowledge Sean has given as well as dive into past traditions, how they were lost and why they have stayed forgotten or unused. Videos, articles, and lectures will be my main source of information.

***PM-46: Investigating What Mutations Break the Voltage-Sensing Phosphatase Dimer*****Taylor Olsen, Microbiology & Cell Biology**

Mentor(s): Susy Kohout, Microbiology &amp; Cell Biology

Voltage-gated proteins are key elements to cellular communication and membrane excitability in neurons and muscle cells. The unique enzyme voltage-sensing phosphatase (VSP), which is similar to most voltage-gated proteins but contains a phosphatase domain, performs catalytic activity by dephosphorylation in response to membrane depolarization by changing intracellular phosphatidylinositol phosphate (PIP) concentrations (Murata et al., 2005) which regulate cellular processes such as endocytosis and actin assembly (Schrapf, 2012). Multimerization is a key characteristic of many voltage-sensing proteins and is also critical for VSP where dimerization is favored at higher concentrations (Rayaprolu, 2018). The functional relevance of VSP dimerization is still unknown, so mutagenic experiments have been performed to generate a VSP monomer to investigate these effects. Co-immunoprecipitation (co-IP) experiments are currently testing which mutations break the dimer. To provide additional evidence of which mutations break the dimer, the properties of fluorescent proteins (FPs) can be split where each half protein is not fluorescent until complemented by the other half (Romei, 2019). When VSP dimerizes, the FP halves fit together like a puzzle piece and fluoresce which allows direct visualization of either dimerization or monomerization. These results show which mutations break the VSP dimer by the loss of that fluorescence. The GFP results will complement the co-IP experiments and confirm our ability to monomerize VSP, which will help explore the functional difference between VSP monomers and dimers.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-63: Contemporary Dye Selection in Navajo Weavings*****Elle Olsztyn, Art**

Mentor(s): Jennifer Woodcock-MedicineHorse, Art

Woven into evolution of Navajo textile work are strong threads of belief, lifestyle, and response to dynamic change. Both their historical and contemporary weavings are working documents of a living culture impacted by subjugation and western expansion. The interaction between colorways and design composition communicates dramatic cultural changes in the Navajo weaving tradition regarding material availability. Beginning in the late 1860s, the synthetic dye aniline, was introduced to Navajo weavers. Celebrated for its unprecedented intensity and brilliance, the invention of aniline inundated the western textile industry and influenced the bright colorways for which Navajo rugs are commercially reputable. Aniline dyed yarns became integrated in woven work alongside vegetal dyed yarns, expressing the expansive reach of production for the world's first large scale synthetic dye manufacture. Aniline integration was not restricted to commerce of spun and dyed yarns, and with prepackaged aniline dyes, Navajo weavers began dyeing their own handspun wools. While synthetic aniline dye provided vibrant

color, its palette was limited, and its waste is harmful on both environment and health. Apart from a strong market for naturally dyed woven works beginning in the 1920s, weavers began revisiting and expanding vegetal dye usage, implementing a wide range of natural dyes and color variations. As access to natural and artificial dyes encouraged contemporary Navajo weavers to find their own voices, imaginative creativity bends traditional weaving practices. With an abundant diversity in material availability, the driving forces in material selection must be explored to better understand contemporary weavers' relationship to their craft.

### **AM-26: Solving the 3D Structure of the First Known Methanogenic Aminotransferase Enzymes**

**Alexi Panos, Chemical & Biological Engineering**

Mentor(s): Martin Lawrence, Chemistry & Biochemistry

The recent discovery of methane-producing aerobic bacteria in oxygenated waters paved the way for inquiry into a novel mechanism for methane production. Since methane synthesis has historically coincided with archaeal metabolism in oxygen-free environments, the bacterial protein responsible is of particular interest. A pyridoxal 5'-phosphate aminotransferase gene was identified as critical to the methane synthesis pathway in the bacteria. Methane production continues to be a hot topic among scientists as methane is potent greenhouse gas as well as a common fuel source. To better understand the methane metabolic pathway for the enzyme responsible, a greater structural understanding is required. This research project is aimed at expressing, purifying, and crystallizing a "methanogenic" aminotransferase (MAT) protein to obtain 3-dimensional atomic structures of the MAT in complex with substrates and products using x-ray crystallography. These structural studies are expected to provide significant mechanistic insight into how these enzymes allow bacteria to produce methane. To date, one MAT from the species *Brevundimonas subvibriodes* has successfully been purified, identified as a dimer, and crystallized using a commercial crystal screen. The commercial crystal screen's conditions will need to be refined to produce larger crystals suitable for x-ray diffraction. Additionally, after testing 20 amino acids with the MAT protein using Differential Scanning Fluorimetry, new substrate combinations for crystallization trials have been identified and are currently being tested. Once larger MAT protein crystals have been grown and properly diffracted, structural determination via molecular replacement can begin.

*Acknowledgments: USP - Undergraduate Scholars Program*

*INBRE - IDeA Network for Biomedical Research Excellence*

### **AM-22: Aerobic Methane Synthesis by a Bacterial Aminotransferase**

**Jordan Pauley, Chemistry & Biochemistry; James Larson<sup>1</sup>; Grace Ludlow<sup>1</sup>; Kristen Gregg<sup>1</sup>; Brooklyn Brekke<sup>1</sup>**

<sup>1</sup>Chemistry and Biochemistry

Mentor(s): Brian Bothner, Chemistry & Biochemistry; Martin Lawrence, Chemistry & Biochemistry

Aerobic methane synthesis is a novel issue under investigation, a process previously believed to be limited to anaerobic methanogens. The McDermott and Bothner labs have isolated a strain *Acidovorax*, a bacteria, which is capable of aerobic methane production. Transposon mutagenesis revealed that a 5' pyridoxal phosphate-dependent aspartate aminotransferase (PLP-AAT) was solely responsible for growth on methylamine and production of methane. This novel enzyme has been termed a methanogenic aminotransferase (MAT). Based on the canonical mechanism of aminotransferases, it is expected that methylamine is first converted to formaldehyde in this process. This is the primary hypothesis that I am currently testing.

The *Acidovorax* MAT proves challenging to express in *E. coli*, resisting purification and displaying minimal solubility. The Bothner Lab has recently obtained a modified *Acidovorax* MAT attached to a

maltose-binding protein (MBP). Through repeated purifications, this fusion enhances both the purity and solubility of this enzyme. I have demonstrated this enzyme retains AAT activity with the MBP fusion and am now testing to determine if this form of the enzyme still binds methylamine and converts methylamine to formaldehyde. Continually, there are several other orthologs capable of methane production. However, the preferred substrate of these orthologs is unknown. I have utilized differential scanning fluorimetry to screen for substrate binding of a series of novel MAT enzymes and measured the thermal stability to characterize their physical and enzymatic properties. A series of experiments have been performed to detect the presence of formaldehyde during in-vitro reactions using ultraviolet-visible spectroscopy and liquid chromatography-mass spectrometry.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-64: Sustainability in Pacific Northwest Indigenous Art**

**Derek Perry, Art**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Indigenous Artists in the Pacific Northwest have long been renowned for their long standing signature art traditions. However, like many indigenous art forms, these traditions are too often contextualized in the past, and judged on their likeness to historical forms through a western lens. Equally, Eurocentric categories of craft and fine art limit the potential of what indigenous artists are achieving through new work and new media. Many contemporary indigenous artists demonstrate the utility of art to aiding in real world problems related to climate change and sustainability. Indigenous cultural perspectives on appreciation for nature, and arts role in society inform the work of many of these great artists. I'm interested in exploring how Native Pacific Northwest artists address problems in sustainability through their work, and how their methods disrupt stereotypes commonly attributed to indigenous art practices. In the project I will be investigating the diverse methods and mediums these artists employ to conceptually communicate related themes. I'll also be examining indigenous perspectives on the significance of nature in the Pacific Northwest, and how they may be crucial when addressing issues in sustainability.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### **PM-03: Watershed Cumulative Risk Analysis: Yellowstone Watershed**

**Ingrid Peters, Liberal Studies Degree**

Mentor(s): Margaret Eggers, Microbiology & Cell Biology; Adam Sigler, Land Resources & Environmental Sciences

This project analyzes data on surface and groundwater quality by river basin (at the level of Hydrologic Unit Code [Huc 8] in Park County, MT). The goal is to assess the cumulative health risks posed by public water supplies using surface water sources or lifetime consumption of home well water. The project will be supervised by Professor Margaret Eggers at MSU, who has outlined data cleaning and cumulative risk calculation methods based on previous water quality research. Data is retrieved from the Montana Ground-Water Information Center (GWIC) database (<https://mbmaggwic.mtech.edu/>). The water quality data graphs show the cumulative risk of lifetime consumption risk for each watershed and the percent exceedence of each contaminant. The goal is to produce data relevant for citizens in Park County who depend on wells and streams for drinking water, and to give the health department information on community health risks in the Yellowstone watershed. -This flyer will be uploaded to MSU's Well Educated Program website as an educational resource. Water quality flyers will be provided to the Park County Health Department, with an invitation to meet and explain our methods and results. The data is for the Yellowstone Headwaters, Upper Yellowstone, and Shields HUC8 river basins in the Upper Yellowstone watershed of Park County, MT. The data will be submitted to Well Educated at MSU and the Park County Health Department at the end of the internship.

*Acknowledgments: USP - Undergraduate Scholars Program  
INBRE - IDeA Network for Biomedical Research Excellence*

### **AM-29: Rheological Study of VitroGel**

**Sarah Peterson, Chemical & Biological Engineering**

Mentor(s): Jennifer Brown, Chemical & Biological Engineering

Organoids are 3D models of organs that can be studied. They are grown in a certain type of gel known as Matrigel. Matrigel has been used for the growth, but there's a shortage and has inconsistent growth of organoids. VitroGel is being looked at as an alternative to growing organoids. It has produced on a more consistent basis and forms at room temperature.

However, the material properties of VitroGel haven't been fully quantified. Rheology is the study of the flow and deformation of matter and is used to measure the material properties of complex fluid such as VitroGel. In this work, the storage modulus ( $G'$ ) and loss modulus ( $G''$ ) as well as the viscosity of different concentrations of VitroGel were measured.

The storage and loss moduli are the measure of crosslinkers' ability to retain original form and storing the added energy even with external movements. The viscosity is a measure of the frictional resistance to flow of a substance. These properties are needed to see if they will interfere or help the growth of organoids. The results of the quantified properties will later be used to determine which of these properties optimize organoid growth.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **AM-65: Impact of sedentary time and habitual glycemic load on glucose responses from a 12-week dietary lentil intervention**

**Emily Peterson, Health & Human Development (Graduate Student);** Stephanie Wilson<sup>1</sup>; Marcy Gaston<sup>1</sup>; Sarah Bronsky<sup>2</sup>; Wan-Yuan Kuo<sup>1</sup> – <sup>1</sup>Health & Human Development; <sup>2</sup>University Health Partners

Mentor(s): Mary Miles, Health & Human Development

Increased sedentary time is linked to decreased glycemic control whereas higher insoluble fiber intake is linked to improved glycemic control. **Purpose:** To examine the effects between sedentary time and habitual glycemic load from consumption of 12 weeks of lentils. **Methods:** Adults with increased WC (women >35", men >40") (n=17) aged 22-69 years consumed 0 (CON) or 140 g of lentils (LEN) daily as a mid-day meal for 12 weeks. A high-fat meal challenge (50 g FAT, 54 g CHO, 12 g PRO) was repeated before and after the diet, with blood collected at fasting and hourly for 5 hours after the meal. Blood glucose was obtained through lipid panels and summarized as iAUC. HGL was gained through an online recall diet history questionnaire. An accelerometer was worn for the first and last week of the intervention, with continuous sedentary behavior expressed as percent sedentary time (PST). A linear mixed effects model was used to assess the impact of the meal intervention and an interaction between HGL and PST on GLU iAUC, accounting for subject variability. **Results:** The joint influence of PST and HGL was an important predictor of GLU iAUC ( $p=0.03$ ), with participants who had greater PST and higher HGL in their diet having greater GLU iAUC. GLU iAUC did not change after 12 weeks of lentil consumption ( $p=0.14$ ); however, a main effect for time was observed ( $p < 0.001$ ). **Conclusion:** Greater PST leads to higher GLU iAUC in individuals with higher HGL diets suggesting higher levels of physical activity and reduced PST is important for improving glycemic responses. The combined effect of incorporating physical activity and fiber may be more important for GLU iAUC than increasing fiber consumption alone.

*Acknowledgments: USDA-ARS Pulse Crop Health Initiative 58-3060-9-040*

### ***PM-24: Geometry Based Fluid Rheology Comparison: Cone and Plate vs. Concentric Cylinder Geometry***

**Lauren Potyk, Chemical & Biological Engineering**

Mentor(s): Joseph Seymour, Chemical & Biological Engineering

Rheology is the study of the flow and deformation of matter. A rheometer measures the bulk response from a fluid upon application of a stress or strain, enabling characterization of the properties of different types of fluids. This is relevant in many industries including consumer products and pharmaceuticals. However, the measured bulk fluid response depends on the geometry utilized.

In this project, five samples including glycerol, a Newtonian fluid and four unique emulsion samples from Proctor & Gamble were characterized with hysteresis loop testing. This compares increasing and decreasing shear rate response. Identical procedures with both a cone and plate and concentric cylinder geometry were utilized. The objective of this project was to compare the flow curves of stress response versus applied shear rate for each fluid generated using the two geometries of interest.

Hysteresis loop flow curves on glycerol utilizing both geometries were linear, indicating Newtonian behavior with constant viscosity of 0.69 Pa.s. Utilizing the cone and plate, flow curves for emulsion samples 1-4 indicated varying extents of non-linear, and hence non-Newtonian, behavior with decreasing stress responses corresponding to incrementally applied shear rates. Additionally, flow curves for samples 1 and 3 displayed different behaviors when subjected to increasing and subsequently decreasing shear rates. These fluids have thixotropic or time-dependent characteristics. Materials displaying this type of behavior undergo micro-scale structural changes during testing and were found to have memory. These results were compared to the corresponding flow curves for each of the five samples produced using a concentric cylinder geometry.

*Acknowledgments: USP - Undergraduate Scholars Program*

### ***AM-05: Effect of sizing deposition and fiber length on the uncured handleability and formability of stretch broken carbon fiber***

**Riad Morshed Rezaul, Mechanical & Industrial Engineering (Graduate Student)**

Mentor(s): Cecily Ryan, Mechanical & Industrial Engineering; Douglas Cairns, Mechanical & Industrial Engineering

Carbon fiber reinforced polymer composites find extensive application, in the aerospace industry due to their outstanding strength and stiffness. When manufacturing components with complex geometries, discontinuous carbon fibers offer superior formability compared to continuous carbon fibers. Stretch broken carbon fiber (SBCF) is a type of discontinuous carbon fiber generated by stretch breaking the fibers at their natural flaws. The resulting fibers are shorter in length compared to the continuous fibers. Uncured SBCF tows can be challenging to handle due to lack of fiber continuity. As with continuous fiber tows, a thin polymeric coating known as sizing can be applied to the SBCF. In SBCF, this coating serves to increase handleability as measured via tensile strength. The amount of sizing deposition on the tows during the SBCF generation can be controlled by choosing a desired sizing bath concentration. The objective of our work is to evaluate how the different sizing bath concentrations change the amount of sizing deposition on the SBCF tows generated using our Proprietary Bobcat machine. A temperature-controlled tenacity test setup is used to determine the back-tension ability and formability of the SBCF as a function of sizing deposition on the tow. The effect of process variables during the creation of SBCF (stretch ratio, nip force, and line speed) on the fiber length distribution and mean fiber length is also being investigated. The results obtained from our laboratory generated SBCF will be compared to the Hexcel Legacy materials, a commercially available SBCF.

*Acknowledgments: Department of the Army*

**PM-51: Trend Analysis for Volunteer Water Monitoring Groups****Meghan Robinson, Land Resources & Environmental Sciences**

Mentor(s): Adam Sigler, Land Resources &amp; Environmental Sciences

Volunteer monitoring programs provide an important service in understanding water quality challenges in watersheds across Montana. Data collected through volunteer efforts are frequently under leveraged due to a lack of analytical expertise and insights about sample collection planning that may produce data best poised to answer monitoring groups' questions. Working with two fifteen-year datasets collected over 6–7-month sampling seasons, we identified different seasonal trends with implications for groups whose data collection is limited to summer season volunteer programs. We found that monitoring plans with data collection limited to summer months did not capture differing water quality trends observed by programs with longer monitoring windows. We also assessed differences in the statistical strength afforded by seasonality versus flow as covariates in understanding water quality trends and found that especially in streams with large flow fluctuations during spring runoff, the season-based analysis alone may not fully describe trends. We have also identified common issues faced by volunteer groups, such as unreliable pH data, and have proposed solutions to minimize data quality concerns. This work shows the wide range of applications of volunteer collected data and illustrates the importance of careful statistical analysis in understanding data trends.

*Acknowledgments: USP - Undergraduate Scholars Program*

**AM-17: Determining the cellular interaction required for fungal clearance by immune cells****Julia Roemer, Microbiology & Cell Biology**

Mentor(s): Kelly Shepardson, Microbiology &amp; Cell Biology; Agnieszka Rynda-Apple, Microbiology &amp; Cell Biology

It is estimated that 4 to 8 million people worldwide suffer from pulmonary infections caused by the human fungal pathogen *Aspergillus fumigatus* (Af). The recent rise in people acquiring Af infection after Influenza or SARS-Cov-2 infection suggests that anti-viral immune responses create a transiently suppressed immune environment, allowing Af to thrive. Our previous results indicate that anti-viral type I interferon (IFN) signaling, via the type I IFN receptor (IFNAR1/2), creates a pulmonary immune environment susceptible to secondary infections, specifically via regulation of damage by the individual IFNAR subunits. Indeed, our results found that absence of IFNAR2 (*Ifnar2*<sup>-/-</sup> mice) resulted in increased lung damage and morbidity during Af infection, but also increased clearance of Af, while absence of IFNAR1 (*Ifnar1*<sup>-/-</sup> mice) did not. However, when we looked at the capacity of the *Ifnar1*<sup>-/-</sup> or *Ifnar2*<sup>-/-</sup> immune cells to kill Af, we found that *ex vivo* killing of Af was not different, suggesting that signaling from lung epithelial cells may be required for IFNAR2-regulated damage and fungal clearance by immune cells. Our results found that direct interaction between lung epithelial cells and immune cells led to greater killing of Af. Specifically, *Ifnar2*<sup>-/-</sup> neutrophils tended to be more efficient at killing Af compared to WT neutrophils when indirectly cultured with WT lung epithelial cells. Future directions include *in vivo* experiments to observe the effects of dynamic conditions on Af killing. Importantly, understanding this IFNAR regulation of damage and pathogen clearance could have broader implications for treatments for both viral and fungal infections.

*Acknowledgments: INBRE - IDeA Network for Biomedical Research Excellence*

**AM-27: Using SPR to Test Cooperative Binding Constraints of Nucleic Acids****Jaelynn Roesler, Chemical & Biological Engineering; Esther Stopps, Chemical and Biological Engineering****Mentor(s): Stephanie McCalla, Chemical & Biological Engineering**

Hybridization between complementary DNA strands is an integral component of many molecular detection techniques. The thermodynamics of these interactions has been thoroughly studied and characterized, but the kinetics of complex DNA hybridization is less researched. The purpose of this project was to measure the kinetic rate constants of five different DNA binding pairs using surface plasmon resonance (SPR) and compare them with theoretical parameters to make predictions about structure design and responses. SPR is an optical biosensor technique that measures the binding of molecules in real time. Each binding pair consisted of a DNA template between 24-30 nucleotides long and the complementary 10-nucleotide DNA trigger. The DNA templates had various linear or looped configurations with either one or two binding sites for the trigger. The multi-site templates should exhibit cooperative kinetics, where the initial binding event changes the likelihood of the next binding event, producing a switch-like response upon hybridization. DNA templates were immobilized on the sensor via a streptavidin-biotin interaction. Each trigger was injected at five different concentrations in triplicate with a 2.5-minute association time and a 7.5-minute dissociation time. The sensor was regenerated between injections with 10mM glycine-HCl to remove bound trigger. The binding curves were analyzed using TraceDrawer™ software and fit with a one-to-one binding model to find the association rate constant,  $k_a$ , and the dissociation rate constant,  $k_d$ . However, this one-to-one binding model was not sufficient for the templates with two binding sites, therefore, we are currently developing a MATLAB® programs to fit cooperative models.

*Acknowledgments: USP - Undergraduate Scholars Program*

**PM-30: Phase Spectroscopy as an Alternative for Analyzation of the Black Hole GRS 1716-249****Gracyn Ross, Physics; Jaiverdhan Chauhan, Physics****Mentor(s): Anne Lohfink, Physics**

Accreting black holes display flux and spectral variations on all timescales. Most of this variability is somewhat random and related to changes in the accretion rate. Some sources however show quasi-periodic variability, the so-called quasi-periodic oscillations (QPOs). The cause of the QPO phenomenon is still uncertain but most theories hypothesize that the origin is related to changes in the accretion geometry. We present a phase-resolved spectral analysis of the accreting black hole GRS 1716-249 using observations from the NuSTAR telescope spanning several days. We observe QPOs with rapidly changing frequencies and thus the need to accurately differentiate between wavelength dependent accretion related changes and those causing the QPO phenomenon. Performing broadband spectral analysis of the QPO-phase-independent spectra, we observe no coherent changing behavior in the modeling parameter. Instead of this simple average spectral analysis, we then implement a strategy to more accurately analyze the spectral data of the black hole known as phase spectroscopy. This method allows for the separation of spectral observations into “on” and “off” phases. By viewing the data from this perspective, we gain a better understanding of the exhibited behavior related to the QPO and more accurately test possible driving forces behind the QPOs.

***PM-65: New Growth: Protecting and Sustaining Indigenous Cultural Rites*****Olivia Ross, Art**

Mentor(s): Jennifer Woodcock-Medicine Horse, Native American Studies

Issues surrounding the effects of climate change have become increasingly more pronounced in public discourse in recent years. Alongside this discussion arises questions regarding sustainable practices and a more conscientious treatment of natural resources. What is often neglected in this conversation however, is how the steady depletion of these resources and overbearing conservation efforts, both actively bar Indigenous communities from practicing their traditional cultural rites. In this project I will provide historical context to the Indigenous cultural practices currently being affected by climate change issues, explain how the ongoing solutions to these issues fail to consider Indigenous traditional practices, and explore a variety of solutions that act in the interest of the environment's resources and its people. Interviews with Indigenous community members, the research of Native ecologists, and Indigenous artworks will be the principal sources of information in this project.

***PM-70: Saving young lives by addressing native youth suicides and preventions*****Elise Russell, Gallatin College**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Montana has been in the top five states with the highest national suicide rates for the past forty years (Suicide prevention plan 2017 - Montana state legislature). Montana's suicide rates by Native American youth are higher than the non-Native youth in the state. I will show this by comparing suicide rates among different ethnicities of youth on a national and statewide scale. Next, I will address some of the factors of why native youth are more at risk, such as, historical trauma, poverty, exposure to violence, not having access to healthcare services and exposure to suicide. This study concludes with the many suicide prevention methods for Native youth created by members of Native American communities.

***PM-20: Plastic-Reinforced Cement Mortar: A Sustainable Solution for Reducing Global Carbon Emissions*****Kylee Rux, Civil Engineering**

Mentor(s): Chelsea Heveran, Mechanical &amp; Industrial Engineering

From rising sea levels to extreme weather and the loss of biodiversity, the effects of climate change have reached every corner of the Earth. Two major contributors to carbon emissions are the continuously increasing demand for cement infrastructure and single-use plastic. Headway can be made against both challenges by using recycled plastic as a filler in concrete. An additional challenge is that contaminated plastics cannot feasibly be recycled if coated in food or oily residues. The objective of our research was to understand how much clean and contaminated waste plastic can replace cement in concrete. Furthermore, we are investigating whether a biomineral coating on the plastic will enhance the overall strength. In order to examine our hypothesis, actual waste plastic was biomineralized using the established microbially induced calcium carbonate precipitation protocol. A portion of the plastic was also soaked in vegetable oil to represent contaminated plastic. At a 5% volume replacement for cement, the results reveal that biomineralization rescued the strength for oil-treated plastics by approximately 20%. Mortar cylinders were then prepared with clean plastic at a 5%, 10% and 20% replacement. Even at a 20% replacement, the compressive strength is above the required strength for applications such as sidewalks, driveways, and foundation walls. Whether the precipitated mineral or washing of the plastic through the biomineralization process is causing this increase in strength is still under investigation. This eco-friendly building material is one of many sustainable methods that could prevent the climate system from reaching its tipping point.

*Acknowledgments: USP - Undergraduate Scholars Program*

**PM-38: Crystallization of Methanogenic Aspartate Aminotransferase from *Burkholderiales* sp.****Celina Sanchez, Chemistry & Biochemistry**

Mentor(s): Martin Lawrence, Chemistry &amp; Biochemistry

The rise in global atmospheric methane, a potent greenhouse gas, has led to increased research into the sources of both anthropomorphic and natural methane emissions. These include biogenic methane sources, which are traditionally attributed to methanogenic Archaea under anaerobic conditions. However, aerobic methane production, deemed the “methane paradox”, is steadily increasing. This includes consumption of methylamine with concomitant production of methane by bacterial *Acidovorax* species in aerobic columns of Yellowstone Lake (Wang et al, PNAS). A PLP dependent aminotransferase gene was identified as a central player in *Acidovorax* methane biogenesis, and when expressed in *E. coli* grown with methylamine as the sole nitrogen source, methane production was again observed. The *Acidovorax* methanogenic aminotransferase (MAAT) has proven difficult to work with, but we have identified five additional orthologs from other bacterial species. In particular, an MAAT from *Burkholderiales* may prove to be more suitable for biochemical and structural studies. Expression, purification, and size exclusion chromatography were conducted to successfully purify the B-MAAT for initial crystallization screens. Additionally, multiple enzymatic assays have been conducted to measure the catalytic activity of B-MAAT, along with the identification of potential substrates from differential scanning fluorimetry trials. From the initial screen, one crystallization condition could potentially be optimized with the addition of the cofactor and substrates to propagate the growth of the crystal. Structural determination of the MAAT via X-ray diffraction will contribute significantly to the knowledge of methanogenic aminotransferases.

*Acknowledgments: USP - Undergraduate Scholars Program  
McNair Scholars Program*

**PM-44: Big Hole Watershed Impacting Human Health due to Contaminants Affecting Water Quality****Pilar Santos, Microbiology & Cell Biology**

Mentor(s): Margaret Eggers, Land Resources &amp; Environmental Sciences

Water contamination can pose a serious risk to human health. In Montana, groundwater is an important resource that supplies 94% of Montana’s rural domestic water. Contamination of Montana water supplies can be caused by mine deposits, animal waste, sewage, industry, farming practices, and naturally occurring minerals. Regarding arsenic, geothermal springs in Yellowstone National Park contribute to the high levels found in many watersheds, along with mine deposits which may be relevant in the Big Hole drainage basin (HUC 10020004) in Deer Lodge and Silver Bow Counties, in southwest Montana. The goal of the research is to address and analyze the groundwater quality of the Big Hole River Basin. The water quality data was obtained from the Montana Ground Water Information Center database (GWIC) (<https://mbmgwic.mtech.edu/>). Data were cleaned to remove high-level non-detect values, analyzed in MS Excel, and graphed in R Studio. Contaminants of concern for wells and streams were observed to be arsenic, cadmium, uranium, and nitrate, which pose risks to human health with chronic effects from consumption. High levels of iron were also found, however iron is only considered a nuisance contaminant as it does not pose much health concern. An initial assessment of cumulative health risks from these contaminants will be conducted and presented. Ultimately, the goal of this research is to provide results in a public report to be made available to Montana residents and shared with the relevant county health departments. Acknowledgements to Klara Aspelin for the R Studio code.

**PM-75: Imagery of Native Americans in Children's Books and Films****Ryland Schmidt, Education**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

Native American representation in children's literature and cinema has been a complicated topic to comprehensively break down. The basis of this topic can be linked to the forced ideology of assimilating native culture into Western society throughout the 20th century. The imagery of Native Americans in children's literature and in films has affected the socialization of native and non-native youths. The youths in our education system are at a stage in their life where they can easily be malleable to the curricular policies that are implemented by the local school boards across the nation. In regard to this problem, questions have arisen about the nature of literary censorship and proper fair representation in the school systems. Multicultural education is becoming more prominent in the education field and is an important aspect in order to create a safe learning environment. Students should feel that they are being equally represented in today's literature and films. By utilizing books, graphic novels, and movies, I can better understand the discrepancies of Native American imagery that is being presented to the youth.

**PM-08: The Use of the Internet as a Historic Primary Source: War in Iraq****Tyler Schwarzbach, History & Philosophy**

Mentor(s): Molly Todd, History &amp; Philosophy

In the years following the September 11th, 2001 terrorist attacks in New York and Washington D.C, many in the United States wanted answers. Some turned to the Mainstream news media, but an increasing amount would turn to the growing internet, as it was becoming more prevalent for people to find and share their thoughts, and opinions. In my Senior research project, I researched what the early Internet thought of this war. This was done by looking through websites published from March 2003-December 2003, preserved by the Library of Congress. I sought to gauge the opinions of not only the website publishers, but of the archivists. These websites range from those run by the U.S. government, as well as interest groups with their own opinions on the War on Terror and the actions of then-President George W. Bush. The results were that the selected websites each had their own strong opinions, but no clear majority of representation of viewpoints in what was saved was apparent. This is shown with government sources and organizations like the VFW being supportive of the Bush administration's invasion of Iraq, while others such as "Americans Against World Empire," and "VoteNoWar.org" and more to be against the invasion as it went against what many of them considered to be moral or fiscally justifiable. This project serves to explore an overlooked aspect of history in our modern world, and to help draw more attention to other historical events that have a digital footprint in history.

**AM-12: Characterizing microbiome diversity in tiger sharks with unusual diets****Courtney Scott, Microbiology & Cell Biology**

Mentor(s): Frank Stewart, Microbiology &amp; Cell Biology; Zoe Pratte, Microbiology &amp; Cell Biology

Tiger sharks (*Galeocerdo cuvier*) are apex predators in the ocean that directly impact the food web and health of marine ecosystems. Like other animals, tiger sharks host a microbiome, a collection of diverse microorganisms that provide beneficial services—such as aiding food breakdown and defending against pathogens—and therefore impact the overall health of the host. Many factors influence a host's microbiome including diet and environmental conditions. Tiger sharks in the vicinity of Norfolk Island, Australia are unique in that they consume cattle carcasses discarded into the ocean by farmers. This diet is distinct from the shark's typical all-marine diet of diverse fishes, crustaceans, and marine mammals. We hypothesize that the unique Norfolk Island diet influences the gut microbiome of resident tiger sharks. We test this hypothesis by comparing microbiome diversity of Norfolk Island sharks to that of other tiger shark populations worldwide. By analyzing cloacal swabs, which capture material from the fecal

microbiome, we show that Norfolk Island shark microbiomes have higher species richness and are taxonomically distinct from other tiger shark populations. These results suggest that consumption of terrestrially-derived mammals may restructure the gut microbiota of tiger sharks. Understanding how microbiomes change in response to diet alterations can provide insight to how these animals might respond to more widespread changes in their ecosystem, such as those induced by human intervention.

*Acknowledgments: USP - Undergraduate Scholars Program*

***PM-37: Simulating Solutions to The Schrödinger Equation for Generalized One-dimensional Piece-wise Constant Potential Wells: A Web-hosted Teaching Tool***

**Meilo Seiter, Physics**

Mentor(s): Carla Riedel, Physics

The introduction of quantum mechanics at the undergraduate level poses one of the greatest leaps for students in physics education. Despite this, there is sparse practice and exposure to anything but the proverbial analytical solutions to the schrödinger equation. This paper proposes a more flexible and available web-hosted approach to computational solutions of the schrödinger equation. This quantum sandbox provides user-determined well-size, potential functions, and particle type. By implementing a LAPACK algorithm for solving eigenvalue problems in conjunction with approximating the hamiltonian using a finite difference method, the program delivers the energy eigenvalues and converging wavefunctions to custom potentials. With energy eigenvalues accurate to the third decimal point, this algorithm is an accurate and efficient approach to solving and visualizing bound state wavefunction behavior.

***PM-55: An Exploration of Alternatives for Landowners with Small Acreage***

**Marki Sharkey, Department of Agricultural and Technology Education**

Mentor(s): Shannon Arnold, Department of Agricultural & Technology Education

Small acreage is becoming more prominent in Montana, especially in Lewis and Clark County. Many individuals do not want to necessarily farm their land but they still want to do something productive with it. This research paper focuses on different options landowners can use for their farm land and the potential pros and cons of each of the choices. Through a survey conducted at a small acreage land management class, the information gathered showed what a sample of Lewis and Clark County residents with small acreage would have preferences for and what guidelines they were following. About 81% of the participants had joined the class to learn about soil management and 72% wanted to learn about pasture management. All of the participants were wanting to create healthy environments and habitats for animals and later generations. A main theme gathered from this survey is that approximately 50% did not have a budget for this project and were willing to put in large amounts of time to create a better environment.

***AM-30: Hydraulic bulge testing to compare formability of continuous and stretch broken carbon fiber prepreg laminates***

**Yoni Shchemelinin, Mechanical & Industrial Engineering (Graduate Student); Jared Nelson<sup>1</sup>; Douglas Cairns<sup>1</sup>;**

**Dilpreet Bajwa<sup>1</sup>; Cecily Ryan<sup>1</sup> - College of Engineering**

Mentor(s): Amendola Roberta, Mechanical & Industrial Engineering

Demand for high-strength, low-density materials is leading to an increase in the use of carbon fiber reinforced polymers (CFRPs). Continuous fiber composites possess high strength-to-weight ratio, but the low formability of this material limits their wider adoption. Stretch Broken Carbon Fiber (SBCF) is a form of carbon fiber characterized by the randomized breaking of aligned fibers at inherent flaw points in a

tow. This manufacturing form of collimated carbon fiber fragments creates a material that can exhibit pseudo-plastic deformation by allowing fibers to slide past one another. Prior research using a hydraulic bulge tester compared uncured carbon fiber prepreg using continuous and SBCF Hexcel IM-7 fiber in a Huntsman RDM 2019-053 resin matrix. While the preliminary results showed that the SBCF samples demonstrated better formability, additional research was conducted on the samples post-curing to investigate the forming behavior in greater detail. Sheet metal in a bulge testing environment forms into an oblate spheroid shape, with material thinning at the apex until rupture failure. The SBCF samples showed closer to spheroid forming using internal surface area and volume measurements, with sample thinning at the apex. The continuous samples showed greater deviations from a spheroid shape, and failed to demonstrate sheet thinning throughout the entire sample cross section post-forming.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### **PM-81: The States and the Reich**

**Stone Sherman, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

For my research, I will look at the International Relations between the United States and Nazi Germany between 1933 and 1945, this interests me because it is an important time in history, and it involves international relations with the German Reich. I want to see how the US treated the German Reich on the international scale, see how we addressed them or if we even recognized Adolf Hitler after he declared himself Fuhrer. I have found that the United States was relatively dismissive of the German Reich, but they did have knowledge of Germany's persecution of the Jewish community. During the war, the US actually supported working with the German puppet government of Vichy France under Philippe Petain over the Free French under Charles deGaulle, as they saw Petain's government as more legitimate. I will be using the Library of Congress Archives, the National Security Archives, and the Eisenhower Library. I chose these due to the good amount of content relating to this very topic, as the archives contain a lot of documents relating to US National and International affairs. My final result for this assignment is a Senior Capstone Essay, since that is the outcome I am most familiar with. This is important because it looks at a very important time in US international relations, looking at how the US government under Franklin D Roosevelt and Harry S Truman treated the German Reich on the international scale before, during, and directly after World War 2.

### **AM-58: Searching for Variability in APOGEE Spectra**

**Charlie Siders, Physics**

Mentor(s): David Nidever, Physics

When observed over a sufficiently long period or at sufficiently high spectral resolution, the majority of stars are observed to be variable with time due to a variety of mechanisms, including pulsations, binarity/multiplicity, and stellar winds. Detecting and characterizing the variability is critical to our understanding of stellar structure and evolution. To that end, the Apache Point Observatory Galactic Evolution Experiment (APOGEE) has collected high resolution near-infrared spectra for over 650,000 stars. The multi-visit nature of these spectra make them ideal for detecting variable spectral features, but a catalog of variable features in APOGEE spectra has yet to be created. We detect variable features by using  $\chi^2$  statistics to calculate the p-value for each visit. We are also able to detect which parts of the spectrum are variable by how much they contribute to  $\chi^2$ . By restricting the calculation to only use the parts of the spectrum that are near specific emission and absorption lines, we also determine whether these lines are variable. Using these techniques, we assemble one of the largest catalogs of variable stars to date.

**AM-59: Outlaws and the Law in Montana****Abigail Sites, History & Philosophy**

Mentor(s): Molly Todd, History &amp; Philosophy

Modern law, particularly in the American West, has been influenced by the law from the past. Both the law and outlaws of the American West have been famously depicted in modern day films and cinema. The question that will guide my research is: how was the law handled, by whom and who were the outlaws? My research will explore the west, specifically in Madison County, Montana during the mid nineteenth century. I will be specifically examining individuals such as Henry Plummer, Jack Slade, and James Thurmond, who were all outlaws. Using the American West archive, I found out how the law was handled in regards to the outlaws throughout the west, more specifically Montana which has greatly influenced the state's history. The book, *The Vigilantes of Montana or A Popular History*, reveals more specifically how the law was handled by the locals regarding the outlaws. The two articles, "The Hanging of 'Captain' Jack Slade," and "A One time Outlaw Lawyer in Alder Gulch, James Thurmond Became a Judge and Mayor in Texas," examine the lives of individuals and their careers as outlaws. This poster examines the research done for my capstone project. The overall purpose of this project is to help others understand how the law has influenced the west, specifically, the outlaws of the west; while also giving people an opportunity to learn about this important and fascinating period of our nation's history.

*Acknowledgments: USP - Undergraduate Scholars Program*

**PM-56: Assessing College of Agriculture Students' Perceptions of Agricultural Images through Heat Mapping****Anna Slivka, Department of Agricultural and Technology Education**

Mentor(s): Shannon Arnold, Department of Agricultural &amp; Technology Education

In daily function, human beings sometimes do not realize how dynamically images and visual environments affect cognitive psychology. According to *Thermopylae Sciences and Technology*, "human beings are absolutely visual creatures." About ninety percent of the information that is transmitted to the brain is visual data, and humans process this visual information about 60,000 times quicker than text (*ThermoSciences*). In this study, heat mapping technologies are utilized in order to determine the perceptions or emotions tied to different agricultural images influenced by optic flow or color-related cognition that students attending Montana State University in the College of Agriculture might have. The findings of this study are important in order to provide more information surrounding the use of images in social media on specific platforms. As agricultural organizations continue to utilize social media to reach large audiences and spread factual information, it is vital that data surrounding what viewers focus on or see first is applied in social media management practices. If heat mapping studies conducted to provide more information for agricultural literacy are published, agricultural organizations would be better able to stand among misinformative campaigns and have a greater span over target audiences when utilizing social media.

*Acknowledgments: Other funding or support; N/A*

**AM-31: Novel Microstructures for Enhanced Performance Monopropellant Thrusters****Hayden Sofie, Mechanical & Industrial Engineering**

Mentor(s): David Driscoll, Mechanical &amp; Industrial Engineering

Traditional catalyst beds are comprised of packed ceramic beads coated in a reactive iridium metal catalyst. Packed beds represent little advancement in engineered porous materials and present disadvantages regarding thruster performance and lifetime. Disadvantages of packed beds are as follows: variable pressure drops across catalyst bed over thruster life, bed particle self-pulverization from thermal shock,

catalyst attrition from extreme environmental conditions during thruster operation, and shifting of bed affecting pulse-to-pulse reliability. Freeze tape casting (FTC) techniques pioneered at Montana State University (MSU) offer the unique ability to not only ameliorate the disadvantages of packed beds but offer transformative performance advancements. An aqueous suspension comprised of ceramic particles is passed over a cooled bed where microstructure formation is a result of ice growth within the suspension. Opposed to common tape casting, MSU possesses the ability to control the ordering of ice domains, representative of pores after sublimation of ice crystals. Cooling bed temperature and casting speed greatly affect the geometry of the pore structures; such control over the bulk domain ordering and geometry allows for the tailoring of flow behavior through the pore microstructure. Advantages observed by utilizing a FTC engineered bed include: bulk morphological stability, self-supportive at high porosity, thermal shock resistance, flow predictability through low tortuosity pores, and beneficial surface-area-to-mass ratio that reduce the mass of costly iridium catalysts while increasing fuel-catalyst interaction. Incorporation of iridium catalysts by a chloroiridic acid precursor will be reported by electron microscopy to ascertain the distribution and surface coverage on the FTC supports.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### **AM-75: Parent's Experience of Parent Child Interaction Therapy**

**Abbigail Sparks, Health & Human Development;** Peyton Vining, Health and Human Development

Mentor(s): Kalli Decker, Health & Human Development; J. Mitchell Vaterlaus, 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 parents' experiences with receiving in-home PCIT services? The authors partnered with PCIT therapists to invite families to participate in a survey and in-depth interview if they had received in-home PCIT services. Preliminary results highlight the positive experiences of both parents and children who participated in PCIT services. Trends have emerged showing common experiences of PCIT experiences. These results include families having a positive, enjoyable relationship with the therapist, learning specific skills that benefit their parenting and life experiences, and preferring PCIT delivery in the home to delivery in the clinic.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-28: Non-face-to-face tilings of the Euclidean plane and their duals**

**Marie Steiger, Mathematical Sciences;** Michael Bruner<sup>1</sup>; Heidi Steiger<sup>2</sup>

<sup>1</sup>Mathematics - Montana Technological University; <sup>2</sup>Metallurgical Engineering - Montana Technological University

Mentor(s): Atish Mitra, Mathematics – Montana Technological University

We extend the classical combinatorial encoding of face-to-face mosaics (tilings) of the Euclidean plane to include non-face-to-face tilings. This encoding allows us to extend the natural concept of duality to such tilings, and to give an algorithm for constructing such duals. We provide a simple geometric proof of the Jordan-Schönflies Theorem for our class of tilings. We discuss our theory in studying the average properties of tilings. In particular, we give possible applications of our theory in analyzing metallic grain structure.

**AM-28: Synthesis of a Triply Periodic Minimal Surface Graphene Foam Material****Anna Stewart, Chemical & Biological Engineering**

Mentor(s): Nicholas Stadie, Chemistry &amp; Biochemistry

A three-dimensional material comprised exclusively of carbon whose underlying structure lies on a triply periodic minimal surface (TPMS) is a member of the class of hypothetical carbon allotropes known as schwarzites. These are a class of materials highly sought-after due to their fundamental significance (the last remaining unknown crystalline allotrope of sp<sup>2</sup>-hybridized carbon) and likely interesting properties (e.g., ballistic conduction at room temperature). Other properties include a large pore volume and high surface area for gas and ion adsorption, making them a class of candidate materials for many applications such as supercapacitor electrodes and gas storage. A true schwarzite has not been synthesized, despite their predicted low energies of formation compared to other fullerenes.

This research focuses on the synthesis of an interpenetrating schwarzite-like material. A templating strategy has been designed to achieve this through the synthesis of a free-standing graphene foam material whose structure lies on a TPMS by a hard-templating route. This requires a template that carries the Ia-3d space group with an optimal pore to wall ratio, such as ordered mesoporous silica materials. Pore structure for these materials can be optimized by changing hydrothermal temperature, addition of inorganic salts, and various combinations of cationic and neutral structure-directing agents. Along with the type of template materials, varying aluminum to silica ratios have been explored. All mesoporous silica materials have been tuned with carbon vapor deposition in mind.

*Acknowledgments: USP - Undergraduate Scholars Program*

**PM-14: Parental and Peer Influences on Adolescent Eating Behaviors and Beliefs****Nievalinda Strong, Psychology**

Mentor(s): Benjamin Oosterhoff, Psychology; Zack Wood, Psychology

Previous research has revealed that youth are strongly influenced by those around them, and other studies have shown that multiple psychosocial variables can play a role in the development of disordered eating in adolescents. Through secondary data analysis, the current study sought to understand how these influences on adolescents, specifically from parents and peers, either predicted or moderated the presence of disordered eating and thoughts around food. Data analyzed in this study were collected for a previous study in 2014 that surveyed 614 students from two public high schools in the Eastern United States (Ferris, 2014). The participants ranged in age from 13 to 19 years old ( $M = 15.9$ ); 56.8 percent of participants were female. During data collection, adolescents completed several surveys assessing thoughts and behaviors around food and eating, as well as the level of relative influence from parents and friends. To date, data analysis has revealed a statistically significant relationship between high parental influence and high disordered eating for adolescents aged 13-16. In contrast, adolescents aged 16-19 were more influenced by their friends. This was also predictive of greater disordered eating. Even so, there was still a statistically significant influence from parents. This indicates that the role of peers becomes increasingly important in determining disordered eating outcomes. Such knowledge may help inform future preventative strategies.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **AM-14: Decreased Total Sleep Time is Associated with Increased Heart Rate Reactivity in Women**

**Kassidi Thompson, Microbiology & Cell Biology;** Alyssa Mandich, Microbiology and Cell Biology

Mentor(s): Jason Carter, Health & Human Development

Stress reactivity is an important predictor of future health outcomes. However, the role of habitual total sleep time (TST) in physiological stress reactivity has not been adequately examined. We hypothesized that a reduction in habitual TST would be associated with increased heart rate (HR) reactivity to cold pressor test in healthy adults. TST was determined via subjective (sleep diary) and objective (wristwatch actigraphy) measures in 22 healthy participants (12 men, 10 women, age:  $25 \pm 1$ , BMI:  $25 \pm 1$ ). Participants' cardiovascular function was assessed via electrocardiogram (ECG) during a 3-minute resting supine baseline and a 2-minute cold pressor test. Bivariate correlations were utilized to determine the association between TST and HR reactivity. Contrary to our initial hypothesis, TST was not significantly associated with HR reactivity when assessing all study participants ( $r = -.382$ ,  $p > .05$ ). However, when separated based on participant sex, the relationship between subjective TST and HR reactivity appeared to have a significant negative correlation in women ( $r = -.744$ ,  $p < .05$ ) but not in men ( $r = -.234$ ,  $p > .05$ ). This finding in women was corroborated by objective TST and HR reactivity data, showing a near-significant negative correlation in women ( $r = -.598$ ,  $p = .068$ ), but not men ( $r = -.087$ ,  $p = .810$ ). In summary, habitual TST appears to be significantly associated to HR stress reactivity solely in women. These findings indicate a differential impact of short habitual sleep on cardiovascular reactivity between men and women.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

### **PM-71: Exploring Health Anxiety Impacts on Quality of Life of Nursing Students During the COVID-19 Pandemic**

**Sophia Thompson, Nursing**

Mentor(s): Sally Moyce

**Purpose:** To explore the impact of COVID-19-related Health Anxiety on the Quality of Life of Nursing students.

**Background:** Health anxiety is the term to refer to the worry about one's health. Health anxiety (HA) is common among students studying healthcare; however, we know little about how the experience of health anxiety changes during a global pandemic. We hypothesized that nursing students, already at risk for health anxiety, would have increased levels of anxiety and lower quality of life (QOL) scores during the pandemic.

**Methods:** We adapted the Health Anxiety Inventory tested and validated by Salkovskis (2006) and the Health-Related Quality of Life Questionnaire from the CDC (2018). The final questionnaire consisted of 15 items (7 for HA and 8 for QOL). HA questions included 4-point Likert-scale, with higher scores indicating higher levels of health anxiety. Quality of life questions were a 5-point Likert-scale, with higher scores indicating better quality of life (range 8-40). A list of nursing students enrolled at MSU was generated from university records. The survey was sent via email by a third party. Potential participants were asked to complete a survey and students were told that continuation of the survey indicated their consent.

**Results:** We received 153 responses (25% response rate). The mean HA score was 13.02 (SD 3.47); the mean QOL score was 21.57 (SD 6.07). Health anxiety is associated with a lower quality of life score ( $\beta = -0.32$ ,  $p < 0.01$ ). Perceived likelihood of contracting COVID-19 was associated with higher levels of health anxiety ( $\beta = 2.36$ ,  $p < 0.01$ ).

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-17: Autism-Relevant Behavior in Doodles**

**Kierstyn Toth, Psychology**

Mentor(s): Mariana Olsen, Psychology

The purpose of this study is to extend the findings from previous research regarding Autism Spectrum Disorder (ASD)-relevant characteristics in poodles and analyze how such characteristics apply to “doodles,” a breed of direct poodle decent. Previous research by Zamzow and colleagues (2017) found three behavioral constructs to characterize ASD in dogs based on similar criteria in humans: initiation of reciprocal social behavior, response to social interaction, and communication. This study will test whether standard Poodles, Aussie-doodles, and Golden-doodles differ in the prevalence of these constructs. I hypothesize that both “doodles” will score greater in social behavior than Poodles, as well as hypothesizing Aussie-doodles will have higher scores than Golden-doodles in all three behavioral constructs. Seven hundred and forty owners of standard-sized members of one of these three breeds provided information about their dogs’ behavior using SurveyMonkey. Each owner completed a twenty question owner-report survey. Questions consisted of demographic information (age, breed, health conditions) and behavioral characteristics. All behavioral questions are similar to the questions asked in the previous study and based off the Autism Diagnostic Observation Schedule (Lord, Rutter, DiLavore, & Risi, 2000). Dogs may be a precise model for human comparison when it comes to complex human behavior, more so than rodents - a currently popular model. This information would be useful for service dog trainers and breeders because it may provide evidence of characteristics that may produce a better service dog. The results of this study, as well as the previous study, indicate that dogs may be just that.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **PM-66: The Indigenous Futurisms Movement**

**Rachel Towery, Art**

Mentor(s): Jennifer Woodcock-Medicine Horse, Art

The Indigenous Futurisms movement works to decolonize artistic expressions, reclaim historic narratives, and create a non-exclusionary space for expression by contextualizing contemporary media inside Native narratives. At the core of many Indigenous cultures is the tradition of passing down knowledge systems, beliefs, and perspectives through oral storytelling. This tradition was severely disrupted by colonization, mass genocide, and ethnocide. Through the Indigenous Futurisms movement, modern Native artists reclaim representation and self-determined narratives that accurately and positively represent their identities, cultures, and futures. The primary goal of this research is the exploration of these narratives through fine art and film in sci-fi and other sub-genres as they draw parallels between traditional beliefs and subjects in contemporary media.

\* Note: research to be displayed with other coursework from ARTH491

*Acknowledgments: Other funding or support; N/A*

### **PM-57: Perception of winter canola by producers in the Flathead Valley**

**Garrett Tutvedt, Department of Agricultural and Technology Education**

Mentor(s): Shannon Arnold, Department of Agricultural & Technology Education

Research Question: What are producer perceptions about winter canola in the Flathead Valley?

Producers in the Flathead Valley, Montana are exploring the option of plating winter canola as part of their cropping system. To decide on whether to implement this new crop farmers look to many different

sources to make a calculated decision on what will work for their operation. Information on growing winter canola varies. To help make this decision easier qualitative data was collected by interviewing 4 Flathead Valley Producers to gather firsthand information about their experiences and practices with raising winter canola. Three of the identified themes from the data were: variability in the planting dates, the shared similarities of experiencing severe winter kill in at least one field, and the similarity of looking to MSU for information. Since winter canola is a fairly new crop to the flathead valley it will be important to assess the farmers who have experimented and project the best practices to produce this crop in the future.

***PM-82: Adverts and Indians: Selling the American West***

**Paul Velk, History & Philosophy**

Mentor(s): Molly Todd, History & Philosophy

This poster, based on the research done for my senior research capstone project, analysis how travel advertisers sold “the western experience.” By working through the “Leisure, Travel & Mass Culture: The History of Tourism” archive, this poster focuses on how travel advertisers, from the 1920s to the 1980s, portrayed the American West with a focus on Native Americans in particular. For this purpose, this poster details how the literary device of an “ideal pastoral” played into the advertising strategies of different travel agencies and publishers. Native Americans were, in this way, advertised in terms that fell under the overall umbrella creating an idealized escape from modernity but not totally removed from it. This poster categories these advertisements into four separate categories. These are, “The Noble Savage”, “The Stoic Indian,” “The Bloodthirsty Savage,” and “the Happy Primitive.” This research shows that while a plethora of different perceptions of Native Americans existed among travel advertisers, they all related in some way to the idealized pastoral image. In these advertisements, Native Americans, and the American West in general, became a symbol of a bucolic lifestyle.

***PM-12: Moderating the Effects of Childhood Trauma Through Gratitude and Mindfulness Meditation***

**Zoe Waddell, Psychology; Jade Larsen; Taylor Kampf – Psychology**

Mentor(s): Neha John-Henderson, Psychology

Childhood trauma refers to psychological abuse, physical abuse, and/or distress occurring during childhood. There is a link between childhood trauma and poor mental and physical health outcomes later in life (Rossiter et al., 2015). In college students, childhood trauma is associated with loneliness, higher perceived stress, negative affect, and poor physical and psychological health (Counts et al., 2020). The current study examined whether combining mindfulness meditation and gratitude in a novel stress intervention would mitigate the effects of stress for college-aged individuals with childhood trauma. We recruited 150 Montana State University undergraduate students. We took physiological measurements throughout the experiment, including heart rate variability (HRV), blood pressure, and cortisol. Additionally, before and throughout the investigation, participants completed a variety of questionnaires that were used to assess psychological parameters that contribute to overall well-being. Participants underwent an adaptation period and a baseline period before the intervention and were randomly assigned to one of four conditions: Gratitude Meditation, Breath Meditation, Gratitude Journaling, or Control Journaling. After completing the intervention, the participants underwent the Trier Social Stress Test (TSST). Then, the participants sat through both a recovery period and a second baseline period. This study aims to find if mindfulness meditation can bolster the extent to which prosocial qualities, like gratitude, moderate stress and foster greater well-being in individuals with early-life adversity. It is hypothesized that mindfulness meditation will strengthen the positive effects of gratitude through mindful awareness and buffer the effects of childhood trauma.

*Acknowledgments: USP - Undergraduate Scholars Program*

### **AM-53: Detection of Malware Injection on the MSP430 Microcontroller Family**

**Walker Ward, Computer Science;** Michael Heidal, Computer Science

Mentor(s): Clemente Izurieta, Computer Science

Much of our world's critical infrastructure relies on embedded systems and microcontrollers which can be vulnerable to malware injection attacks. This project is focused on the development of a tool to detect real-time malware injection in code written in two programming languages, C and the MSP430 Assembly Language, written for the Texas Instruments MSP430 family of microcontrollers. The detection system is intended to be used as one tool in a larger toolchain that attempts to detect attacks on vulnerable microcontroller systems. Other parts of this toolchain are currently in development by other students.

This project includes a number of testbed programs written for the MSP430. Each testbed program has been targeted with a specific vulnerability that is injected into the source code, such as string format attacks and buffer overflow attacks. The detection system attempts to identify source code files that may have been targeted with an injection attack and provides locations of possible vulnerabilities in those source files as well as a "safety rating" which reports how likely it is that the source file was attacked.

*Acknowledgments: Other funding or support; Raytheon Technologies*

### **AM-32: Effects of Ultraviolet Environmental Aging on Ultrahigh-Molecular-Weight-Polyethylene Composites**

**Jonmichael Weaver, Mechanical & Industrial Engineering (Graduate Student)**

Mentor(s): David Miller, Mechanical & Industrial Engineering

Ultra High Molecular Weight Polyethylene (UHMWPE) presents several distinct advantages as a material with a high strength to weight ratio, durability, and hydrophobicity. Characterizing the change in the mechanical performance of UHMWPE from environmental exposure is necessary to ensure the safety of future applications.

UV aging tests based on ASTM-G154 were performed for 800 hours to interrogate the change in mechanical properties as measured through dynamic mechanical analysis (DMA) and imaged using a scanning electron microscope (SEM) on both Dyneema™ HB-210 and Dyneema™ HB-212. Dyneema™ HB-210, a 15 μm diameter UHMWPE multi-filament fiber laid up in a polyurethane matrix [0/ 90]2 with a thickness of 0.17mm, is compared to the same fiber and orientation system, Dyneema™ HB-212, with a rubber-based matrix under UV aging, humidity and temperature cycling conditions.

DMA showed a decrease in both the storage modulus and loss modulus of the aged material compared to the unaged, even though the  $\tan \delta$  slightly increased. SEM images indicated prolonged UV exposure and erosion lead to matrix spall and embrittlement. Material degradation occurred at a higher rate in Dyneema™ HB-212 compared to Dyneema™ HB-210. Lending the lifespan of the polyurethane matrix in the Dyneema™ HB-210 to perform better in harsh environmental conditions than the rubber-based matrix of the Dyneema™ HB-212.

*Acknowledgments: Federal funding through research mentor (NSF, NIH, NASA, DOE, etc.)*

**AM-72: Native American Stereotypes****Madison Wellman, Gallatin College**

Mentor(s): Jennifer Woodcock-Medicine Horse

In the novel, “Bitterroot”, Susan Devan Harness, a Native American woman who is a member of the Confederated Salish and Kootenai tribes, was only two years old when she was transracially adopted by a caucasian family. The novel focuses on Susan’s hardships living between two worlds and attempting to uncover her own identity while navigating what it means to be an indigenous woman and the hardships/harmful stereotypes she faces while doing so. Contrasting the search for what it means to be a Native American, the novel, “All The Real Indians Died Off”, informs its audience of common misconceptions of Native Americans and their history. For my project, with the illustration of Harness’ true story and the correcting of misinformation inside the novel “All The Real Indians Died Off”, I will be researching and exploring common misconceptions and stereotypes Native Americans face and how/why these stereotypes came to light.

*Acknowledgments: Other funding or support*

**PM-58: An Examination of MSU Students’ Perceptions of Farmland Sales and Development****Knoll Williams, Department of Agricultural and Technology Education**

Mentor(s): shannon Arnold, Department of Agricultural &amp; Technology Education

Urbanization is affecting farmland prices at a rate higher than ever before. This trend has led to an increase in farmland purchases around developing areas. With farmland being valued higher, developers are buying more acreage at prices unaffordable for many others, including other farmers. The developers are then rezoning the farmland for urban development purposes. The purpose of this study is to examine the perceptions and bias of MSU students in Agricultural Economics on farmland sales and development. This study will aim to describe factors of influence for participants on farmland sales and development based on previous literature, including price, emotion, future use, and buyer. This quantitative research study will use survey methodology to collect data on the perceptions and biases of college students on farmland sales and development. This research is in progress.

**AM-66: Impact of Moderate-to-vigorous physical activity and visceral adiposity on postprandial triglycerides in metabolically at-risk adults****Stephanie Wilson, Health & Human Development (Graduate Student); Chantal Vella, University of Idaho, Department of Movement Sciences**

Mentor(s): Mary Miles, Health &amp; Human Development

Postprandial lipemia occurs early in chronic disease progression. The degree of postprandial triglyceride (ppTG) is influenced by physiological and lifestyle factors such as diet, central obesity, and physical activity (PA). However, it is unclear how habitual dietary factors and PA impact ppTG in healthy adults with high central adiposity.

**PURPOSE:** To examine the impact of habitual moderate-to-vigorous PA (MVPA), saturated fat (SF) in the habitual diet, and central adiposity on ppTG in metabolically at-risk adults.

**METHODS:** Non-diabetic adults (n=21) with a high waist circumference (> 35” women, >40” men) completed a high-fat meal challenge (50g FAT, 54g CHO, 12g PRO), with blood collected at fasting and hourly after meal ingestion for 5 h. TG (mmol/L) was determined by lipid panels and summarized as iAUC and the change from fasting (TG<sub>max</sub>). Habitual dietary data was collected through the online DHQ-III, with SF percentage (SF / total fat) used for analysis. Visceral adipose tissue (VAT) was determined

through bioelectrical impedance analysis. Participants wore an accelerometer for 7 days ( $>10$  h/day) and average number of MVPA bouts/day ( $\geq 2690$  counts/min) was derived. Separate linear models for TG iAUC and TG magnitude were used to test the impact of an interaction between average MVPA bouts and VAT, accounting for habitual dietary SF.

**RESULTS:** MVPA, VAT, and habitual dietary SF explain  $\sim 36\%$  of variation in TG iAUC and TG<sub>max</sub>. Average MVPA bouts and VAT jointly impacted TG iAUC ( $p < 0.01$ ), with a ppTG-lowering effect observed with lower VAT and more frequent MVPA bouts and a pronounced ppTG-raising effect observed with greater VAT with frequent MVPA bouts ( $\beta = 1.1$ ). Habitual SF did not predict TG iAUC ( $p = 0.68$ ). Likewise, average MVPA bouts and VAT impacted TG<sub>max</sub> ( $p=0.03$ ), with a TG-raising effect observed with greater VAT despite more MVPA bouts ( $\beta = 0.31$ ). Interestingly, an inverse relationship was observed between habitual SF intake and TG<sub>max</sub> ( $\beta = -0.04$ ,  $p=0.02$ ).

**CONCLUSION:** Frequent MVPA promotes lower ppTG, a benefit that is reversed with increased VAT. These findings suggest that increased VAT promotes ppTG even with regular MVPA, stressing the importance of strategies to decrease VAT in improving regulation of postprandial lipemia in at-risk adults.

*Acknowledgments: Supported by USDA-ARS Pulse Crop Health Initiative 58-3060-9-040*

### **AM-54: Replicating the Replication of Social Science Experiments**

**Joseph Winjum, Mathematical Sciences**

Mentor(s): Mark Greenwood, Mathematical Sciences

Altmejd et al. (2019) collected information on a set of social science experiments where a second set of researchers repeated a previously published study. They collected information on the effect sizes and p-values in the original and replication study as well as features of each of the studies, like sample sizes and characteristics of the researchers. They then assessed how accurately replication of experimental results could be predicted by statistical learning methods such as the lasso and posted their data and code. In this project, we review and critique their results, attempt to repeat their analyses, and understand the methods and code that they used. We also explore some additional results that complement what was included in their article.

### **AM-74: Nutrition and Movement Project**

**Tegan Wold, Psychology; Peyton Vining, Human Development**

Mentor(s): Kalli Decker, Health & Human Development; Brianna Routh, Health & Human Development

The purpose of this project is to find ways to help caregivers, such as early childhood professionals and families, to support their children to have a healthy relationship with food and movement. This can then decrease the probability of eating disorders in the future and can support longer-term health and well-being. To do so, we completed thorough literature reviews on this topic. We searched the literature to find different research-based ways to support children to try new foods at a young age, feel happy with what they eat and when they eat, and engage in joyful movement rather than feeling pressure to 'exercise'. We thoroughly read many research articles, wrote a short summary about each one, and have started to create a presentation that could be provided for free to caregivers. A review and synthesis of the research highlighted 4 themes as potential recommendations: 1) exposure to a variety of foods without pressure, 2) allowing children to play and explore with food, 3) supporting positive interactions between children and caregivers, and 4) providing time and consistency. We also have identified ideas regarding how to support children to engage in different activities that can be done outside to support their enjoyment of movement activities. Next steps for this project would include partnering with early childhood education providers and families to share the information we have synthesized, share our research-informed findings about

how to support children's long term relationships with food and movement, and gather their feedback via a survey.

*Acknowledgments: USP - Undergraduate Scholars Program*

***AM-63: Touched Landscapes: Americans' changing perceptions and interactions with the West***

**Phoebe Zea, Film & Photography**

Mentor(s): Alexis Pike, Film & Photography

In 1854, the United States and Mexico finalized the Gadsden Purchase, in which the U.S. purchased a 29,670 square mile portion of Mexico which later became Arizona and New Mexico—today's "Southwest". Before and since then, the Southwest has undergone major changes in landscape, demographics of its population, culture, beliefs and land uses. Touched Landscapes explores the multitudes of and reasons for such changes within this American region. The project also explores the people who reside within the Southwest, and their shifting beliefs about the land, as well as the ways in which they have in the past, and continue to, interact with and utilize the vast landscapes of Arizona and New Mexico. Touched Landscapes focuses on Southwesterners', as well as generalized Americans', sense of 'place' within the given landscape, and how interactions with various landscapes can affect our sense of belonging to the land. The photographs in this project seek to emphasize the uses of the landscape, the people within, and the diversity of cultures and narratives shared among the region.

*Acknowledgments: McNair Scholars Program*

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